THE EFFECTIVENESS OF FORMAL AND TRADITIONAL LEARNING ABOUT CLIMATE AND DISASTER RESILIENCE IN VANUATU

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Thesis submitted for the degree of Doctor of Philosophy at

Bishop Grosseteste University, Lincoln, UK

November, 2022

BISHOP GROSSETESTE UNIVERSITY

UNIVERSITY OF LEICESTER

Cover photo

Students in Certificate III in Resilience at the Vanuatu Institute of Technology learning how to plant vetiver grass to stabilize the shoreline at Laonamoa village, Pele island, North Efate, Vanuatu, October 2018

FOREWORD

Republic of Vanuatu

THE PRIME MINISTER

République de Vanuatu

LE PREMIER MINISTRE

21st June 2022

Foreword

Climate Change is the defining issue of our time, an era in which Vanuatu's young people are now facing climate impacts that are profoundly changing their ability to enjoy the stable, sustainable and prosperous nation we strive to build. Climate Change is the biggest security threat to Vanuatu and its people now and in the future.

The Government of Vanuatu has prioritized the issue of climate change through Parliamentary Resolution including by making a commitment to sponsoring a motion to the upcoming 77th United Nations General Assembly to request the International Court of Justice for an Advisory Opinion on how international law provides protections for human rights and intergenerational equity.

Our children are our future, and we must do all we can to preserve and enhance their way of life, their identity, and their aspirations in the face of unconscionable loss and damage. Climate Change education is an area in which my government has made substantial progress, including by mainstreaming climate change fully into the formal curriculum, developing technical and vocational climate education and training programs, and documenting, promoting and encouraging traditional education about climate and the environment through chiefs, elders and community champions.

This thesis by Dr Charlie Pierce is a welcome and timely contribution that fills the remaining policy and practice gaps in climate and disaster resilience education. I thank Dr Pierce for his decades of service to Vanuatu, this new and innovative academic work, as well as his unwavering commitment to the resilience of our present and future generations.

Hon. Bob Loughman Weibur MP

Prime Minister of the Republic of Vanuatu

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ABSTRACT

The Effectiveness of Formal and Traditional Learning about Climate and Disaster Resilience in Vanuatu

Charles Andrew Evan Pierce

This research focuses on Vanuatu, one of the planet's most at-risk countries to natural hazards.

Firstly, and using a proposed model for resilience education, I apply mixed methods to investigate the efficacy of formal school and post-school systems in helping students learn about climate and disaster resilience, as measured by changes in their knowledge, skills, attitudes and behaviour. At junior secondary level, a survey among 363 students on the deployment of a pictorial resource on climate change proves that it is most effective in promoting actions that build adaptive capacity, but less so in fostering scientific understanding. At upper secondary level I find potential for resilience education in three optional subjects, but 82% of students have already left school, and course evaluation by 180 students and their teachers reveals an emphasis on cognitive learning, a lack of stimulating resources and limited field experience. There is also a mismatch between national policies on resilience and the classroom reality. Of all formal systems, the most effective resilience education is occurring through Technical and Vocational Education and Training (TVET) courses that involve practical activity, student-centred pedagogy, contextualized learning materials and traditional knowledge.

Secondly, I use surveys and interviews to determine the extent to which informal education about resilience is taking place through the intergenerational transmission of traditional knowledge, skills and social capital, and its relevance to the nation's future. Results demonstrate that such transmission is declining in the face of rural-urban migration and rise of digital technology. However, recent experiences during severe cyclone Harold endorse the value of traditional warnings and resilience strategies for the recovery of remote populations, and TVET courses in Vanuatu offer a model for the introduction of similar programmes in school classrooms.

ACKNOWLEDGEMENTS

My heartfelt gratitude is expressed to the following people:

To Dr Sarah Hemstock, my initial supervisor, for her stimulation, guidance and positivity in getting me through the first year on this academic journey.

To Dr Philip Wood, my supervisor for the remainder of the journey, for his ongoing wise and pragmatic counsels, especially in all things educational.

To Dr Tess Martin, my colleague from the PacTVET project in Vanuatu, who helped me transform the goals of my thesis into a more achievable design.

To Matthew Kensen and 33 other research assistants, for their devoted efforts in collecting quantitative and qualitative data for my two research questions.

To Barbara Pierce, my dear wife, for her forbearance with my withdrawal from many aspects of home life over the past three years due to the exigencies of research.

To Daniel Pierce, my eldest son, for his constant support and practical assistance in creating the automatic table of contents, figures and tables for my thesis.

To Sam Pierce, my youngest son, for his encouragement and his advice regarding the avoidance of value-laden questions.

To Enory Wogale, my son in Vanuatu, for inspiring me to persevere in my efforts to promote climate change education, and now research, over the last eight years.

To all the learners in the first-ever TVET Certificates I and III courses at the Vanuatu Institute of Technology (VIT), for allowing me to have the best teaching experience of my life.

To Rita Foulsham, my late aunt, whose legacy assisted me to meet the requisite PhD fees at the Universities of Leicester and Bishop Grosseteste.

To Payman and Sima Rowhani-Farid, for their long-standing friendship and their magnanimity in providing office facilities for my fieldwork in Vanuatu.

To Steven Bough, for receiving completed questionnaires from my research assistants in Vanuatu during the pandemic, then scanning and emailing them to me.

To Julian Bluett and Iaka Maimai, principals of two secondary schools in Vanuatu that participated in my research, for their whole-school encouragement of climate change education and sincere support of my investigations.

To Ben Boulekouran, the principal of Vanuatu Institute of Teacher Education (VITE) at the start of my research, for agreeing to make VITE my official Vanuatu partner in research, and for providing me with accommodation during fieldwork.

To Dr Joy Botleng, current principal of the National University of Vanuatu’s School of Education (formerly VITE), for continuing to support my research.

To Fifine Tari, the current facilitator of the Certificate III course in Resilience at VIT, for her willing efforts to supply me with data, and for keeping me in touch with developments in the educational programme that I developed.

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LIST OF PUBLICATIONS FROM THIS RESEARCH

Pierce, C. & Hemstock, S. (2022). Cyclone Harold and the Role of Traditional Knowledge in Fostering Resilience in Vanuatu. *Australasian Journal of Disaster and Trauma Studies Volume 26 Issue 1:* 41–60
http://trauma.massey.ac.nz/issues/2022-1/AJDTS_26_1_Pierce.pdf

Pierce, C. & Hemstock, S. (2021). Resilience in Formal School Education in Vanuatu: A Mismatch with National, Regional and International Policies. *Journal of Education for Sustainable Development 15:2 (2021)*: 206–233

Pierce, C. (2022). An educational activity on climate change for secondary students in Vanuatu: Does gender influence performance? Submitted to *Australasian Journal of Disaster and Trauma Studies* in October 2022, and currently being peer reviewed.

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ABBREVIATIONS

A/D	Agree / Disagree
ADRA	Adventist Development and Relief Agency
APCP	Australia-Pacific Climate Partnership
AUF	Agence Universitaire de la Francophonie
AusAID	Australian Aid
CC	Climate Change
CCA	Climate Change Adaptation
CCCPIR	Coping with Climate Change in the Pacific Island Region
CCDRR	Climate Change and Disaster Risk Reduction
CCE	Climate Change Education
CCESD	Climate Change Education for Sustainable Development
CConA	Community Conservation Area
CDCCC	Community Disaster and Climate Change Committee
CDU	Curriculum Development Unit
CO_2	Carbon Dioxide
COP	Conference of the Parties
COVID-19	Coronavirus Disease 2019
DAEU	Diplộme d'Accès aux Études Universitaires
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DRRE	Disaster Risk Reduction Education
DS	Development Studies
DSPPAC	Department of Strategic Policy, Planning and Aid Coordination
EAU	Examinations and Assessment Unit
EBL	Enquiry-Based Learning
ECC	Education on Climate Change
ECCA	Education on Climate Change Adaptation
ECCDRR	Education on Climate Change and Disaster Risk Reduction
EDRR	Education for Disaster Risk Reduction
EE	Environmental Education
ENSO	El Niño Southern Oscillation
EPA	Environmental Protection Agency
EPDC	Education Policy and Data Centre
EQAP	Educational Quality Assessment Programme
ES	Earth Science
ESD	Education for Sustainable Development
EU	European Union
EU PacTVET	European Union Pacific Technical and Vocational Education and Training
FAO	Food and Agricultural Organisation of the United Nations
FRDP	Framework for Resilient Development in the Pacific
GAP	Global Action Programme
Geo	Geography
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbait GmbH
IDNDR	International Decade of Natural Disaster Reduction
IEC	Information Education and Communication
IEK	Indigenous Environmental Knowledge
IIEP	International Institute for Educational Planning

ILK	Indigenous and Local Knowledge
IPCC	Inter-Governmental Panel on Climate Change
IT	Information Technology
JICA	Japan International Cooperation Agency
JSS	Junior Secondary School
LACCPW	Learning About Climate Change the Pacific Way
MALAMPA	Province of Vanuatu comprising Malekula, Ambrym and Paama islands
MOE	Ministry of Education
MOET	Ministry of Education and Training, Government of Vanuatu
NAB	National Advisory Board on Climate Change and Disaster Risk Reduction
NDC	Nationally Determined Contribution
NDMO	National Disaster Management Office
NGO	Non-Government Organisation
NSDP	National Sustainable Development Plan
NUV	National University of Vanuatu
NZAid	New Zealand Aid
OECD	Organisation for Economic Cooperation and Development
PACCSAPP	Pacific Climate Change Science and Adaptation Planning Programme
PACE-SD	Pacific Centre for Environment and Sustainable Development
PACRES	Pacific Adaptation to Climate Change and Resilience Building
PASSA	Participatory Approach for Safe Shelter Awareness
PCCB	Paris Committee on Capacity Building
PEB	Pro-Environmental Behaviour
PENAMA	Province of Vanuatu comprising Pentecost, Ambae and Maewo islands
PGDCC	Post-Graduate Diploma in Climate Change
PRCR	Pacific Regional Certificates in Resilience
PRFRP	Pacific Regional Federation of Resilience Professionals
PRP	Pacific Resilience Partnership
PUBG	Players Unknown Battle Ground
QC	Questionnaire on Course
QS	Questionnaire for Student
QTK	Questionnaire on Traditional Knowledge
RE	Resilience Education
RQ	Research Question
RTC	Rural Training Centre
SANMA	Province of Vanuatu comprising Santo, Malo and Aore islands
SARS-COV-2	Severe Acute Respiratory Syndrome Coronavirus 2
SD	Standard Deviation
SDG	Sustainable Development Goal
SHEFA	Province of Vanuatu comprising Efate, Shepherds and Epi islands
SIDS	Small Island Developing State
SOE	State of Emergency
SPC	Secretariat of the Pacific Community
SPFSC	South Pacific Form Seven Certificate
SPREP	South Pacific Regional Environment Programme
SPSS	Statistical Package for the Social Sciences

SSEN	Santo Sunset Environment Network
SWOT	Strengths, Weaknesses, Opportunities and Threats
TAFEA	Province of Vanuatu comprising Tanna, Aniwa, Futuna, Erromango and Aneityum islands
TC	Tropical Cyclone
TEK	Traditional Ecological Knowledge
TK	Traditional Knowledge
TORBA	Province of Vanuatu comprising Torres and Banks islands
TVET	Technical and Vocational Education and Training
UNC	Université de la Nouvelle-Calédonie / University of New Caledonia
UNCED	United Nations Conference on Environment and Development
UNDESA	United Nations Department of Economic and Social Affairs
UNDESD	United Nations Decade of Education for Sustainable Development
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNISDR	United Nations Inter-Agency Secretariat of the International Strategy for Disaster Risk Reduction
USAid	United States Aid
USB	Universal Serial Bus
USP	University of the South Pacific
VAC	Vanuatu Agricultural College
VCAN	Vanuatu Climate Action Network
VCC	Vanuatu Cultural Centre
VCCDRRP	Vanuatu Climate Change and Disaster Risk Reduction Policy
VIT / ITV	Vanuatu Institute of Technology / Institut de technologie du Vanuatu
VITE / IFEV	Vanuatu Institute of Teacher Education / Institut de formation des enseignants du Vanuatu
VMS	Vanuatu Meteorological Service
VNCS	Vanuatu National Curriculum Statement
VNSO	Vanuatu National Statistics Office
VQA	Vanuatu Qualifications Authority
VRDTCA	Vanuatu Rural Development Training Centres Association
VSSC	Vanuatu Senior Schools Certificate
WHO	World Health Organisation
WMO	World Meteorological Organisation

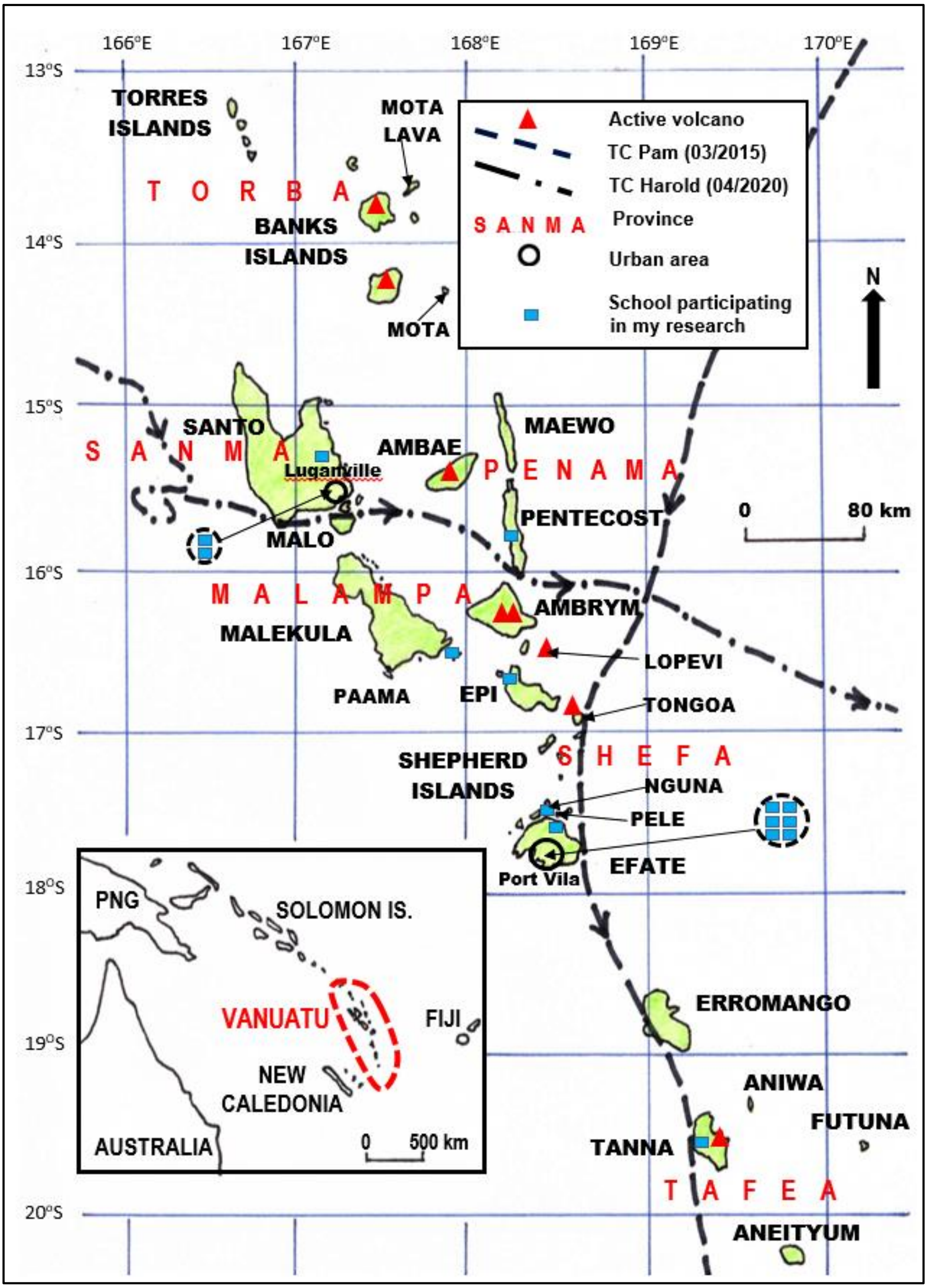
CHAPTER 1: INTRODUCTION

1.1 Background to the Research

Vanuatu is an archipelago of 83 volcanic and raised reef islands in the tropical south-west Pacific (Figure 1.1). Culturally part of Melanesia, along with Papua New Guinea, the Solomon Islands, New Caledonia and Fiji, it has been inhabited for some 3,000 years (Valentin et al, 2016). Named the New Hebrides by Captain James Cook in 1774, the islands attracted European explorers, traders and missionaries, and in 1906 became a joint colony of Britain and France, known as the Anglo-French Condominium of the New Hebrides. In 1976, 105 different indigenous Austronesian languages were identified as still extant in the island group (Tryon, 1976, p. 87), although a few of these may now have disappeared. The New Hebrides achieved independence in 1980, becoming the Republic of Vanuatu and adopting English, French and Bislama (a variety of Pidgin English/French) as its official languages. In the national census of 3 August 2020, Vanuatu had a population of 300,019, of whom 66,753 (22%) were living in the two main urban areas of Port Vila and Luganville. Approximately 39% of the total population were aged 14 years and younger (Vanuatu National Statistics Office, 2021).

As a Geography graduate and trained educator, I first came to the New Hebrides in 1971 as a young volunteer teacher at Nur Bahá'í School in Port Vila. I then worked for the Condominium Bureau of Statistics, specialising in census operations, and in this capacity had the opportunity to visit and interact with the inhabitants of almost all islands and a majority of villages. Just prior to Independence I was invited to serve on the New Hebridean committee that chose the name and national symbols for the new nation. Between 1979 and 2013, I was employed in various educational projects, including head of Geography and Social Science at Malapoa College, the nation's leading and largest English-medium secondary school; lecturer and course developer at the Vanuatu Institute of Teacher Education; chief examiner in Geography and Development Studies at year 12 and 13 level for Vanuatu and the South Pacific region; part-time tutor in Geography and Earth Science at the University of the South Pacific's Emalus Campus in Port Vila; and consultancy work on climate change commissioned by the Secretariat of the Pacific Community (SPC) and Deutsche Gesellschaft für Internationale Zusammenarbait GmbH (GIZ).

Figure 1.1 Map of Vanuatu showing active volcanoes, tracks of category 5 cyclones Pam (2015) and Harold (2020), and schools participating in my research



Author, 2022

Always fascinated by weather, climate and environmental change since childhood, almost five decades in Vanuatu have seen a growing motivation to enable my students to become actively involved in climate change mitigation and adaptation - a desire reinforced through my real-life experiences of severe cyclones and burgeoning environmental degradation in coastal areas. Thus between 2014 and 2018 I created and taught two specialised semester-long courses on climate change and disaster risk reduction for delivery at TVET (Technical and Vocational Education and Training) level, initially designed for 35 of Vanuatu's Rural Training Centres in the outer islands, but actually delivered at the Vanuatu Institute of Technology. The experience of working with young adults in these two courses (Pierce, 2019) has set me on a path of learning to investigate the most effective ways of educating children, youth, adults and communities in Vanuatu to become more resilient to disasters and the impacts of climate change.

Another incentive for the present research arises from a survey carried out by my Certificate 3 Resilience students on the island of Nguna during 2018 (Pierce, 2019). Nguna is the largest of the small islands off the north coast of Efate, and has been the target of awareness programmes on climate change and disaster risk reduction by government and non-government agencies over the past decade, perhaps to a greater extent than on any other island of Vanuatu with the exception of nearby Pele. The students (Figure 1.2) interviewed a total of 120 people (64 males and 56 females of all ages) in the five villages in which they were living in order to ascertain respondents' perceptions of climate change. Results show that although most people in the sample had heard of climate change, only about half of them had some understanding of its meaning. Regarding its causes, 90% of respondents could identify pollution and/or deforestation as key factors, but no-one mentioned carbon dioxide and only 2% mentioned natural factors. For impacts, the three most commonly reported were changes in yields of crops and fruits; sea level rise and coastal erosion; and changes in temperature and seasons: the wide range of other impacts mentioned reflects the keen observations of populations dependent on natural ecosystems for their livelihoods and survival. My learning from this initial survey was that even after many interventions to raise community consciousness of climate change and of practical strategies to address it, the general level of understanding among Nguna's population remains fairly limited. The implication is that on other islands of Vanuatu, which have not benefited from such attention, awareness of climate change and actions to mitigate and adapt to its impacts could be even lower. Hence research is needed to investigate ways of educating individuals and communities throughout Vanuatu so that they can build greater adaptive capacity to climate change.

Figure 1.2 Resilience students interviewing a family about climate change in the village of Malaliu, Nguna, Vanuatu, in December 2018

Author, 2018

A third significant factor motivating my research into resilience education is an overarching conviction in the set of principles enunciated by Bahá'u'lláh, Founder of the Bahá'í Faith. The Bahá'í Writings explain that God is beyond the understanding of human minds, but that throughout the ages, He has sent a succession of divine messengers, known as Manifestations of God, to educate and guide humanity. Bahá'u'lláh (1817-1892) is the most recent of these Manifestations (Bahá'í International Community, 2021). Bahá'í beliefs address essential themes such as the fundamental equality of all humans, the oneness of God and religion, the imperative to promote unity and justice, the abolition of all forms of prejudice, community-building based upon spiritual and material reality, equal opportunities accorded to women and men, a symbiotic relationship between humans and their environment, the harmony of science and religion, universal education, the need for consistency between belief and practice, and many others. As a Bahá'í, I understand that the purpose of education is to bring out each individual's potentialities, and so any course on resilience must involve participatory learning, with the learner at the centre. It must also promote cooperation rather than competition, emphasize service to the community, and show that the delicate balance between humans and their natural environment is today being compromised by excessive resource consumption and consumerism.

1.2 Vulnerability of Vanuatu to Hazards and Climate Change

As a small island developing state (SIDS) in the South Pacific, Vanuatu is highly vulnerable to the impacts of natural hazard-related disasters and climate change (Connell, 2013; Le Dé et al, 2018). In 2021, the World Risk Report (Bündnis Entwicklung Hilft, 2021), calculated for 181 countries on the basis of exposure, vulnerability, susceptibility and coping and adaptive capacities, identified Vanuatu as the planet's most at-risk country to natural hazards, with an index of 47.73 – much higher than that of the next two countries, the Solomon Islands (31.16) and Tonga (30.51). By 2022, however, calculation of the World Risk Index is fundamentally restructured: based on a wider range of factors, the Philippines is now the most at-risk, with Vanuatu ranked 49th of 193 countries (Bündnis Entwicklung Hilft, 2022).

Vanuatu's vulnerability can be explained by its high exposure to extreme natural events and on-going sea-level rise; its location along the junction of the Pacific and Indo-Australian tectonic plates, with eight active volcanoes (Figure 1.1), frequent earthquakes (Walshe & Nunn, 2012), occasional tsunamis and landslides; its position in the heart of the cyclone belt of the tropical south-west Pacific; lengthy droughts during El Nino periods; and the concentration of its inhabitants in coastal areas. Recent impacts of geological hazards include the eruption of Mt Lombenben (Manaro Voui) on Ambae in September 2017, resulting in severe ashfalls over the next 13 months that destroyed food gardens, contaminated water supplies, caused the collapse of homes, and damaged the health of people and animals. This eruption culminated in the evacuation of the island's entire population of over 11,000 to other islands in October 2017 and then again from July to October in 2018, when the eruption ceased (Global Shelter Cluster, 2018; Rovins et al., 2020). The two volcanoes on Ambrym and Mount Yasur on Tanna are continuously degassing. Mount Yasur also ejects intermittent moderate ashfalls, with the latest episode in early 2020.

In Vanuatu, climate change can be viewed as a slow-onset disaster. One of its major impacts is sea-level rise and the concomitant coastal erosion that occurs during storms (Figure 1.3). Projections of sea level rise for 2015-2090 range from 25 to 59 cm for a very low emissions scenario and 42–89 cm for a very high emissions scenario (PACCSAPP, 2015, p.9). A warmer atmosphere and oceans are expected to result in the increased intensity, but decreased frequency, of tropical cyclones (ibid, p. 7). Other observed and expected environmental impacts include: more very hot days and extreme rainfall events (ibid, p.8); an increase in ocean acidification and decline in the health of reef ecosystems (ibid, p.9); and reduced terrestrial biodiversity (Taylor & Kumar, 2016).

Figure 1.3 Coastal erosion of a village graveyard on Pele island, Vanuatu, 2018

Author, 2018

As with other tropical oceanic islands, Vanuatu's vulnerability to hazards and climate change results from both human and natural factors. Writing over two decades ago, Nunn et al (1999) pointed out that during the last 100 years, Pacific oceanic island environments have experienced non-human impacts such as temperature rise, increased frequency of tropical cyclones and rising sea levels, with the latter leading to increased inundation, shoreline erosion and groundwater salinization. At the same time, human impacts on island coasts have been significant: in Vanuatu, they include a reduction in inland forest cover, bringing greater run-off, erosion and sedimentation, removal of mangroves, conversion of shoreline vegetation to species less likely to withstand stress, land reclamation, sand mining and exploitation of reef food resources - impacts most readily observed on Santo and Efate, but present to some extent on all inhabited islands, where populations are mostly concentrated along narrow coastal strips. To build resilience to these negative factors, Nunn et al (1999) urged the use of traditional systems of coastal resource management to complement modern strategies such as environmental legislation, but lamented the disappearance of such traditional knowledge in the face of population growth, urbanisation and economic factors.

Richmond & Sovacool (2011) identified the three major vulnerabilities encountered by populations in Vanuatu as coastal erosion, potable water security and flooding. However, their research was based on interviews with residents of just three coastal villages - Lateu (Torres islands), Luli (Paama) and Panita (Tongoa) - villages that already have a heightened exposure due to their location: Lateu has experienced tectonic subsidence and sea level rise, and its inhabitants have already relocated further inland; Luli is directly opposite the active volcanic island of Lopevi and suffers ash falls brought by prevailing south-east Trade winds. Panita is at the scarp foot of a small, densely populated volcanic island with no rivers or surface water.

During the 41-year period between 1969 and 2010, the islands of Vanuatu experienced an average of 2-3 tropical cyclones per annum, although this figure varied between 0 and 6 (PACCSAPP, 2015, p.3). But between 2015 and 2020, the country suffered from two of the most intense cyclones in recorded history (Figure 1.1) - TC Pam in March 2015 and TC Harold in April 2020, both at category 5 (SPC, 2016, p. 45; FAO, 2020, p.2).

Cyclone Pam smashed into the central and southern islands on 13-14 March 2015. Sustained winds of 250 km/hour flattened homes, schools and villages, affecting an estimated 188,000 people and causing 15 deaths, many injuries and the displacement of some 65,000 from their homes. In SHEFA and TAFEA provinces, 96% of agricultural crops were destroyed and 81% of homes sustained some level of damage (SPC, 2016, pp. 6, 11). Costs of repairing the damage were almost $600 million (Mcdonald, 2020).

Cyclone Harold, also of category 5 intensity, was smaller in size than TC Pam, but its passage was slower and with winds gusting up to 294 km per hour, its destructive impacts very similar. It lingered off the west coast of Santo from 4-6 April before moving along the south of that island and across to Pentecost, leaving Vanuatu waters on 7 April. ReliefWeb states that 80-90% of homes and 50% of schools in SANMA province were destroyed, as were 96-95% of homes on Pentecost (Figure 1.4), so displacing some 80,000 people (Ober & Bakumenko, 2020).

Figure 1.4 Village of Melsisi, Central Pentecost, three weeks after the impact of TC Harold. The building on the left is the largest church in Vanuatu

Stein, G., 2020

Many communities were cut off from support due to flooding and destruction of roads. The United Nations estimated that over 160,000 people, or more than half of Vanuatu's population, were affected (OCHA, 2020), and some 17,500 ha of cropland were damaged, including root crops and other staples that had been almost ready for harvesting (FAO, 2020, p.1).

TC Harold arrived in Vanuatu shortly after a state of emergency had been declared due to COVID-19 and while the National Disaster Management Office (NDMO) was already struggling to cope with major ashfalls afflicting Tanna. Despite the severity of the damage, the NDMO banned foreign aid workers from entering the country because of the pandemic, saying that the response to Harold would be “localised”. In terms of foreign aid, $2.5 million was provided from the United Nations Emergency Humanitarian Fund, and $8 million worth of supplies came from Australia, New Zealand, France and China: however, distribution to needy communities was hampered by strict decontamination and quarantine measures, damage to inter-island vessels, erosion of roads and the sheer remoteness of many villages (Mcdonald, 2020). In general, there was a significantly weaker external humanitarian response to TC Harold than for TC Pam (Ober & Bakumenko, 2020), so that communities were compelled to adopt local responses to the emergency, such as managing food security through traditional resilience strategies and values.

1.3 Vanuatu’s Education System and How it is Dealing with Resilience

1.3.1 Historical Background

Formal education in Vanuatu began in the 19th century with the arrival of Catholic, Presbyterian and Anglican missionaries, who realised that in order for their converts to understand the Christian message, they had to learn to read and write. Mission schools and churches were established in coastal locations, leading to a concentration of people who had previously lived in scattered family groupings in the upland interior of most islands. Catholic missions taught their students in French, while Presbyterians and Anglicans used English, setting a pattern for the dual system of education that persists until today. Under the Condominium Government, departments such as public works, statistics, agriculture and aviation were run jointly by British and French officials, but others such as law enforcement, health and education operated as independent entities, one under each colonial power. During the 1960s, both British and French administrations realised that mission education was limited and under-resourced, and each began a separate, often competitive, drive to scholarize the indigenous population. The British up-graded the many English-speaking mission schools and established a teacher’s training college, while the French embarked upon a well-financed programme of new, free, French-medium state schools, aiming to cater for at least half the school-age population of the islands (Woodward, 1978). The two systems followed differing curricula, pedagogies and educational philosophies: English-medium schools tended to follow those of the United Kingdom, Australia, New Zealand and other Commonwealth countries, while French-medium schools adhered strictly to those used in France. In 1980, the newly-born nation of Vanuatu inherited two separate and divergent educational systems and a consequent legacy of political polarisation between “anglophones” and “francophones”.

It has taken several decades to fuse these two educational systems into one, and even today, the divisive anglophone and francophone terminology is still used. But major strides have been made, particularly since the formulation of the Vanuatu National Curriculum Statement (VNCS) in 2010 and its subsequent implementation. The reformed programme acknowledges the existence of a dual system, with English and French enshrined by law as the principal languages of education, but states that all children from kindergarten to Year 13 must follow the same curriculum - one which ‘encompasses our cultural diversity, multilingual context and the Christian principles and values on which Vanuatu is founded…’ (Ministry of Education, 2010, p.2).

The expansion of education since Independence has been rapid, with the number of children receiving formal school education increasing threefold over thirty years - from 30,380 in 1989 (Macfarlane, 2000) to 99,363 in 2021 (MOET, 2022). There are currently 1,472 schools in the nation, of which 779 are at kindergarten/pre-primary level, 461 at primary level (Years 1-6) and 110 at secondary level (Years 7-14) (MOET, 2022). Vanuatu’s literacy rate in 2018 was 96.3% for the age group 15-24 years, 87.5% for youth and adults aged 15 years and over, and 50.9% for people aged 65 years and over (UIS, 2021).

1.3.2 Formal School Education in Resilience

Formal school education about disasters and climate change is very recent, largely dating from the implementation of the VNCS during the last decade. In the revised curriculum for primary schools (Years 1 to 6), aspects of resilience are covered in Science and Social Science in Years 4, 5 and 6 (CDU, 2013). Teacher’s Guides provide desired outcomes and examples of student activities, and in 2022 have already been produced and distributed for use with Years 4 to 6 – meaning that these topics are already being taught at those levels. At junior secondary level (years 7 to 10), revised curricula are still being developed, so that in 2022, schools are still reliant upon pre-2010 content in which fairly limited coverage in Basic

Science and Social Science is given to climate change and disasters. In Social Science, for example, global warming and cyclones are briefly covered in the last unit of Year 10 - Our Changing Society. For those in the senior secondary cycle of education (years 11 to 13), new curricula were first implemented at the start of 2019 at Year 11 level, and will not be completely in place until 2023. Resilience issues only feature in the curricula for Geography, Earth Science and Development Studies through strands that are delivered in increasing complexity through the three years of the senior secondary course (MOET, 2018). However, these subjects are "optional", each studied by only one third or less of the students who manage to attain this level.

An important aspect of the educational system remains the high rate of student attrition. Education is not compulsory in Vanuatu, but the Government subsidises school attendance. Tuition fee grants are provided to all children at pre-primary level and to pupils at primary and junior secondary levels (Years 1 to 10) in government and government-assisted schools - extended to all schools during 2020 in response to the COVID-19 pandemic. For senior secondary pupils (Years 11 to 13/14), a smaller "operational grant" is given, but because of the restricted number of schools at this level, such students are no longer living in their home villages and must meet additional travel and boarding costs. This is one factor accounting for the high rate of student attrition in the country (Table 1.1). Another relates to national examinations at the end of Years 8, 10 and 12, which permit only those with higher grades to continue. In 2021, 87% of Year 8 primary students continued on to Year 9, and 58% of Year 10 students moved to Year 11. Only 2,155 students had reached Year 11 and just 1,408 were enrolled in Year 13, as compared with 9,848 in Year 1 (MOET, 2022): this represents attrition rates of 78% and 86% respectively. More accurately, statistics for 2009 reveal that when the 2021 cohort of Year 13 students were in Year 1, they numbered 7,851 (MOE, 2011, p. 21): thus the exact attrition rate between Years 1 and 13 in 2021 was a loss of 82%.

Table 1.1 Total students in Vanuatu schools enrolled in each level, 2021

ECCE*	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
16,571	9,848	9,974	10,073	10,191	9,217	7,769	6,084	5,203
% change between successive years		+ 1.3%	+ 1.0%	+ 1.2%	- 9.6%	- 15.7%	- 21.7%	- 14.5%

Year 9	Year 10	Year 11	Year 12	Year 13	Year 14**	Total
4,542	3,936	2,281	2,034	1,408	232	99,363
- 12.7%	- 13.3%	- 42.0%	- 10.8%	- 30.8%		

Source for student numbers: MOET, 2022, p.17

* Early Childhood Care Education (Kindergarten/Pre-Primary)

** Year 14 only exists in French-medium senior secondary schools. It is being phased out as the new Vanuatu National Curriculum for Years 1 to 13 is implemented, but is still operating in 2022.

1.3.3 Post-Secondary Education in Resilience

Table 1.2 shows the tertiary educational establishments in Vanuatu offering courses in climate and disaster resilience in 2022, either as dedicated programmes or included within other degree or diploma programmes. The Vanuatu Institute of Technology offers dedicated Certificate I and III level courses on Resilience, Climate Change and Disaster Risk Reduction. The University of the South Pacific (USP), based in Suva, Fiji, has its Emalus Campus in Port Vila, specializing in law and linguistics, and operates several distance learning centres in the major islands of Vanuatu; it offers the Post-Graduate Diploma in Climate Change and Certificate IV in Resilience as on-line courses. The University of New Caledonia (UNC) has a degree course on Environmental Science, which includes climate change, but this must be taken in Nouméa. The National University of Vanuatu (NUV), first opened in 2021, includes climate change and disasters in its Bachelor of Environmental Science; dedicated diploma and degree courses in Climate Change and Humanitarian Action are in process of development.

The NUV's School of Education, formerly the Vanuatu Institute of Teacher Education (VITE) / l'Institut de formation des enseignants du Vanuatu (IFEV), trains teachers for primary and secondary schools in Vanuatu. Between 2010 and 2019, when operating as VITE, all trainee teachers followed courses that included aspects of climate change that can be taught at primary and junior secondary level. Those at primary level were exposed to global warming and climate change through Preliminary Basic Science. Those specialising in junior secondary mathematics and science took a course in Earth Science that included many aspects of climate science and anthropogenic climate change, while those specialising in language and social science took a course on Planet Earth and its Resources that included anthropogenic climate change. Disaster risk reduction was not specifically covered. Those who followed these courses now work as trained teachers.

Table 1.2 Tertiary educational establishments offering courses in climate and disaster resilience in 2022

	Name	Location	Offers courses in Resilience		Comment
			Dedicated course	**Included in other courses**	
1.	National University of Vanuatu (NUV)	Port Vila	Not yet	Bachelor of Environmental Planning	In preparation: Diploma, Advanced Diploma & Degree in Climate Resilience and Humanitarian Action
2.	University of the South Pacific (USP)	Port Vila Suva, Fiji	PGDCC	Bachelor of Geography	Post-Graduate Diploma in Climate Change offered since 2010. On-line
3.	University of the South Pacific	Port Vila Suva, Fiji	Cert. IV in Resilience	No	Dedicated TVET course since 2020. On-line
4.	University of New Caledonia (UNC)	Port Vila Nouméa	No	Bachelor of Environmental Science	
5.	NUV School of Education (formerly Vanuatu Institute of Teacher Education)	Port Vila	No	Bachelor of Science	From 2010 to 2019, climate change featured in Certificate and Diploma programmes offered by VITE.
6.	Vanuatu Institute of Technology	Port Vila	Cert. III in Resilience	No	Dedicated TVET course in Climate Change and Disaster Risk Reduction since 2017
7.	Vanuatu Agricultural College	Luganville	No	Certificates in Crop & Animal Science. Diploma in Agriculture	
8.	Vanuatu Nursing School	Port Vila	No	No	
9.	Vanuatu Maritime College	Luganville	No	No	
10.	Vanuatu Police Training College	Port Vila	No	No	

The Vanuatu Institute of Technology (VIT) began delivering certificate courses on climate change and disaster risk reduction in February 2017 (Pierce, 2019). This first-ever Technical and Vocational Education and Training (TVET) course, at Certificate I level, had originally been designed for use in some 35 rural training centres (RTCs) scattered around the Vanuatu archipelago, under the guidance of the Vanuatu Rural Development Training Centres Association (VRDTCA). Such centres provide vocational training for students unable to continue their education beyond Year 10 level. VRDTCA felt that these students would be able to pass on knowledge and skills to the coastal communities around them, and in 2014 engaged a consultant to do this through funding from the Coping with Climate Change in the Pacific Island Region (CCCPIR) programme run by Deutsche Gesellschaft für Internationale Zusammenarbait GmbH (GIZ) and the Pacific Community (SPC).

Materials were produced in English and French and trialled in the outer islands, but delivery stalled after the demise of VRDTCA in 2015. Two years elapsed before the first Certificate I level course in Climate Change and Disaster Risk Reduction was finally launched at VIT with financial assistance from the European Union Pacific Technical and Vocational Education and Training (EU PacTVET) project, this time with students who had for the most part completed 13 years of secondary education. The course ran for 6 months, after which the Institute of Technology insisted that the consultant produce a higher level course to upskill the Certificate I graduates and give them better career and further study opportunities. The Certificate III course in Resilience (Climate Change and Disaster Risk Reduction) ran from August to December 2018. Both courses were formally accredited by the Vanuatu Qualifications Authority for delivery at VIT – Cert I in August 2017 and Cert III in August 2019. Following this first group of students, a second cohort completed both Certificate courses in 2020. Since 2021, the two courses have been merged into one Certificate III programme that in 2022 is being taken by a fifth cohort.

During the same period that Vanuatu's own TVET courses in Resilience were being created, a parallel development has been the formulation of the Pacific Regional Certificates in Resilience (PRCR), again with the assistance of the EU PacTVET project. This is a generic TVET qualification, accredited in Fiji and offered at Certificate levels I, II, IIII and IV for those who may already work in a resilience-related field or who wish to pursue a career in resilience. In 2020, Certificate IV was offered for the first time through USP's Emalus Campus in Port Vila.

1.4 Non-Formal Education in Resilience

Outside the formal education system, public and community education about disasters and climate change takes place through warnings, short courses and workshops effected by government and non-government agencies.

Initially, such education was restricted to warnings broadcast on Radio New Hebrides about approaching cyclones and sudden volcanic eruptions. Later, through the World Meteorological Organisation, a regional tropical cyclone warning system enabled warnings and advisories to be transmitted through Radio Vanuatu, short-wave radio, telephone, telex and fax. In 1987, severe cyclone Uma, with winds reaching 150 knots/278 km per hour, caused 45 deaths and wreaked havoc on vegetation, infrastructures (Figure 1.5), businesses and livelihoods in central and southern islands (Emrys-Roberts, 1987; Longworth, 1994): it was a wake-up call for national agencies to engage in better preparedness.

Figure 1.5 Cyclone Uma, February 1987: in Port Vila, violent winds have bent these reinforced steel utility poles down to the ground

Author, 1987

Accordingly, in the early 1990s the Vanuatu Meteorological Service published the first educational material on cyclones, including a cyclone tracking map that could be used by radio listeners to estimate the degree of threat (Longworth, 1994). In 2022, the Ministry of Climate Change Adaptation, Meteorology, Geo-Hazards, Environment, Energy and Disaster Management oversees five departments that are capable of accessing and instantly disseminating the latest information on weather and climate science to the entire Vanuatu population, most of whom have ready access to mobile phones and social media that display warnings, satellite images, volcanic ash advisories and cyclone tracking maps. Under the Vanuatu Climate Change and Disaster Risk Reduction Policy, adopted in 2015, all five branches of the Ministry of Climate Change are involved in resilience education through the promotion of mitigation and adaptation projects; awareness programmes on climate change; promotion of disaster preparedness, response and recovery; advancing the use of renewables, and fostering biodiversity and environmental conservation.

In the last few years, most of this public education has been undertaken by international, national and local non-government and civil society organisations such as the Red Cross, Save the Children Australia, World Vision, Oxfam Australia, Care International, Live and Learn Environmental Education, the Vanuatu Christian Council, Caritas-Vanuatu, Adventist Development and Relief Agency (ADRA) and Wan Smolbag Theatre, usually with the aid of external funding from Australia, France and/or other donor partners. Such agencies send teams into the field to hold short training courses at community level (Figure 1.6), raising awareness among adult populations of mitigation measures for hazard reduction and of strategies for climate change adaptation.

Figure 1.6 Residents of Rewoka village, Nguna, North Efate, compile a risk map as part of their training in DRR conducted by a two-person team from Oxfam, February 2020

Author, 2020

A common aim is to empower local communities to assess their own vulnerability and develop their own resilience strategies based on local knowledge. The *Community-Based Handbook for Disaster Risk Reduction*, produced by the National Disaster Management Office (NDMO), provides basic guidance for such courses. Two recent trends I have observed in this form of community education are for training and awareness to focus on disaster preparedness rather than on climate change, and for this training to be given to sub-national institutions and local decision-making bodies rather than at grass-roots, village level (Figures 1.7 and 1.8).

Figure 1.7 An example of non-formal learning: Facilitator for a week-long training course in February 2020 for Red Cross volunteers held in Luganville, Santo, Vanuatu. The training was entitled "Participatory Approach for Safe Shelter Awareness (PASSA)"

Author, 2020

Figure 1.8 As part of his field training, a participant in the PASSA course analyses the features of a makeshift dwelling in Luganville in order to assess whether it is safe or unsafe in the face of cyclones, earthquakes and flooding

Author, 2020

Finally, mention must be made of the contribution to non-formal resilience education in Vanuatu from agencies of the United Nations and bilateral donor partners – for example, the United Nations Children's Fund (UNICEF), the World Health Organisation, Peace Corps (USA), Australian Aid (AusAID), New Zealand Aid

(NZAid), Japan International Cooperation Agency (JICA), the Canada Fund, the European Union and the Governments of France and the People's Republic of China.

1.5 Transmission of Traditional Knowledge, Skills and Values

Another significant way in which resilience education is taking place is through the inter-generational transmission of traditional environmental knowledge, skills and values that generally occurs through oral means in village settings. In common with other Pacific island populations, the people of Vanuatu have had long experience in building adaptive capacity to extreme weather events, particularly cyclones and droughts, through their indigenous and local knowledge and traditional values of mutual support and community cohesion (McMillen et al, 2014; Granderson, 2017). Such strategies include house design, ways of enhancing food and water security and behavioural norms that embrace close cooperation, obedience to local leaders and resource-sharing. Traditional knowledge and wisdom has often been the key to survival, but is fast disappearing in the face of population growth, urbanisation, globalisation, modern education and the movement of young people away from their village roots. It would seem that any investigation into resilience education must include the contribution of this form of learning.

1.6 Research Questions

When considering the high level of vulnerability to hazards and climate change faced by the islands and people of Vanuatu, and the vital need to promote effective education on individual and community resilience to these challenges, several questions must be asked. For example, what is the response of the formal educational system? How are public, community-based agencies reacting? Is traditional knowledge on disaster resilience and environmental change still relevant in today's world?

Covering such a vast field has proved to be beyond the scope of this thesis, especially when investigations over the three-year period December 2019 to October 2022 have been hampered by two significant external factors – Tropical Cyclone Harold in April 2020 and the on-going COVID-19 pandemic – both causing severe disruptions to schools, population mobility and the ability of the researcher to conduct face-to-face fieldwork.

Accordingly, my research questions have been restricted to the following:

1. How effective is formal education on climate and disaster resilience in Vanuatu in terms of knowledge and skills gained, changes in attitude and behaviour and impacts on individuals and their communities?
2. To what extent are traditional knowledge, skills and values relevant to climate and disaster resilience in Vanuatu?

Analysis of the valuable role of other agencies in fostering climate and disaster resilience – government departments, non-government and civil society organisations, international benefactors – has regrettably been omitted.

1.7 Outline of the Thesis

After this initial introduction, which serves to highlight the main issues involved in resilience education, Chapter 2 will examine the relevant literature and formulate a conceptual framework for guiding the research. Chapter 3 will deal with research methodology, showing how both quantitative and qualitative data will be used and justifying the use of certain data collection tools. In Chapters 4, 5 and 6 I will present the results and discussion of investigations into research question no. 1, separating them by educational levels: primary and junior secondary in Chapter 4, senior secondary in Chapter 5, and post-secondary in Chapter 6. Research question no. 2 will be addressed in Chapter 7, while overall conclusions and recommendations will appear in Chapter 8.

CHAPTER 2: LITERATURE REVIEW

2.1 Overview

We will first look (Section 2.2) at how two concepts central to this thesis – resilience and modes of learning – are covered in the literature. Resilience will be explored in relation to two processes – climate change and disaster risk reduction – adopting the viewpoint that recent climate change is largely due to anthropogenic factors, but acknowledging the existence of contrary opinions. For modes of learning, we will investigate various explanations of formal and informal education and use these to create definitions that are appropriate for learning about resilience in Vanuatu. Thus informal learning will focus on the transmission of traditional knowledge, wisdom, skills and values.

This exploration of key concepts will lead in Section 2.3 to a consideration of the nature and evolution of resilience education, finding that it has emerged from the fields of environmental education (EE) and education for sustainable development (ESD), and recognizing that it includes education for disaster risk reduction (EDRR) and education on climate change (ECC) or climate change adaptation (ECCA). Resilience education thus represents the fusion of climate change education and education for disaster risk reduction.

Examples of resilience education will then be examined in literature relating to the two modes of learning already defined. Section 2.4 will focus on formal learning in schools and tertiary institutions, and Section 2.5 on the transmission of traditional knowledge, wisdom and values. Both sections will mention literature on the situation in other countries, but focus on a Pacific island context and Vanuatu in particular, showing how resilience education is an outcome of the archipelago's extreme vulnerability to disasters and climate change as well as the role played by funding agencies in driving educational initiatives.

In section 2.6, we will consider literature on how the effectiveness of resilience education might be measured, investigating how participants might change in terms of their knowledge, skills, attitudes and behaviour. We will look at the most suitable methods of data collection; appropriate questions to be asked; relevant models; and how effectiveness is determined by materials used, modes of delivery and characteristics of facilitators and students.

Finally, in section 2.7, findings from the Literature Review will be synthesized into a broad conceptual framework that guides the research. This framework covers the overall content and purpose of resilience education, the pedagogy of effective teaching and learning, and the characteristics of a model educational programme on resilience.

2.2 Key Concepts

2.2.1 Resilience, Vulnerability and Associated Concepts

In physics, resilience is the ability of an elastic material such as rubber or animal tissue to absorb energy (such as from a blow), and release that energy as it springs back to its original shape (Merriam-Webster Dictionary, 2020). More generally, resilience is the ability of people or things to feel better quickly after something unpleasant, such as shock, injury, etc. (Oxford Learner's Dictionaries, 2020).

In this thesis, however, the term "resilience" will be used in relation to two processes - climate change and disaster risk reduction. The standpoint adopted is that while the Earth's climate has been constantly changing over geological history, the rise in average global surface temperatures since approximately 1750 is due to increases in greenhouses gases (GHGs) that are 'unequivocally caused by human activities' (IPCC, 2021, p.5). In turn, the warming of the lower atmosphere and oceans has affected other atmospheric processes and led to an increase in extreme weather events and changes in climate. Consequently, the mitigation of climate change requires a radical reduction in greenhouse gas emissions, a low-carbon economy and widespread reforestation, and this must be a component of any educational programme on climate change. A minority of scientists (e.g. Singer, 2016; Spencer, 2017) deny the greenhouse effect and dispute the role of carbon dioxide in causing global warming, so rebut the need to reduce fossil fuel consumption. The influence of politics and the fossil fuel industry on climate change scepticism is well documented (e.g. Beeson & McDonald, 2013; Dunlap, 2013; Pawluk & Braithwaite, 2014). However, the literature abounds in attempts to discredit the arguments of climate change deniers and sceptics (e.g. Dunlap, 2013; Diethelm & McCee, 2009;

Maslin, 2019) and there is no need for my thesis to expand any further upon this topic.

The concept of resilience is explained by the Intergovernmental Panel on Climate Change (IPCC) in its *Glossary*:

> The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation.
> (IPCC, 2014, p.127)

A similar definition comes from the Vanuatu Climate Change and Disaster Risk Reduction Policy 2016-2030:

> The ability of a system, community or society exposed to hazards and/or climate change to resist, absorb, accommodate, and recover from the consequences of a hazard event or from climate change in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions. (SPC, 2015, p.31)

More simply, **resilience** can be described as the ability of a person, household or community to cope with hazards, their capacity to prepare for hazards and cope with climate change, and their ability to recover from disasters that occur. In other words, a community is resilient to hazards and climate change if it has taken steps to prepare for and handle them, and is able to recover from the damage without external help. A resilient community can cope with hazards when they arrive.

A related concept is **adaptive capacity**, which is defined by the IPCC as:

> The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences. (IPCC, 2014, p.118)

For the purposes of this thesis, it will be assumed that adaptive capacity is broadly similar to resilience, and the two terms will be used synonymously.

Explanations of resilience must be linked to those of climate change, hazards and disasters. The IPCC defines climate change as follows:

> Climate change: A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. (IPCC, 2014, p.120)

Updated definitions of hazard and disaster are provided by the United Nations Office for Disaster Risk Reduction:

> Hazard: A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation. Hazards may be natural, anthropogenic or socio-natural in origin….. Several hazards are **socio-natural,** in that they are associated with a combination of natural and anthropogenic factors, including environmental degradation and climate change. (UNDRR, 2021, Hazard)
>
> Disaster: A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts. The effect of the disaster can be immediate and localized, but is often widespread and could last for a long period of time. The effect may test or exceed the capacity of a community or society to cope using its own resources, and therefore may require assistance from external sources, which could include neighbouring jurisdictions, or those at the national or international levels.
> (UNDRR, 2021, Disaster)

Thus a hazard <u>may</u> cause losses, damage and destruction, but becomes a disaster when it affects a population with high vulnerability and insufficient capacity to cope with the potential negative consequences. The implication is that if a population has built resilience to particular hazards through various adaptive strategies, then that hazard may not become a disaster. It is interesting to note that the UNDRR considers socio-natural hazards as a distinct third category, and that this specifically includes climate change. In 2002, the United Nations Development Programme made the same differentiation, pointing out that socio-natural hazards are caused by human modifications of natural ecosystems: deforestation can lead to hazards such as landslides, erosion and flooding; destruction of mangroves can lead to coastal erosion; and greenhouse gas emissions to climate change. (UNDP, 2002). On the other hand, managing and restoring natural ecosystems makes them more resilient to extreme events and enables them to reduce disaster risk in two ways: firstly by providing natural protective barriers, such as when forests or other natural vegetative cover prevent landslides; secondly by sustaining human livelihoods through the provision of food, medicines and building materials (Estrella & Salismaa, 2012; Rawart et al, 2012).

For the purposes of this thesis, the above definitions will be simplified. **Climate change** can be considered as a long term continuous change in the climate or in the range of weather (for example, in the occurrence of more extreme events), measured over several decades, hundreds of years or millennia, and supported by statistical evidence. A **hazard** is a dangerous phenomenon, substance, human activity or condition that could cause loss of life, injury or other health impacts, damage to property, loss of livelihoods and services, social and economic disruption, and/or environmental damage. A hazard may or may not lead to a disaster. Examples of natural hazards are tropical cyclones, earthquakes, landslides and volcanic eruptions. A **disaster** happens when a hazard strikes a community and the resulting level of impact exceeds the affected community's ability to respond and allow the community to get back to normal.

As already indicated, another key concept closely linked to resilience is vulnerability, which is its antithesis. The IPCC defines it as:

> The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt. (IPCC, 2014, p.128)

More simply, and in the context of climate change and hazards, **vulnerability** can be seen as the extent to which persons, families or communities are likely to suffer from a hazard or from the effects of climate change because they lack the capacity to cope and adapt. At the United Nations Development Programme Expert Group Meeting held in Havana, Cuba, held twenty years ago, the essential message was that disaster losses are mainly due to human vulnerability and lack of resilience, as well as location. In other words, the vulnerability of a population to hazards and climate change is not just dependent on physical location or exposure, but also on factors such as the level of poverty, equity of access to resources, health, social capital and degree of dependence on natural ecosystems. Furthermore, climate change is expected to intensify all of these factors (UNDP, 2002).

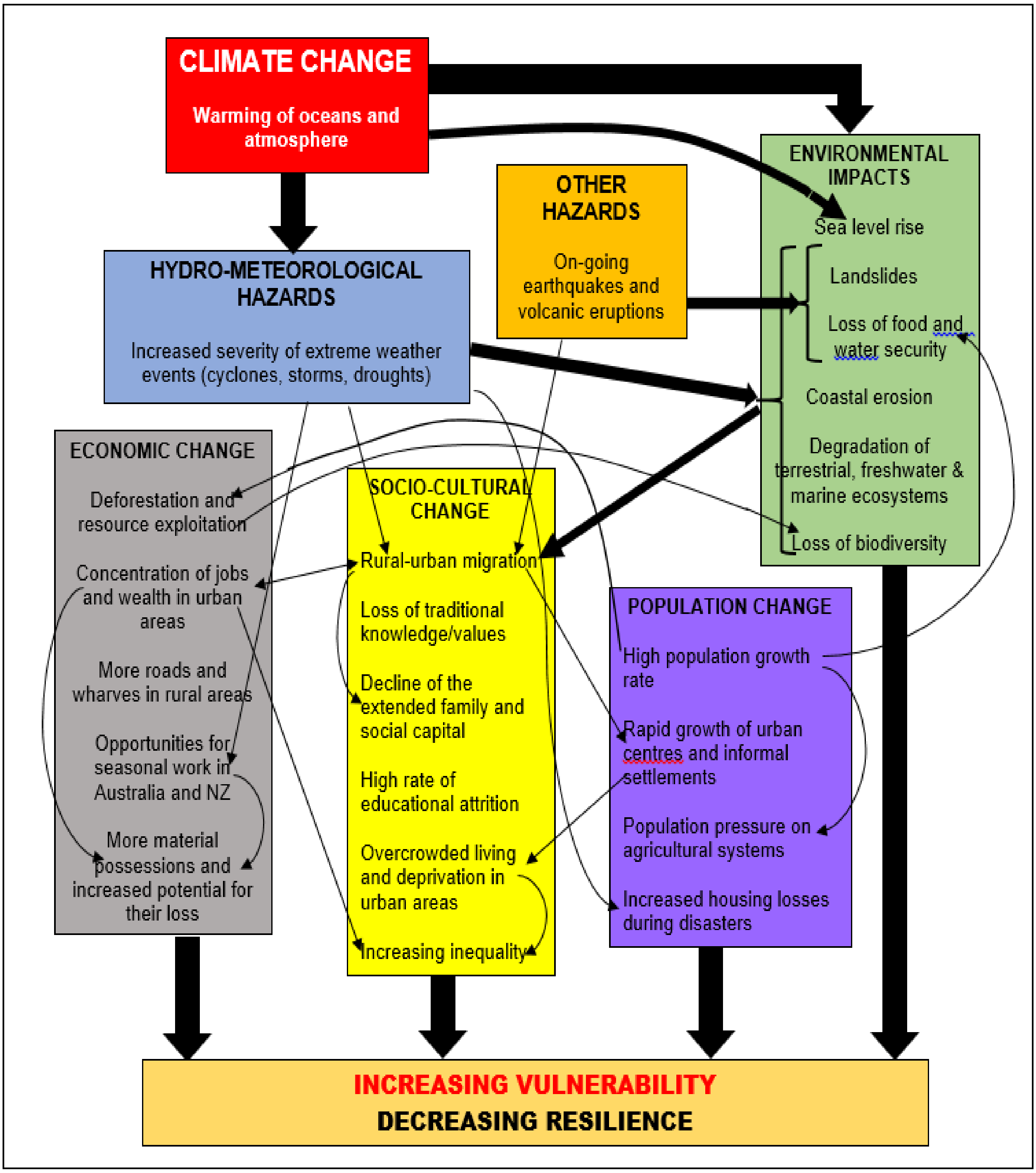
At the same meeting, Hay (2002) presented a paper from a South Pacific perspective on the integration of disaster risk management with adaptation to climate variability and change. He said that climate change would increase the likelihood of extreme events and so bring greater disaster risk, explaining that the impacts of climate change were being exacerbated by factors such as population growth, urbanisation, increasing poverty, increasing material possessions and changes in international aid regimes. Adapting Hay's model (2002, p.93), I propose the following interplay of factors that influence vulnerability and resilience in Vanuatu (Figure 2.1).

Figure 2.1 attempts to show how vulnerability in Vanuatu is influenced by economic, socio-cultural, population and environmental factors, but that the impacts of climate change and other hazards is aggravating these factors. Thus the warming of oceans and atmosphere ("Climate Change" in the topmost box) has direct environmental impacts and also leads to the increasing severity of extreme weather events. Hydro-meteorological and other hazards produce further environmental impacts that cause rural-urban migration and ultimately, increasing inequality. High population growth rates and rapid urbanisation add to these effects. Economic change leads to more infrastructures and material possessions and a greater potential for losses from disasters. Thus the vulnerability of people and ecosystems increases, and resilience is compromised.

The concept of **resilient development** is also relevant. In the context of the Pacific islands, it has been defined by the Secretariat of the Pacific Community in its document *Framework for Resilient Development in the Pacific* (SPC et al, 2016; Hemstock et al, 2018):

> Development processes and actions that address the risks and impacts of disasters and climate change while progressing to stronger and resilient communities. (SPC et al, 2016, p.31)

Figure 2.1 Factors influencing vulnerability and resilience in Vanuatu



Author, 2022, adapted from Hay, 2002

Two further concepts pivotal to climate change and disasters need to be clarified – **mitigation** and **adaptation**.

For climate change, the IPCC defines mitigation as ‘a human intervention to reduce the sources or enhance the sinks of greenhouse gases (GHGs)’ (IPCC, 2014, p.125).

It defines adaptation as:

> The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.
>
> (IPCC, 2014, p.118)

For disasters, mitigation is defined in another way, as explained by the United Nations Office for Disaster Risk Reduction (UNDRR):

> Mitigation: The lessening or minimizing of the adverse impacts of a hazardous event. The adverse impacts of hazards, in particular natural hazards, often cannot be prevented fully, but their scale or severity can be substantially lessened by various strategies and actions. Mitigation measures include engineering techniques and hazard-resistant construction as well as improved environmental and social policies and public awareness.
>
> (UNDRR, 2021, Mitigation)

For the purposes of this thesis, I propose to use simpler definitions. **Mitigation of climate change** means taking measures to reduce its causes - the increased emissions of greenhouse gases such as carbon dioxide, methane and nitrous oxide that have been set in motion through human activities, particularly industrialisation and changes in land-use. **Adaptation to climate change** means taking measures to reduce its impacts, with people adjusting their ways of living in order to cope with the harmful effects of a warming atmosphere and oceans. **Mitigation of disasters** means taking measures to reduce the severity of their impacts. Reducing the causes of natural hazards is generally impossible, but actions can be taken to build resilience to their impacts.

Thus disaster risk reduction and climate change adaptation are very similar, and the same strategies can often be used to address both. An example is illustrated in Figure 2.2, where the provision of an improved tank and rainwater catchment system reduces the impacts of hazards such as cyclones and storms, and at the same time serves as an adaptation measure against longer periods of drought that the village is experiencing as a result of climate change.

Figure 2.2 Improved tank and rainwater catchment system in Worasiviu, Pele island, Vanuatu

Author, 2018

2.2.2   Modes of Learning

Since this thesis seeks to find out the similarities and differences in the way that resilience education is carried out through formal and informal modes, it is important to seek guidance from the literature on the exact meaning of these terms. There is a rich field of resources available, but little that specifically relates to Vanuatu.

Simple definitions of formal and informal learning are provided by the Organisation for Economic Cooperation and Development (OECD, 2005) and by Workforce Skill Development Australia (Misko, NCVER, 2008). Thus formal learning takes place when a learner follows a programme of instruction in an educational institution or in the workplace, and is always recognized in a certificate or qualification. Informal learning is achieved outside of organised education or training, is not structured, and does not lead to certification; in most cases it is unintentional from the learner's perspective.

Such definitions perhaps reflect the perspectives of western, economically-developed nations, and are echoed by other authors from those backgrounds. Melnic & Botez (2014) suggested that formal education has a well-defined set of features, presenting a rather rigid curriculum as regards objectives, content and methodology, while informal education is spontaneous, pedagogically un-organised and may not have specific objectives. According to Tudor (2013), informal learning is not deliberately organised to ensure student's learning, but is effective and probably the most common form of learning among adults. Cofer (2000) argued that in formal education, the goals, locations and methods are externally determined by the educational or training providers, whereas in informal learning, the aims and pursuit of knowledge or skills are determined by the individual or group. Digby (2010) reminded us that in addition to learning from the experiences of everyday living, informal education also includes learning through the internet, newspapers, magazines, television, radio, and conversations with others.

Insights into learning styles in non-industrialized societies were provided by Fasokun et al (2005), who suggested that in pre-colonial Africa, indigenous knowledge was generated by local communities in response to the particular environmental, social and cultural challenges they faced. Such learning can be classed as informal, and is relevant to traditional forms of learning that occur in Vanuatu and other Pacific islands, whereby beliefs, ideas, behaviours and practices are transmitted from one individual to another, one community to another and one generation to another. Informal learning in the Solomon Islands (Ninnes,1991) and in remote traditional Aboriginal communities in Australia (Grimes & Crawford, 2011), occurs through observation, imitation and trial and error in real life settings, respects common cultural themes and is determined by the status of the person holding and transmitting the knowledge. Philips & Vaughn (2009, p.52) reminded us that 'non-Western perspectives put greater emphasis on interdependent, communal, holistic, and informal learning.'

According to the United Nations Educational Scientific and Cultural Organisation, formal education 'typically takes place in educational institutions that are designed to provide education for students in a system designed as a continuous educational pathway', while informal learning is defined as 'forms of learning that are intentional or deliberate, but are not institutionalised (UNESCO, 2011, pp.11-12).

In the context of Vanuatu, the following working definitions will be adopted.

Formal learning is equivalent to that in all other countries, occurring when a learner follows a programme of instruction in an educational institution or in a workplace that normally leads to the acquisition of a certificate or other academic qualification. In Vanuatu, the curriculum has specific learning outcomes, content and methodology, determined by the Vanuatu Ministry of Education and Training (MOET) and based upon the National Curriculum Statement (VNCS) formulated in 2010 and currently being implemented. Formal learning takes place in pre-primary, primary and secondary schools and in tertiary institutions such as the National University of Vanuatu, the University of the South Pacific, the Vanuatu Institute of Technology, the Vanuatu Agricultural College and the Vanuatu Nursing School. Individuals are receiving formal education on a full-time basis before they first enter the labour market or participate full-time in the subsistence economy

Informal or life-long learning comprises learning activities in the household, workplace and local community, and is not institutionalised. For most young people, it includes learning that comes through the use of mobile phones, social media and the internet, acquired intentionally or involuntarily. However, a major component for many families is the acquisition of traditional indigenous knowledge, wisdom and values that results from inter-generational transmission and/or mentoring. Because this thesis focuses on learning about resilience, I will focus on this traditional aspect of informal learning – the way that beliefs, ideas, behaviours and practices are transmitted between individuals and communities, usually in an oral manner. Such cultural traits may have been generated within communities in response to particular environmental challenges faced in the past, and they arise through observation of natural ecosystems, imitation, and trial and error. As Phillips & Vaughn (2009) pointed out, important aspects of this traditional learning are interdependence, communal actions and a holistic worldview that interlinks humans and their environment.

In Vanuatu and other Pacific countries, cultural knowledge, including how to respond to environmental change, has been passed on from one generation to the next over thousands of years. The significance of traditional knowledge (TK), traditional wisdom, traditional environmental knowledge (TEK) and indigenous and local knowledge (ILK) in building resilience through the sustainable management of natural ecosystems and resources has been stressed by Hill (1994), Berkes et al (2000), Thaman (2000), Houde (2007), Torri & Herman (2011) and Hawley et al (2004). The role of traditional knowledge in ensuring sustainable development, especially when integrated with non-indigenous information sources, has been underscored by Walshe & Nunn (2012) and by Nakamura & Kanemasu (2019).

A useful definition of TK came from Connor (2005), cited by Rai & Khawas (2019, p.3):

> Traditional Knowledge refers to the undocumented knowledge or oral knowledge which has been passed down from generation to generation to a particular cultural community, in the form of stories, songs, folklore, proverbs, cultural beliefs, rituals, community laws, local languages, culinary recipes and agricultural practices.

2.3 The Nature and Evolution of Resilience Education

2.3.1 Environmental Education (EE)

In historical terms, educating students on climate change and disasters is very new, and is pre-dated by general environmental education (EE), which has its roots in the "nature study" and "conservation education" that took place in schools in Europe and North America in the first half of the 20th century. Formal environmental education only began in the late 1960s and early 1970s.

In the USA, a definition of "environmental education" was first proposed in *The Journal of Environmental Education* (Stapp, 1969, p.30):

> Producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work towards their solution.

At almost the same time, Senator Gaylord Nelson of Wisconsin conceived the idea of a "nation-wide teach-in on the environment" that resulted in the celebration of the first Earth Day on 22nd April 1970. Earth Day soon expanded into a global observance encouraging education and stewardship of the planet's natural resources. In the USA, it led to the establishment of the Environmental Protection Agency (EPA) on 2nd December 1970 with the aim of regulating and enforcing national pollution legislation (EPA, 2021).

Two years later, the United Nations Conference on the Environment – the first international gathering to make the environment a major issue – convened in Stockholm in June 1972. One of its major outcomes was the creation of the United Nations Environment Programme (UNEP), based in Nairobi, Kenya. UNEP's initial focus was on the management of pollution, marine life, protection of resources, environmental change, natural disasters and biological change. Today, it is concerned with climate change, disasters and conflicts, ecosystem management, environmental governance, chemicals and waste, resource efficiency, and environment under review, with an overarching commitment to sustainability (UNEP, 2021).

2.3.2 Education for Sustainable Development (ESD)

Ten years after the establishment of UNEP, a major step in educating people about environmental issues was the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil, in June 1982. Known as the Earth Summit, this meeting produced Agenda 21, a comprehensive plan of action to be taken globally, nationally and locally. Section IV of the Declaration refers to the means of implementation of Agenda 21 and in sub-section 36.3 there is specific reference to education, public awareness and training as indispensable tools for addressing sustainable development:

> Education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues.
> (UNDESA, 1982)

This marked the official start of education for sustainable development (ESD) as an outgrowth of environmental education. Agenda 21 used the term "environment and development education", specifying that it should cover the physical/biological and socio-economic environment as well as human and spiritual development, and should embrace both formal and non-formal methods (ibid, 36.3). Highly relevant to this thesis, in which resilience education can be considered as an extension of ESD, is the statement in Agenda 21 that education is the key for achieving environmental and ethical awareness, values, attitudes, skills and behaviour, and that this should be done both formally and non-formally.

ESD received further stimulus during the United Nations Decade of Education for Sustainable Development 2005-2014 (UNDESD) as a means of taking positive action on global challenges. Its overall goal was 'to integrate the principles, values and practices of sustainable development into all aspects of education and learning' (UNESCO, 2020, p.1).

ESD literature written during the first decade of the 21st century included that by McKeown (2002), who provided a comprehensive framework for teaching and analysing environmental issues, with emphasis on knowledge, issues, skills, perspectives and values central to sustainable development in each of three components – environment, economy and society – and adapted to the needs of a particular community. I would argue that knowledge could be combined with issues, and perspectives with values, but that pro-environmental behaviours should also be added. Vare & Scott (2007) explored the relationship between education and sustainable development, pointing out that there are two complementary approaches: ESD1 is the promotion of informed, skilled behaviours and ways of thinking, while ESD2 builds capacity to think critically about what experts say and to test ideas, exploring the contradictions inherent in sustainable living. I submit that this kind of critical thinking, including the ability to handle opposing views on anthropogenic climate change and strategies for mitigation and adaptation, is essential when facilitating learning on resilience.

Leal & Pace (2016, p.2) defined ESD as:

> The process of equipping students with the knowledge and understanding, skills and attributes needed to work and live in a way that safeguards their environmental, social and economic well-being, both in the present and for future generations.

They argued that in higher education institutions, ESD should prepare students for a future that is as yet unknown, providing learning experiences that develop critical thinking, problem-solving, creativity and communication skills, and encouraging student participation in the development of learning programmes. Their ideas on the pedagogic skills required have influenced the formulation of questionnaires I use in this thesis to investigate teaching strategies and methods of delivery used in formal courses on resilience.

Literature on the effectiveness of environmental education in bringing about changes in primary school students' environmental behaviour and attitudes is exemplified by two studies from Western Australia (Salter, 2013; TeachWild, 2015).

2.3.3 Climate Change Education (CCE)

Regarding education about climate change, Moser (2010) showed that after the mid-to-late 1980s, there was a steep rise in public communication in the media about anthropogenic climate change and the implications of global warming, with most of this communication focusing on scientific findings and synthesis reports such as those published by the Intergovernmental Panel on Climate Change (IPCC).

Similarly, most literature in the first decade of the 21st century that dealt with climate change education tended to concentrate on teaching the scientific aspects of climate change, as well as its mitigation, and expressed fear and uncertainty about its impacts (e.g. Monbiot, 2006; Romm, 2007; Lynas, 2007; Lovelock, 2009). However, Kagawa & Selby (2009) challenged such views, pointing out that the root cause of climate change is consumerism and that the remedy to the problem lies in education to transform structures and systems. They argued that such education should draw on 'cultural, social, economic, ethical, political and spiritual intelligence' (2009, p.1), should lead to direct community engagement, and draw on local and indigenous knowledge.

During the second decade of the present century, as more and more empirical evidence of the impacts of rising temperatures on the earth's physical, biological, social and economic systems came to light, the literature has echoed this view and placed greater focus on the role of adaptation in building resilience to impacts. For example, Stevenson et al (2017) said that climate change education is about 'learning in the face of risk, uncertainty and rapid change' (p.1), requires learning that is 'reflexive, creative and participatory' (p.3), involves adaptation education in which students 'learn by doing' (p.3), and sees disaster risk reduction as an aspect of adaptation (p.4).

The link between climate change education and education for sustainable development was emphasized by UNESCO, when in 2010 it started giving specific attention to climate change education (CCE) as a key element of ESD through the establishment of the Climate Change Education for Sustainable Development programme (CCESD). We can consider this programme as broadly similar to what is now termed resilience education in that it 'incorporates key sustainable issues such as climate change, disaster risk reduction and others into education that addresses the interdependence of environmental sustainability, economic viability and social justice', aiming to 'empower learners to change their behaviour and take action for sustainable development' (UNESCO, 2015, p.5). UNESCO's investigations found that 'the education sector remains under-exploited as a strategic resource to mitigate and adapt to climate change', and that 'formal teacher training opportunities to learn about climate change and how to teach it are still limited.' (ibid, p.66).

Then in 2014, at the conclusion of the DESD, UNESCO launched the Global Action Programme (GAP) on ESD, putting climate change as a critical thematic focus and aiming to make climate change education a more central and visible part of the international response to climate change (UNESCO, 2020)

Most literature on CCE or on education about climate change adaptation (ECCA) appeared after the launching of the DESD in 2010 and the GAP in 2014 in order to increase climate literacy among young people. This marked a delay of almost 20 years since the United Nations Framework Convention on Climate Change (UNFCCC) had in 1992 recognised that education is an essential element for mounting an adequate global response to the problem.

2.3.4 Education for Disaster Risk Reduction (EDRR)

It was during the International Decade of Natural Disaster Reduction (IDNDR) in the 1990s that significant public education on disasters emerged in many nations, and "hazards education" took root in science classes in schools (Petal, 2009). Since 2000, a plethora of educational materials for schools and the general public has emerged, largely stimulated by the Hyogo Framework for Action 2005-2015. This Framework, formulated at the United Nations World Conference on Disaster Reduction in January 2005 in Kobe, Japan, aimed to:

> Promote the inclusion of disaster risk reduction knowledge in relevant sections of school curricula at all levels and the use of other formal and informal channels to reach youth and children with information.
>
> (UNISDR, 2005, p.11, par 18 (ii)(h))

The overall goal was to 'use knowledge, innovation and education in order to create a culture of safety and resilience at all levels' (ibid, p.5, par 14.4). The Hyogo Framework has now been superseded by the Sendai Framework for Disaster Risk Reduction 2015-2030.

Literature on education for DRR and its effectiveness is exemplified by Torani et al (2019), who stressed the importance of starting disaster education in childhood, focusing on the learning of preparedness measures in primary schools; they also emphasized the need to focus on training for the most vulnerable, especially women, the elderly and the disabled. Bernhadsdottir et al (2015) studied efforts to educate students on earthquake risk reduction in Iceland, Portugal and Italy, comparing schools' degree of preparedness in terms of earthquake drills, safety equipment, buildings and the involvement of local authorities in promoting awareness. Mamon et al (2017) assessed the disaster-related knowledge, preparedness, readiness, adaptation, awareness and risk perception of 120 Grade 11 students from one urban school in the Philippines. Apronti et al (2015) conducted research among teachers and students in two primary/junior high schools in two villages in semi-arid Northern Ghana, where the main hazards faced are floods, droughts, fire, health epidemics and infestations from pests and parasites. They compared provision for DRR education contained in school syllabi with what actually happens in the classroom, using the six criteria for teaching and learning techniques for DRR suggested by UNICEF & UNESCO (2012). They found that teachers relied on recall techniques to evaluate student understanding during disaster lessons, and that there was little use of action-oriented or application strategies.

The methodology used by Kagawa & Selby in the UNICEF/UNESCO (2012) case studies of DRR education in 30 countries involved assessment of pedagogy (modalities such as interactive learning, affective learning, enquiry learning and field experiential learning), modes of student assessment (e.g. written tests, peer assessment, oral questioning, demonstrations) and the professional development of teachers. This methodology is highly relevant to my research into formal resilience education in Vanuatu.

2.3.5 Resilience Education as the Fusion of CCE and EDRR

In general, resilience education can be described as:

> education that gives children and young people the opportunity to develop a range of social and emotional skills that can influence the way they make choices and decisions in challenging situations.
>
> (SDERA, 2022, Resilience Education).

More simply, educating young people to be resilient enables them to cope with tests and difficulties of all kinds, no matter whether they are physical, mental, emotional, spiritual or social.

For this thesis, however, I will take resilience education to mean how students are enabled to cope with and recover from the impacts of climate change and disasters, acknowledging that such coping mechanisms may involve dealing with the types of stress mentioned above. Further, coping with climate change and disasters is not just an individual issue, but involves whole families and communities.

Literature that mentions resilience education in terms of disaster risk reduction and climate change or climate change adaptation is very recent. Kagawa & Selby (2012, p.209) argued that disaster risk reduction education (DRRE) and climate change education (CCE) 'constitute two education responses to present and anticipated increases in both the severity and incidence of hazards globally'. They stressed that both DRR and CCE involve building resilience against hazards and advocated the integration of DRRE and CCE as a way of achieving sustainable development. They did not use the term "resilience education", but spoke of "storm-ready pedagogy and "storm-ready sustainability education" (ibid, pp.214-215)

Pacific countries have taken a world lead in linking CCE and DRRE together as resilience education. The Pacific understanding of climate change as a slow-acting disaster was adopted by the European Union-Pacific Technical and Vocational Education and Training (EU-PacTVET) project in 2015-2016 as a basis for integrating the two fields as education for resilience (Hemstock et al, 2020). Formal regional qualifications in “Resilience” and “Sustainable Energy” were developed for vocational training at Certificate levels 1 to 4, accredited regionally by the Pacific Community’s Educational Quality Assessment Programme (EQAP), and the Pacific Regional Federation of Resilience Professionals (PRFRP) was established to work on the further development of such formal qualifications in the TVET sector (Hemstock et al, 2016). Also in 2016, the sixteen member states of the Pacific Islands Forum[1] formulated the *Framework for Resilient Development in the Pacific (FRDP)*, a regional policy tool with guidelines on an integrated management of CCA and DRR with the goal of improving the resilience of Pacific island communities (Hemstock et al, 2016). After its endorsement in 2017, the FRDP launched the Pacific Resilience Partnership (PRP) as a network of stakeholders that drive resilience action at national, sub-national, regional and international levels. Basically, these are the governments of Pacific Forum nations that support and facilitate effective implementation of the FRDP (GEM, 2017).

The FRDP has three goals - to strengthen integrated adaptation and risk reduction in order enhance resilience to climate change and disasters, to foster low-carbon development, and to strengthen disaster preparedness, response and recovery (SPC et al, 2016). For each goal, there are priority actions related to education and training. For climate change and disasters, for example, knowledge is to be strengthened ‘on the causes, local impacts and responses to climate change, hazards and disasters … through formal and non-formal education systems’ (SPC et al, 2016, p.15).

2.4 Formal Learning about Resilience in Schools and Tertiary Institutions

Countries such as Australia and South Africa have included climate change education in curricula for sustainable development (ESD), but in general, formal programmes on climate change education (CCE) have been slow to develop. UNESCO’s work in promoting the CCESD programme has already been mentioned.

[1] The Pacific Islands Forum is the region’s principal political and economic policy organisation that aims to enhance cooperation between countries and territories of the Pacific Ocean, including a trade block and regional peacekeeping operations. Its members comprise 16 Pacific island states, Australia and New Zealand.

Other literature on climate change education and its effectiveness is limited, especially in relation to the Pacific region. Vize (2012) provided a useful historical overview of educational programmes to bring climate change adaptation to Pacific communities, but there was no evaluation of the effectiveness of specific programmes, and in view of other initiatives since that time, the findings are now out of date. Walid (2017) critiqued the educational resource *Learning about Climate Change the Pacific Way* that was developed for use in junior secondary schools in Vanuatu, Fiji, Kiribati, Tonga and Samoa, and is a tool that will be assessed in this thesis. Walid's criticisms are that the 16 pictures in the Toolkit lack specific details about individual island ecosystems, do not cater for all grades and rely heavily on top-down communication. As one of the co-creators of this visual resource, I would rebut these points by saying that the pictures are meant to be studied in the classroom through bottom-up, participatory discovery learning, that there is a comprehensive teacher guide whose content is suited to a wide range of abilities and ages, and that a creative teacher can use the pictures as a basis for students to carry out field work in their own local ecosystems.

Literature on a combined formal educational approach to DRR/DRM and Climate Change (CC) or Climate Change Adaptation (CCA) is particularly relevant to Australasia and the Pacific islands, many of which face impacts not only from hydro-meteorological but from geological and biological hazards. Stevenson et al (2017, pp.2,4), in advocating principles for teaching Australian students about climate change, said that '… climate change education is about learning in the face of risk, uncertainty and rapid change', and must include education on disaster risk reduction, which 'builds community resilience through a process of identifying, assessing and reducing risk'. Hemstock et al (2017 and 2018) pointed out that in the Pacific islands, formal education must combine CCA with DRR /DRM and that this was one of the justifications for establishing the European Union-Pacific TVET project to build regional and national capacity and technical expertise for adaptation to climate change and the promotion of sustainable energy. These two articles, however, pre-date the actual delivery of such courses, so do not address their effectiveness.
In Vanuatu, the first dedicated courses in CCDRR and then Resilience were developed at the same time as the term "resilience" in relation to education and training for climate change and disasters was entering into the vocabulary of

Pacific administrations and curricula. Literature relating to these courses is limited, comprising my own report on experiences from teaching the first-ever Çertificate I and III courses on Resilience at the Vanuatu Institute of Technology (VIT) (Pierce, 2019B), an independent tracer study on graduates' reactions to the Certificate III course (VIT, 2019), and the report on the Certificate I course submitted by the Vanuatu Government to the Paris Committee on Capacity Building (UNFCCC, 2017). These reports highlighted the ground-breaking significance of the delivery of these first courses at TVET (Technical and Vocational Education and Training) level in the Pacific region. Indeed, we can argue that just as Vanuatu was one of the first countries in the world to establish a Ministry of Climate Change, in December 2013, and a dedicated policy on climate change and disaster risk reduction, in 2015, so it has pioneered the creation and delivery of dedicated vocational courses in resilience during 2017-2018. There are no studies that evaluate the effectiveness of ways in which formal or non-formal education on climate change and disasters are being undertaken in Vanuatu, and this provides a justification for the present investigation. In that sense, this thesis is the vanguard of such research.

We can identify three factors behind the evolution of resilience education in Vanuatu. Firstly, there is the nation's extreme vulnerability to disasters and the impacts of climate change, and the use of traditional and modern adaptation strategies to build resilience to these impacts (Vize, 2012; Leal, 2017; Pierce, 2019A; Pierce, 2019B).

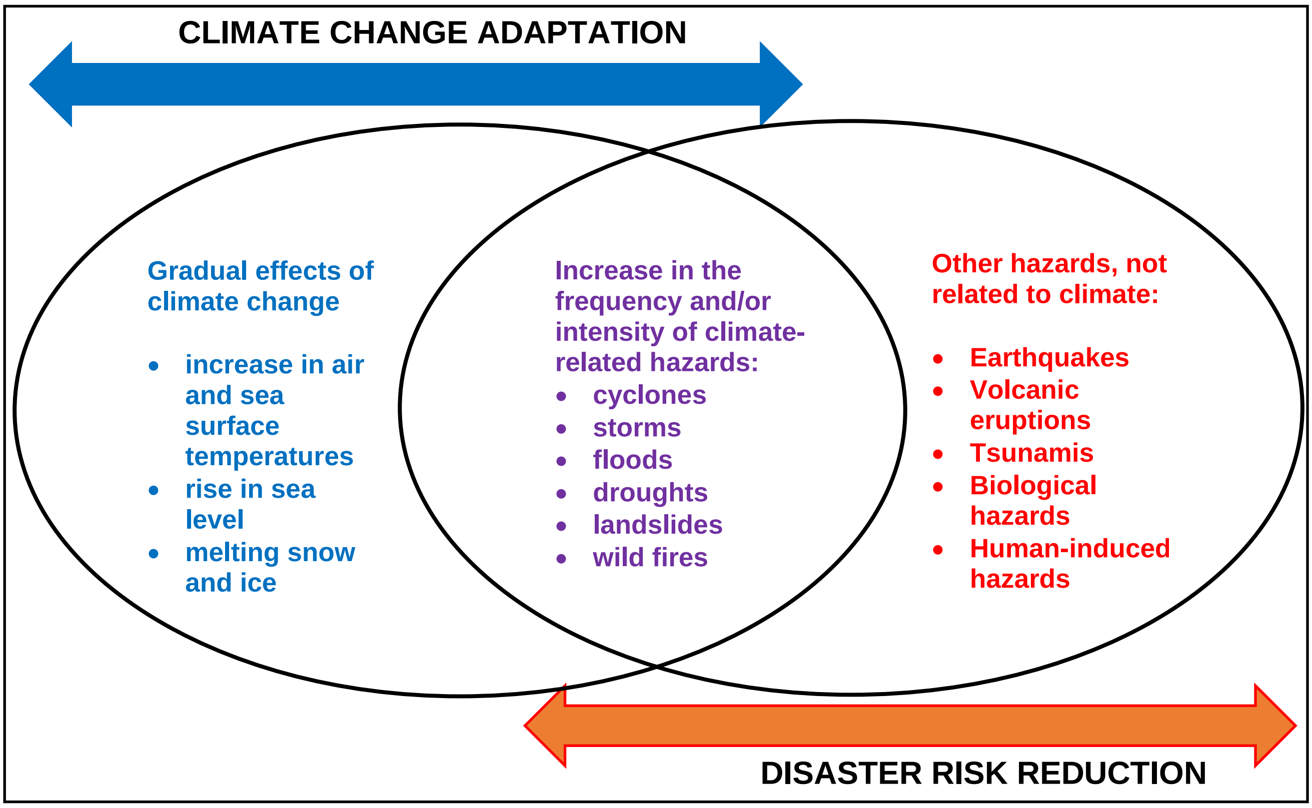
Secondly, I have already demonstrated that resilience education in Vanuatu and other Pacific islands is an outcome of the integration of climate change education with education on disaster risk reduction. Hemstock et al (2017 and 2018) argued that in the Pacific islands, where climate change is seen as a slow-onset disaster, formal education must combine climate change adaptation (CCA) with strategies for disaster risk reduction (DRR). The strategies for both are very similar – for example, the use of risk maps, strengthening of building designs and sea defences, and food preservation techniques. Gero et al (2010) further pointed out that it is essential to integrate DRR and CCA in the Pacific region in order to enhance aid effectiveness and reduce confusion for communities.

With reference to Vanuatu, the title of the Government's official policy on climate change and disasters, the *Vanuatu Climate Change and Disaster Reduction Policy 2016-30*, confirms its integrative approach to these fields, and the document itself contains several direct references to this strategy. For example:

> Successful climate change adaptation and disaster risk reduction actions in Vanuatu require co-implementation that is inclusive and builds on both indigenous and externally derived knowledge (SPC, 2015, Section 7.4, p.17)

Such an integrative approach features in the new curriculum being implemented in primary and secondary schools in Vanuatu, and has already been adopted in resilience courses delivered at VIT. For example, the Learner Guide for Units 5 & 6 in Certificate III contains Figure 2.3 (MOET, 2018).

Figure 2.3 Relationship between CCA and DRR in Vanuatu



FRDP/Author, 2018

A third factor in the evolution of resilience education in Vanuatu is the role played by funding agencies in driving such initiatives. Just as in other developing countries such as Nepal (Tuladhar et al, 2015) and Bangladesh (Amjad, 2016), educational projects on climate change and disasters in Vanuatu and other Pacific island states have relied on initial or on-going funds, technical advice and material resources provided by international, regional or national donor partners. Such assistance has been encouraged by the United Nations Framework Convention on Climate Change, and constitutes one of the three main aims of the Paris Agreement on Climate Change, signed in April 2016 (UNFCCC, 2019, p.1).

Financial assistance to educational projects on climate change and disasters in the Pacific region has come from the European Union through its EU-PacTVET programme (Hemstock et al, 2016; Hemstock et al, 2017), SPC-GIZ's Coping with Climate Change in the Pacific Region (Vize, 2012), the South Pacific Regional Environment Programme (SPREP) (Walid, 2017), the Asian Development Bank (Pierce, 2019B), and other bilateral assistance programmes initiated by Australia, Japan, France, New Zealand, UK and other nations. Vanuatu has benefited from such aid, as well as from more modest capacity-building programmes financed by non-government organisations such as Oxfam, Save the Children Australia, Red Cross / Red Crescent, World Vision, and Care International. Without such financial and technical assistance from donor partners, the first TVET courses in resilience would not have started at the Vanuatu Institute of Technology, and the educational resource for secondary schools *Learning about Climate Change the Pacific Way* would not have been created and used in Vanuatu, Fiji, Kiribati, Tonga or Samoa. The effectiveness of these formal educational initiatives in Vanuatu will be examined in Chapters 4 and 6 of this thesis.

2.5 Informal Learning about Resilience

In relation to the transmission of indigenous and local knowledge (ILK), McMillen et al (2014) pointed out that in the Pacific islands, ILK systems are critical to understanding resilience and adaptation because of the islands' long exposure to environmental variability: over thousands of years, islanders have developed adaptive responses to living in marginal habitats for food production that face periodic severe disturbances from drought, cyclones, tsunamis and volcanic eruptions. Lefale (2010) showed how the Samoan traditional calendar is based on the observation of local environmental changes, which are influenced by weather and climate. Observations of cloud formation and wind direction, together with the monitoring of changes in plants and in animal behaviour, provide key indicators for forecasting the onset of extreme climatic events. Percival (2008) looked at the importance of indigenous environmental knowledge (IEK) in the Pacific region for building resilience to environmental changes that result from a warming climate: using examples from Samoan, Maori and other cultures, he revealed how traditional weather forecasting takes place through observable seasonal changes, cloud formations, other natural environmental changes and animal behaviour, and provided examples of traditional adaptation practices such as farming techniques that protect watersheds and promote crop diversification and methods of food storage. As with Lefale's article, this study offered a reference point for comparisons with Vanuatu, but did not deal with the transmission of such knowledge.

Fletcher et al (2013) explored traditional coping strategies in four Pacific island countries – Cook Islands, Fiji, Samoa and Vanuatu – showing that coping with climate and weather extremes is a natural aspect of Pacific islanders' way of life. They identified five strategies used to respond to disasters and climate change – recognition of traditional coping strategies, the importance of religious beliefs and faith-based systems in building resilience, the role of traditional governance and leadership, extended family and community involvement, and traditional knowledge and skills in agriculture and food security

Two recent studies also emphasise the value of TK and TEK and provide a little more information about the transmission of such knowledge.   Apis-Overhoff (2017) demonstrated that there is a rich repository of traditional wisdom in the atoll communities of the Federated States of Micronesia. Because traditional coping mechanisms cannot meet the increasing intensity of climate variability and extreme events, she proposed the *Engin Kehlap* (collaborative effort) model to enable atoll populations to develop their own adaptive solutions to environmental and climate change, especially rising sea levels and increasing salinity. Regarding transmission pathways for traditional knowledge and wisdom, the greatest information flows were found to be from father to son and mother to daughter. The effectiveness of such flows was not assessed, but it will be relevant to compare these traditional pathways with those encountered in the islands of Vanuatu. Tuisavusavu (2017) looked at traditional farming practices in Vanua Levu, Fiji, showing how they contributed to effective community-based adaptation to climate change. He explained how young people had acquired their own TK through observation and participation in agricultural activities with their elders. Such transmission pathways have much in common with those in Vanuatu, where informal ways of learning to cope with environmental change have existed for millennia, beginning from the first colonisation of the islands approximately three thousand years ago. It is now believed that these initial colonisers, known as the Lapita people because of their distinctive pottery, came from Taiwan and northern Philippines, and not from the neighbouring Australo-Papuan populations of Australia, Papua New Guinea and the Solomons that had been in the region for 40,000 to 50,000 years (ANU, 2016).

Most investigations in Vanuatu on the role of traditional values, ecological knowledge and skills in building resilience to climatic and environmental change, extreme weather events and other disasters have focused on individual islands. Researchers have emphasized the importance of transmitting techniques of food security and careful resource management, as well as maintaining social networks of support and reciprocity. Campbell (1990) found that in the Banks Islands prior to the mid-1800s, food security in the aftermath of cyclones was maintained through the use of resilient crops, agricultural diversity, "famine" and forest foods, and through inter-island exchange, whereby customary networks and friendships ensured assistance in terms of surplus crops; however, European contact, colonialism and independence led to an expectation that external relief will be supplied through the government and overseas donors. In the remote Torres Group, Mondragon (2018) showed that islanders generated their own environmental and indigenous knowledge in response to risk, that such knowledge was intimately linked to culture, and that it was modified through interactions with external agents and interventions. Pascht (2019) found a similar situation in Siviri, North Efate, stating that climate change is perceived by villagers as occurring within a combined environmental and socio-cultural context. On Tongoa, Granderson's research (2017) indicated that five aspects of *kastom save* (traditional knowledge) were important for building adaptive capacity to climate change - observing and predicting weather and climate, careful management of local resource use, maintaining networks of relations and reciprocity, customary governance and leadership, and cultural beliefs and values such as cooperation and forward planning; however, such aspects were declining in the face of Western education, a capitalist economy and urban migration, so that opportunities for transmission to younger generations were much reduced. McNamara & Prasad (2014) carried out research in two villages in North Efate and one on Tanna; they documented traditional strategies for shelter, food and water security in the face of cyclones and droughts, finding that experiences, stories and practical know-how transmitted between generations constituted a core strength in enhancing resilience. They also noted that these traditional resilience strategies were disappearing due to globalisation, changes in weather patterns and the provision of external disaster relief by aid donors. My own investigations into the transmission of traditional knowledge on resilience will confirm the findings of the above researchers.

In summary, there is a body of research in Vanuatu that demonstrates how resilience to climate change and disasters at a local level is generated not only through close observations of and interactions with the local environment, traditional agricultural techniques and oral transmission of past experiences, but also through traditional social resources, or "social capital" - networks and relationships among and between families, friends and communities that provide support and resource-sharing. A community's adaptive capacity is best achieved when it is locally led and owned by the community itself, guided by local institutions and taking a more flexible, "whole of island" approach, rather than through being sponsored or driven by an external agency (Westoby et al, 2020; Westoby, Clissold et al, 2020). At the same time, rural communities are ready to combine traditional resilience strategies with modern techniques such as cyclone warnings texted to mobile phones, and crop breeds that can withstand extreme weather. Yet while traditional strategies are important in planning for disasters, they may not be so effective in the future, when changing weather patterns affect the implementation of traditional agricultural calendars, and climate change increases the severity of extreme weather events (McNamara & Prasad, 2014; Nakamura & Konemasu, 2019).

Nevertheless, there is a gap in the research: a lack of data on the effectiveness of traditional ways of transmitting resilience strategies from older to younger generations. My thesis can help us learn whether the transmission of traditional knowledge is still significant in helping Vanuatu's communities to adjust to disasters and climate change.

2.6 Measuring the Effectiveness of Resilience Education

2.6.1 Aspects of Effectiveness to be Measured

In formal education, it is important to measure the extent to which the student is meeting the specific learning objectives of the course being followed. The assessment of student performance enables the teacher/facilitator to measure not only the progress of individual students but also whether educational goals are being met, as well as the effectiveness of the teacher and the pedagogy being used (Vanderbilt University, 2021; Edutopia, 2021). Methods of assessment include self-assessment, peer-assessment, essays, assignments and examinations, and can be both formative and summative.

The educational system or programme itself can also be evaluated. According to UNESCO's International Institute for Educational Planning (2021), the quality of an educational system can be analysed in terms of context, specific inputs, social or institutional processes and outputs or outcomes, all of which can be measured by indicators. Context indicators provide information on factors that affect learning, such as culture and policies. Input indicators measure the deployment and use of financial, material and human resources to facilitate learning, such as availability of textbooks and teachers. Process indicators measure how an educational process is conducted in practice, e.g. teaching standards, penetration into the community. Output indicators measure the effects of the educational programme, and whether its objectives were attained, for example, numbers of students achieving a particular grade in a national examination.

To measure the effectiveness of a formal or non-formal programme of resilience education, whether it be CCE/ECC, EDRR, ECCDRR or RE, a similar set of indicators can be applied. In Vanuatu, learning will be affected by whether or not the student must pay fees for the course and by national policies on resilience (context); by the quality of course materials and pedagogy (inputs); and by access to resilience programmes (process). Outputs can be measured in terms of course outcomes - which for a resilience course could refer to changes in knowledge, skills, attitudes and pro-environmental behaviours of participants and whole communities.

Having looked at different ways in which resilience education is taking place globally and in Vanuatu, I will consider literature that explores the effectiveness of such education, and use this as a base for proceeding with the present research. The aim is to discover how people's knowledge, skills, attitudes and behaviour might change through taking a course on resilience, and how such changes could be measured, both quantitatively and qualitatively. I will investigate the most suitable methods of data collection and sampling, appropriate types of question, availability of models, the relative influence of materials and course delivery, and techniques of analysis.

2.6.2 Methods of Data Collection

Salter (2013) used questionnaires completed by students and teachers in two successive years, interviews with teachers and parents, mind-maps completed by students, case studies, first-hand observations, and document searches. Fletcher et al (2014) used questionnaires for students, face to face interviews with teachers, and interviews by phone or Skype with teachers and other stakeholders, while Nolasso et al (2015) used focus-group discussions in their study of school and community resilience to hydro-meteorological hazards in Naga City, Philippines.

Other studies on the effectiveness of DRR education have relied exclusively on questionnaires, either distributed as hard copies (Tuladhar et al, 2014; Mamon et al, 2017), or circulated online (Bernhardsdottir et al, 2015). Online questionnaires may not be feasible everywhere in Vanuatu at current levels of technology, but school closures in 2020 and 2022 due to the COVID-19 pandemic have already forced some urban schools to communicate with their students via the internet.

2.6.3 Suitable Questions to Ask

There is a considerable amount of literature demonstrating suitable questions for assessing the effectiveness of environmental education, and on education and training for equipping students and communities for disaster risk reduction. But very few articles provide any methodology for assessing the impact of climate change education on young people, and this gap in the literature provides a rationale for the research undertaken in this thesis.

Environmental education

Several studies examine the way that environmental education affects pro-environmental attitudes and behaviours, using questionnaires completed by students, teachers and stakeholders.

Salter (2013) conducted surveys in three schools in Perth, Western Australia, to assess the environmental and sustainability knowledge of upper primary students, their environmental behaviours, the relationship between their attitudes and their behaviours, and the family dynamics contributing to the uptake of new environmental behaviours in students' homes. Students' pro-environmental behaviours (PEBs) were assessed according to a checklist of 7 items, including turning off lights at home, recycling and having short 4-minute showers, with the frequency of each PEB being measured.

Similarly, Fletcher et al (2014) assessed behavioural change in 224 students drawn from 9 primary schools in three states of Australia before and after interventions by visiting scientists as part of Earthwatch Australia's TeachWild Fellowship programme for teachers and students. The focus was on environmental sustainability, especially the removal of marine debris and actions to improve the health of oceans and inland waterways, with students and teachers participating in interventions and field activities on these topics. The same questionnaire was used to measure changes in attitude/behaviour before the intervention, and two months afterwards. Questions measured three gradations of change in attitude/behaviour – increased concern, behavioural intention (e.g. buying bottled water), and actions taken (e.g. picking up rubbish and becoming an advocate). A similar approach can be adopted in this thesis. Changes in knowledge, attitudes and behaviour can be assessed by providing a list of statements relevant to climate change and disasters and asking a student whether he/she agrees or disagrees with each statement before and after an intervention takes place: for example, "Ocean temperatures will get warmer in the future" (knowledge), and "I must help to conserve biodiversity" (attitudes).

Disaster risk reduction

Articles on links between education and disaster risk reduction date back to the 1980s. Mishra & Suar (2007) investigated whether education and experience enhance risk perception and disaster preparedness, focussing on heat waves and floods in the Indian state of Orissa. They referred to an earthquake preparedness scale devised by Mulilis, Duval & Lippa (1990) that comprises twelve main items; for each, the respondent states whether he/she performs or has the item, and the degree of difficulty in performing or obtaining the item. One example is whether the respondent has an operating torchlight. Questions and items used in both studies have helped in the formulation of my own questions on courses on disaster risk and climate change in Vanuatu.

Two investigations on disaster education in the Philippines were also helpful. Nolasso et al (2015) measured preparedness for cyclones and floods by asking officials, school personnel and household heads in Naga City to indicate levels of preparedness on a four point scale. More pertinent was the study conducted by Mamon et al (2017) in Las Pinas. They selected 120 Year 11 students from one senior high school, and asked them 20 agree/disagree questions, organised into five disaster-related groups – knowledge, preparedness, adaptation, awareness and perception: for example, “I think my locality is safe from all types of disaster” (perception). Questions were based on a similar study carried out by Tuladhar et al (2014) in 19 randomly selected rural districts in Nepal that addressed the same five aspects of disaster risk education. Modified versions of the questions used in both of these studies will be used for my investigations in Vanuatu.

Climate change/ Climate change and disaster risk reduction

In relation to literature on the effectiveness of climate change education, the article by Scott-Parker & Kumar (2018) on Fijian adolescents’ understanding and evaluation of climate change provided an insight into what young people in a Pacific coastal setting think about climate change, what aspects of it they commonly discuss and those aspects on which they aspire to act. Questions such as “What is climate change?” were designed to promote discussion rather than assess the influence of education on attitudes and behaviour. Similar questions can be used in evaluating the effectiveness of courses on climate change in Vanuatu.

The extent to which late teenagers’ perceptions of climate change affect their pro-environmental behaviour was examined by Ojala (2013) in Sweden. Using a sample of 321 senior high-school students with an average age of 17.2 years, she found that pro-environmental behaviour was strong for those who worry about climate change but cope by seeking information about what they can do or by keeping positive and trusting that solutions will be found. In Vanuatu, where the impacts of climate change are arguably more noticeable than in Sweden, I can pose similar questions to assess the extent of young people's worries about climate change and their willingness to take action.

A tracer study on the first cohort of students to complete the Certificate III course in Resilience at the Vanuatu Institute of Technology (VIT, 2019) used interviews to capture their experiences as they transitioned into further pathways. Questions relevant to my own thesis include “What skills and knowledge did you gain in this training course?”

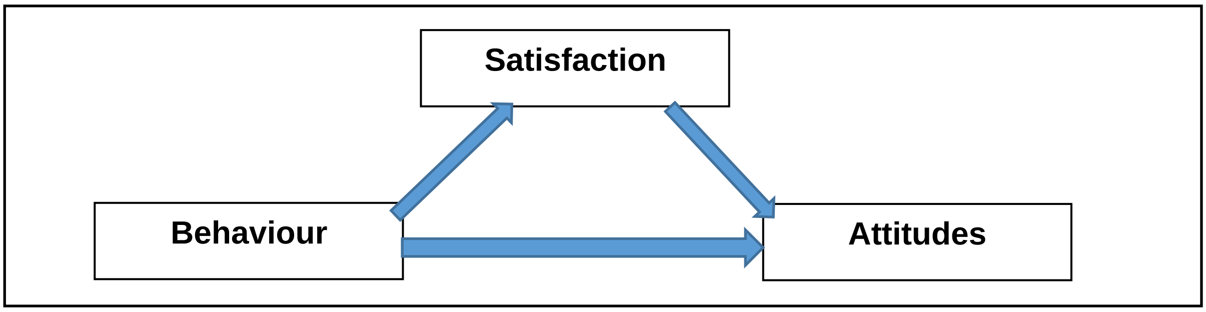
Questions used in these investigations into CCE and Resilience Education can be classified into three groups: those focusing on the acquisition of knowledge and/or skills about climate change and how they are acquired; those examining students’ attitudes towards climate change and how such attitudes influence their behaviour; and those exploring the effectiveness and pedagogy of the training course itself. All three categories apply to the present thesis.

2.6.4 Availability of Models

This refers to models that guide investigations into the relationship between education on climate change and disasters on the one hand, and behaviour/attitudes of participants on the other.

Ertz & Sarigöllü (2019) argued that satisfaction from pro-environmental behaviours (PEBs) will cause an individual to develop a more positive attitude to this type of behaviour and engage in it more frequently (Figure 2.4). They found that public-sphere PEB such as petitioning and demonstrating is more impactful to an individual than private-sphere PEB, so leading to more positive attitudes towards PEB.

Figure 2.4 Simplified model of the relationship between behaviour, satisfaction and attitudes

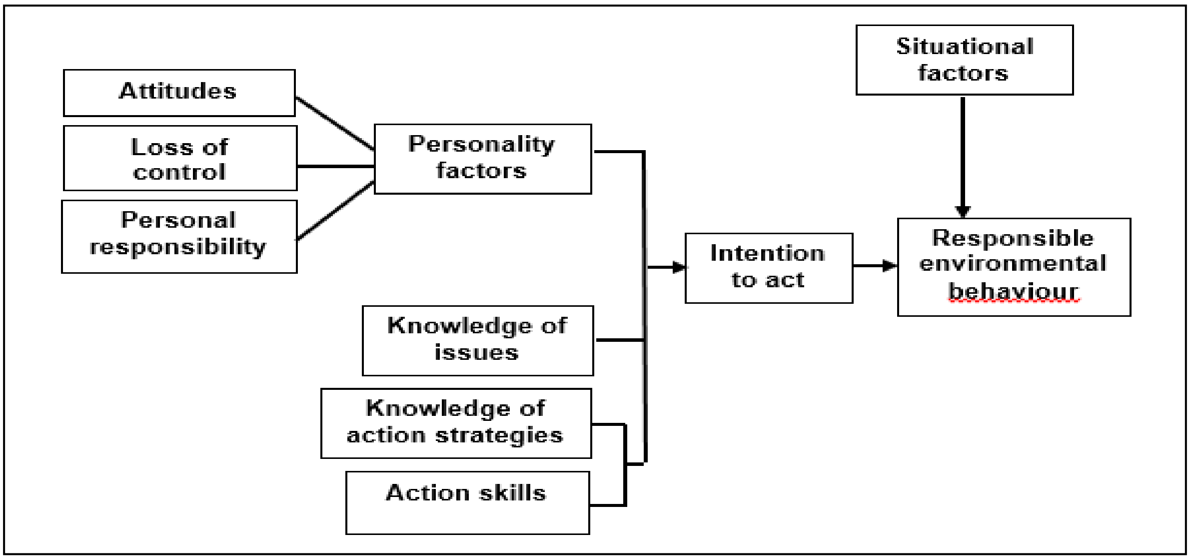


Source: Simplified from Ertz and Sarigöllü. 2019, p. 1119

I will not enter the debate on whether attitudes affect PEB or PEB reinforces attitudes. However, in assessing how a course on resilience affects a participant's motivation to engage in PEBs, there is scope for asking school students whether they would be willing to join a demonstration or strike to draw attention to the climate crisis. Such a question would reflect the strength of the individual's commitment to action and could indicate the influence of a course on intended behaviour.

Salter (2013) used a model (Figure 2.5) from Hines, Hungerford & Tomera (1987) to show how responsible environmental behaviour results from "situational" factors and student dispositions that influence the intention to act.

Figure 2.5 Factors contributing to responsible environmental behaviour

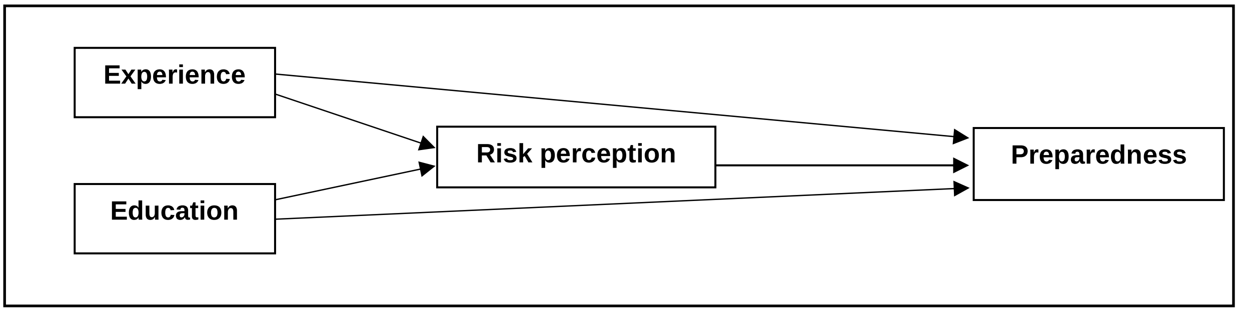


Source: Hines, Hungerford and Tomera (1987), redrawn as Fig. 2.4 in Salter, 2013, p.41

For this thesis, I will assume that personality factors and knowledge combine to influence an individual's attitudes to engage in pro-environmental behaviour. Knowledge and intention to act will be influenced by the course on climate change and disaster risk reduction in which the individual has participated, and situational factors could include exposure to a particular hazard and past experiences of similar hazards.

In that sense, there is a link to the model proposed by Mishra & Suar (2007) in their investigations into the relative importance of experience and education in determining risk perception and disaster preparedness for floods and heat waves in Orissa state, northern India (Figure 2.6).

Figure 2.6 Importance of experience and education in disaster preparedness



Source: Mishra & Suar, 2007, p.146

This model shows that disaster preparedness is a function of both education and experience. In terms of resilience education in Vanuatu, the implication is that the most effective education for disaster risk reduction is one that not only involves cognitive learning but also draws upon students' affective learning – their feelings and emotions linked to previous experience of cyclones, droughts, ash falls, earthquakes and landslides.

2.6.5 Effectiveness as Measured by Teaching Materials and Methods of Delivery

There is an abundance of generic literature on the effectiveness of teacher delivery, although most refers to non-environmental fields. Some studies focus on the qualities of an effective teacher (e.g. Polk, 2006; Cvetek, 2008; Paolini, 2015), with clarity of communication, enthusiasm and subject knowledge featuring prominently. Other articles show how teacher effectiveness can be measured by students, colleagues and self-assessment and suggest questions that might be used (e.g. Napoles & MacLeod, 2013; Paolini, 2015). Dunn et al (2018) concentrated on the learner rather than teacher, showing that learning is affected by an individual's environment, emotionality, sociological preferences, physiological preferences and cognitive processing inclinations. Ideas from all these studies have been used to formulate appropriate questions and approaches when measuring the effectiveness of resilience courses in Vanuatu.

In relation to studies on the effectiveness of materials and delivery in courses on disaster risk reduction and/or climate change, the literature is limited and refers to studies in other countries than Vanuatu, for example by Apronti et al (2015) and UNICEF & UNESCO (2012).

The UNICEF-UNESCO study on disaster risk reduction in school curricula (2012) provides an assessment of the practical reality of DRR learning. The comprehensive set of outcomes used to measure knowledge, skills and attitudes/dispositions can be adapted to provide a yardstick for measuring the effectiveness of teaching and learning materials and methods of course delivery for climate change and disaster reduction education in Vanuatu.

2.6.6 Summary

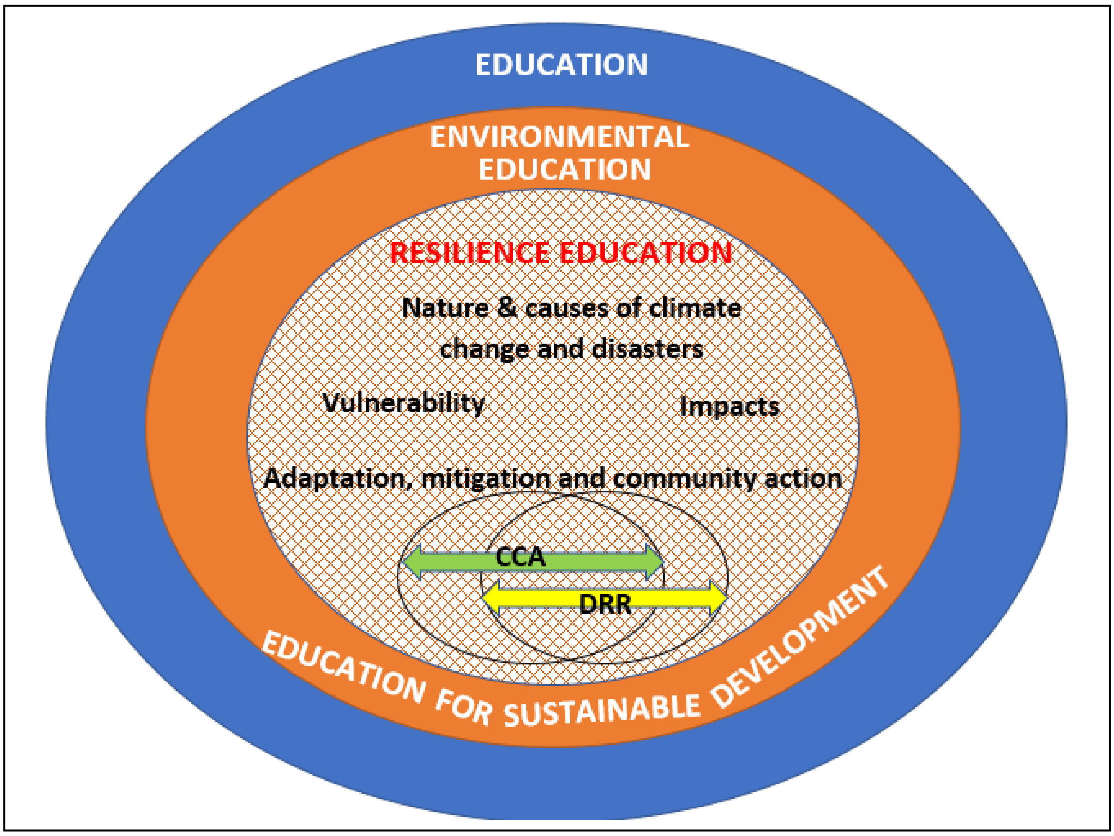
There is virtually no existing literature that evaluates the effectiveness of resilience education in Vanuatu through formal or informal modes. The independent study on graduates' reactions to the Certificate III course (VITE, 2019) is relevant, but published papers on climate change and disaster-related courses taught in schools are not available, and the measurement of the effectiveness of traditional education on disasters in Vanuatu has not been attempted. Thus the field is wide open for further investigation, and this is the rationale for the present thesis.

2.7 Conceptual Framework for the Research

2.7.1 Education, Environmental Education and Resilience Education

We have seen from Section 2.2 how education on resilience has developed within the context of environmental education and education for sustainable development. Figure 2.7 shows how all these fields are situated within education as a whole.

Figure 2.7 Relationship between education and resilience education



There is an abundance of opinion on the purpose of education. Dewey (1934) stated that its purpose is to give the young the things they need in order to develop in an orderly, sequential way in to members of society. Martin Luther King Jr (1948) emphasised that although the function of education is to teach people to think intensively and critically, moral education is also essential, with the goal of true education being "intelligence plus character". Foshay (1991) said that the continuing purpose of education has always been to bring people to as full a realisation as possible of what it is to be a human being.

Bahá'u'lláh (1882) wrote that the purpose of education is to bring out the potentialities already existing within us and to use them to be of service to others:

> Regard man as a mine rich in gems of inestimable value. Education can, alone, cause it to reveal its treasures, and enable mankind to benefit therefrom.
>
> (Lawh-i-Maqsud, Gleanings from the Writings of Bahá'u'lláh, CXXII, p. 259)

I agree with all the above views, but particularly support those of Bahá'u'lláh and Martin Luther King in that education must involve helping people to have an outward orientation towards others and to their environment. These attributes are essential in order to carry out effective education on resilience.

In relation to environmental education, Aristotle (c. 40 BC) is acknowledged as being the first to use observation and reasoning to investigate natural phenomena:

> Science (*epistêmê*), for Aristotle, is a body of properly arranged knowledge or learning—the empirical facts, but also their ordering and display are of crucial importance. The aims of discovery, ordering, and display of facts partly determine the methods required of successful scientific inquiry. Also determinant is the nature of the knowledge being sought, and the explanatory causes proper to that kind of knowledge.
>
> (The Scientific Method, Stanford Encyclopedia of Philosophy, 2016, p.7)

Such ideas are relevant to resilience education, which involves the study of empirical data on our changing climate and on the impacts of climate change and all types of disaster, as well as knowledge of the causes of climate change and hazards, and local observations of vulnerability and impacts.

Theories relevant to environmental education diverge on whether humans are distinct from the environment (Fig. 2.8) or are an integral part of it (Fig. 2.9).

Figure 2.8 Humans as distinct from the environment

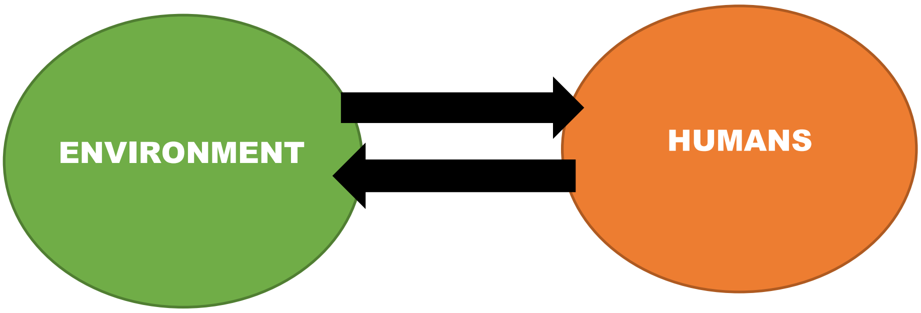
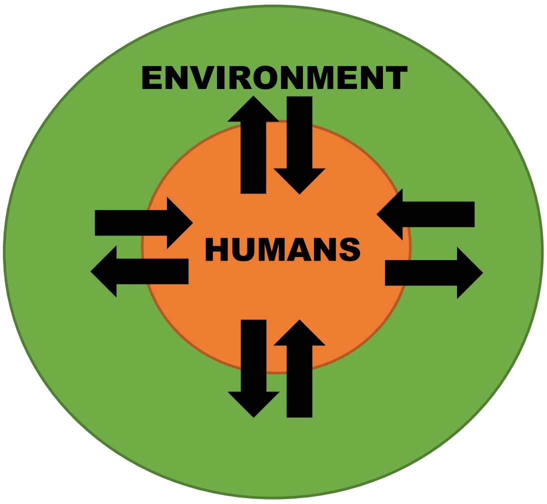
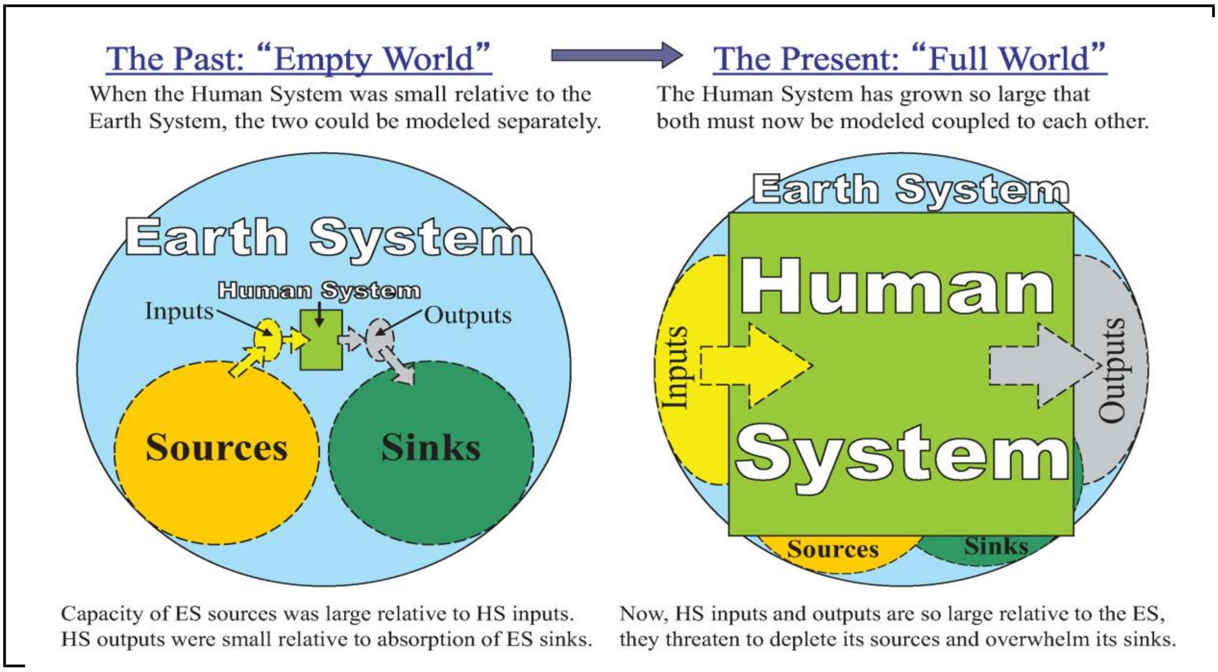


Figure 2.9 Humans as an integral part of the environment



Support for the more integral connection between humans and their environment (Figure 2.9) is exemplified by Motesharrei et al (2016). They demonstrated (Figure 2.10) how the impact of the Human System has become more dominant in the Earth System during the last 200 years through resource extraction, pollution, alteration of land cover, ecosystem fragmentation and reduction of biodiversity. When the Human System was small relative to the Earth System, the two could be shown separately, but the former has grown so large that they must now be coupled together.

Figure 2.10 Changing impact of the human system on the earth system



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In a similar manner, the Bahá'í Writings are very clear about the symbiotic interrelationship between humans and their environment:

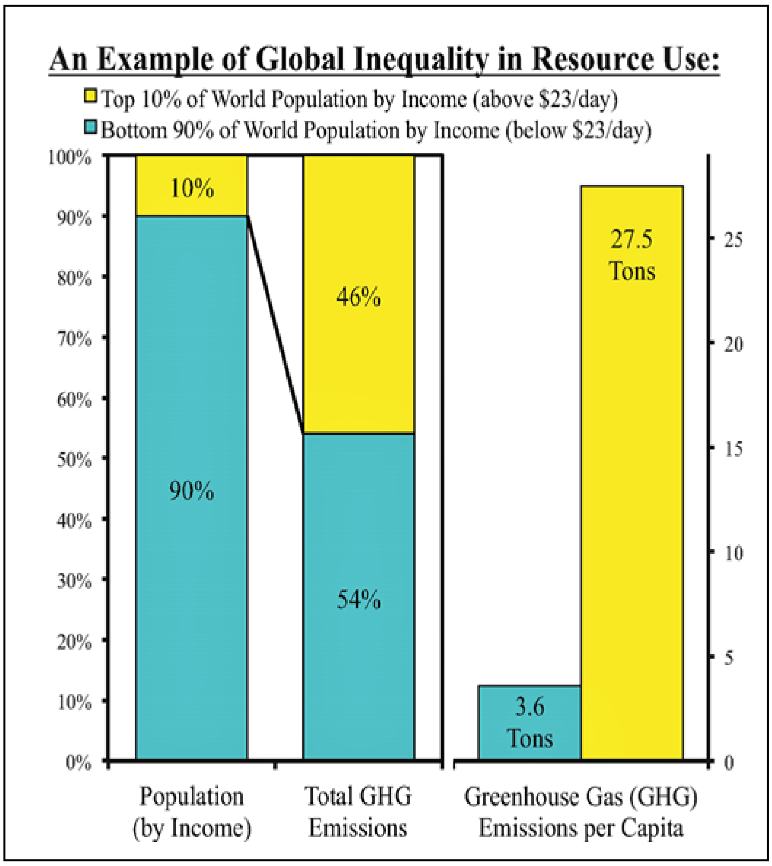
> We cannot segregate the human heart from the environment outside us and say that once one of these is reformed everything will be improved. Man is organic with the world. His inner life moulds the environment and is itself also deeply affected by it. The one acts upon the other and every abiding change in the life of man is the result of these mutual reactions.
>
> (Shoghi Effendi, letter of 17 February 1933 to an individual, quoted in *Valuing Spirituality in Development*, Bahá'í International Community, 1998)

I will adopt this view in my approach to education on resilience. The impacts of humanity on natural ecosystems are visible in pollution, species decline, soil degradation, declining water supplies and excessive resource consumption, as well as through the anthropogenic causes of climate change, while the effects of the environment on humans are demonstrated by climate change, hydro-meteorological, biological and geological hazards, the distribution of population, shortages of food and water, and many others.

One root cause of the current imbalance between humanity and its environment is the disproportionate exploitation of the earth's resources by more economically developed peoples, leading to inequality between and within nations.

Motesharrei et al (2016) illustrated this inequity in resource consumption and waste generation by showing that the top 10% of the world population by income (above $23 per day) produce 46% of total global greenhouse gas emissions – almost as much as the 54% produced by the bottom 90% (Figure 2.11). They stressed the importance of education that raises collective awareness of the current socio-environmental challenges and leads to actions.

Figure 2.11 Global inequality in resource use



Resource use by the wealthiest 10% of world population produces almost as much GHG emissions as the bottom 90%. To raise everyone to the average standard of living of those learning >$23/day would require ~ 5 times total GHG emissions.

Source: Reproduced from National Science Review 3: 470-494, 2016, under the terms of the Creative Commons Attribution License

Kagawa & Selby (2009) argued that the remedy to the problem of consumerism lies in education to transform structures and systems, with such education leading to direct community engagement and drawing on local and indigenous knowledge.

On a more general note, the Universal House of Justice, the international governing council of the Bahá'í community, wrote that:

> The welfare of any segment of humanity is inextricably bound up with the welfare of the whole. Humanity's collective life suffers when any one group thinks of its own well-being in isolation from that of its neighbours or pursues economic gain without regard for how the natural environment, which provides sustenance for all, is affected.
>
> (Universal House of Justice, message of 1 March 2017, p. 1)

Consciousness of this inequitable resource consumption and its socio-economic effects must feature in any educational programme on resilience, since it is through such awareness that practical solutions and action at all levels – international, regional, national and local – can be found. At a local level in a small island state such as Vanuatu, it will also be vital, as Kagawa & Selby and Motesharrei et al have suggested, to ensure that resilience education makes use of traditional environmental knowledge and empowers a community to develop its own coping strategies for adaptation and mitigation. Whether both of these facets of education are actually happening in Vanuatu will be investigated in this thesis.

2.7.2 Pedagogy of Effective Teaching and Learning

I see resilience education as helping people to learn how to face, cope with and recover from the impacts of climate change and disasters. Such education should foster knowledge, skills, attitudes and appropriate behaviour relating to all aspects of climate change and disaster risk – including their nature and causes, vulnerability, world-wide and local impacts, mitigation and adaptation, strategies for community planning and action, food and water security, conservation of biodiversity, frameworks and policies. As Stevenson et al (2017) have proposed, resilience education should involve learning in the face of risk, uncertainty and rapid change and must include education that builds community resilience through a process of identifying, assessing and reducing risk. Additionally, it should:

> …. equip students with the knowledge, understanding, skills and attributes needed to work and live in a way that safeguards their environmental, social and economic well-being, both in the present and for future generations.
>
> (Leal & Pace, 2016, p. 2)

Such is the conceptual framework for the content of a course or programme in resilience education. However, in terms of effectiveness, pedagogic aspects must also be covered.

Pedagogy

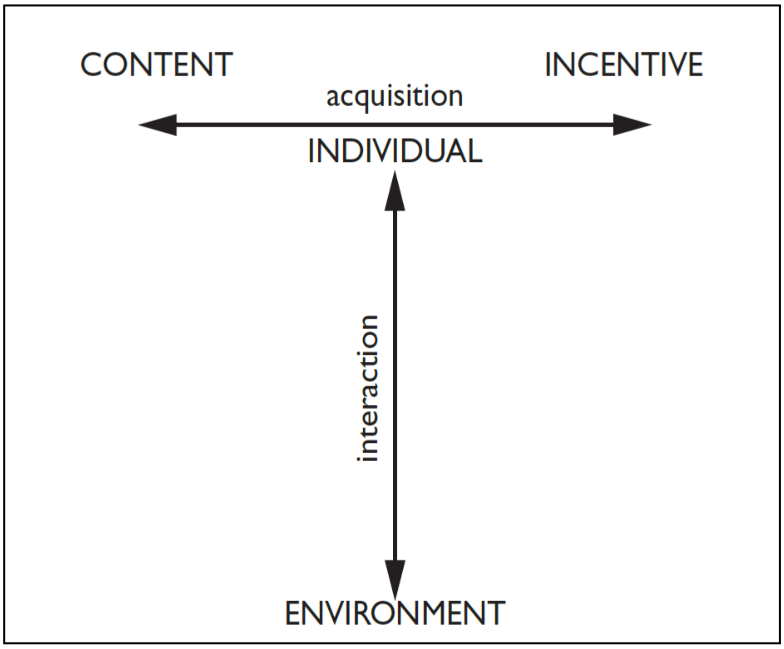
According to UNESCO's International Institute for Educational Planning, pedagogy refers to the interactions between teachers, students, and the learning environment and learning tasks (IIEP, 2021), with pedagogical approaches placed on a continuum from teacher-centred to learner-centred. Another view is that there are four pedagogical approaches – behaviourism, constructivism, social constructivism and liberationism (TES Global, 2018). A behaviourist approach, first suggested through research by Thorndike, Pavlov and Skinner (McLeod, 2017), corresponds to a teacher-centred, didactic approach whereby the teacher is the sole figure of authority and uses direct instruction through lectures and demonstrations. Learning takes place as a result of stimulation from the environment, which in this case is the teacher. A constructivist approach includes cognitive constructivism, proposed by Piaget (Lourenço, 2012), and social constructivism, advocated by Vygotsky (1978): it focuses on the learner constructing his/her own knowledge rather than being wholly dependent on the teacher. Liberationism, advocated by Freire (Irwin, 2012) places student voice at the centre of learning, with the teacher as learner and the class discovering information and ideas together. For teaching and learning about climate and disaster resilience, I suggest that both teacher-centred and learner-centred approaches can be used, with the former appropriate for topics such as the causes and world-wide impacts of climate change, or in introducing a new theme, and the latter relevant for topics where critical thinking and creativity are required, such as vulnerability assessment and community strategies for adaptation. In such areas, students need to be able to play an active role in constructing their own learning through field or simulated experience.

Constructivism

There are multiple views about constructivism, and no single definition that encapsulates them all. Cognitive or radical constructivism, based on the work of Piaget (1896-1980), held that learning is not passive, but occurs by active construction of meaning through our own experiences; we make sense of new information by attempting to associate it with our existing knowledge through processes of assimilation or accommodation (Amineh & Asl, 2015). Vygotsky's social constructivism, on the other hand, stressed that learning is constructed through social interaction – by engaging in dialogue with other humans, with language being the most meaningful way in which we construct reality. Thus significant learning occurs when individuals are engaged in social activities such as interaction and collaboration (Amineh & Asl, 2015). Illeris (2009) proposed a concept of learning that combines constructivism and social constructivism, with the learner actively building his/her learning as mental structures. He said that all learning involves the integration of two processes – an external interaction process between the learner and his/her social cultural or material environment, and an internal psychological process of elaboration and acquisition. There are thus three dimensions of learning – content, incentive and environment (Figure. 2.12). These three influences will be reflected in one of my own questionnaires on formal learning

(QS3) in which a learner is asked to assess the relative importance of the course, the facilitator/teacher and the student.

Figure 2.12 The three dimensions of learning



Source: Reproduced from Illeris K. (2009). Fig. 1.2: The fundamental processes of learning

If we accept that new learning is constructed upon the foundation of previous learning, with interaction with others as an essential element, then there are important implications for teaching (Hoover, 1996). Firstly, the teacher acts as a “guide on the side” rather than a “sage on the stage”. Secondly, learners may not understand something in the same way, and so may need different experiences to advance their understanding. Thirdly, for students to build new knowledge, their learning experience should incorporate problem-solving that is relevant to them rather than to the teacher and must include group interaction. Fourthly, if new knowledge is actively built, then time is needed to build it. Constructivism encourages students to engage in dialogue, both with the teacher and with one another, with the teacher asking open-ended questions (Brooks & Brooks, 1993).

For learning about climate and disaster resilience, I propose that such an active, constructivist approach is essential. Learners construct meaning through active engagement with the world through experiments or real-world problem solving, and understanding must come through making meaningful connections between prior knowledge, new knowledge and the processes involved in learning (McLeod, 2019). Social constructivism is important not only through interactions with peers and the teacher/facilitator, but also through inter-generational dialogue in a community setting whereby students learn traditional wisdom and adaptation techniques from elders, while elders learn more modern techniques from the students.

Constructivism implies the use of strategies such as experiential learning, enquiry-based learning, cooperative learning and fieldwork.

Experiential learning

This is a learner-centred strategy that requires students to cooperate and learn from one another through direct experiences tied to real world problems, with the teacher facilitating rather than directing (ITALI, 2015). Knowledge is continuously derived from and tested out in the experiences of the learner (Kolb, 1984). Experiential learning can be seen as a four stage cycle comprising concrete experience, reflective observation, abstract conceptualisation and active experimentation (Kolb & Kolb, 2008). According to Illeris (2009, p.94), experiential learning can primarily be understood as 'learning in which the learning dimensions of content, incentive, and interaction are involved in a subjectively balanced and substantial way.'

This form of learning is relevant to disaster risk reduction. Learners in Vanuatu can share and reflect on their real-life experiences of cyclones, earthquakes, ash falls, floods and droughts, then draw out concepts relating to personal and community safety that lead to strategies for assessing vulnerability and practical measures for disaster mitigation. Another example relates to the effects of atmospheric warming on the ice in polar regions (Pierce, 2019B): an experiment is conducted in the classroom to demonstrate how the melting of land-based ice sheets leads to global sea-level rise, whereas the melting of sea-ice does not (Figure 2.13)

Figure 2.13 Experiment to show the melting of ice in water (left) and on land (right)

Author, 2018

Enquiry-based learning (EBL)

This is another constructivist strategy. Students are asked to investigate an issue through the collection and analysis of data. They make connections with their existing knowledge and ways of thinking, making sense of new data for themselves through their active involvement in analysis and interpretation (Roberts, 2006). EBL promotes individual research, but is often organised around collaborative work in small groups in which 'students are engaged as partners in the learning process' (Kahn & O'Rourke, 2005, p.1):

Such an approach is relevant to topics in the field of climate change. For example, groups of students can be asked to use internet sources to investigate past geological periods/epochs such as the Carboniferous, Eocene and Pleistocene, when the Earth's climate was much warmer or colder than at present. They then present their findings to the class.

A closely related approach is known as discovery learning, whereby a teacher refrains from passing concepts and information to students, but guides them to "discover" it for themselves through the use of educational resources (Hammer, 2009). The discovery process is aided by a series of carefully-selected questions, with answers explored through discussion in small groups of learners.   An example is the use of the 16 wall pictures depicting the main aspects of climate change in the Pacific islands (*Learning about Climate Change the Pacific Way).* The effectiveness of this educational resource will be evaluated as part of the present thesis.

Cooperative learning

This is an educational strategy in which small groups of students work together on a common task (TeacherVision, 2021). They discover new concepts together and help each other learn, so enhancing their own and their groupmates' learning (Johnson & Johnson, 2018). This exemplifies Vygotsky's social constructivism, because learning takes place as students solve problems beyond their current developmental level with the support of their peers and/or their facilitator. Group size can vary from pairs to half the class, but the disadvantage of large groups is that some individuals may become passive "passengers" who contribute little or no input.

Johnson & Johnson (2018, p. 67) pointed out that cooperative learning is also the foundation of active learning in that 'students engage in dialogue, interact with classmates in small groups, generate new ideas and cognitive structures within the groups, and coordinate with groupmates in the direction and speed of the work'. They stressed that five basic elements are required in any cooperative learning lesson: positive interdependence, individual accountability, promotive interaction, social skills such as conflict management, and group processing - examining the effectiveness of the processes members use to maximize their own and other's learning.

In the context of Vanuatu, where cultural influences favour collectivism rather than individualism, I have found through four decades of teaching experience that young people mix readily with each other in a formal educational setting, and willingly embrace cooperative learning. Thus the first three of Johnson and Johnson's five elements occur almost naturally, while the last element may not be needed at all.

For lessons or courses on climate and disaster resilience, cooperative learning strategies complement experiential and enquiry-based learning, and are highly relevant to fieldwork. The teacher's role is to provide structure in the form of guided questions and educational resources, and to ensure that the selection of pairs or groups is done on the basis of varying criteria, thereby reinforcing the social skills of participants. In formal educational settings, a student-centred, cooperative learning-based classroom can be organised around tables of 4-5 students, with the composition of the group varying according to the task; such a learning environment encourages freer discussion, promotes cooperation rather than competition, builds team spirit, enables students to gain new competencies and knowledge from each other, and helps learners improve their communication skills and become more considerate of others (Pierce, 2019B). Such qualities are needed when helping communities to understand the nature of climate change and disasters and prepare for their impacts.

One aspect of cooperative learning that students need to develop is the capacity to present the group's findings to others. A strategy for empowering even the most diffident student to do this is known as the "carousel" technique (Gray, S., 2016; Simon, C. 2021), described in Appendix D.

Fieldwork

Fieldwork is a process of observing and collecting data about people, cultures and natural environments (NGS, 2021), and can be defined as 'any component of the curriculum that involves leaving the classroom and learning through first-hand experience' (Boyle et al., 2007, pp.299-300). As such, fieldwork is an application of experiential learning. With careful planning by the teacher/facilitator, it can follow Kolb's four stage cycle of learning. Thus students studying vulnerability can visit a community, observe physical and human features and talk to residents (concrete experience), reflect on aspects that make the community vulnerable to flooding, erosion and storms (reflective observation), produce a hazard map (abstract conceptualisation) and propose measures that would reduce hazard impacts (active experimentation). Fieldwork is more engaging when a learner-centred experienced-based approach is adopted, rather than being teacher directed (Leydon & Turner, 2013; Ballantyne & Packer, 2009), and when linked to enquiry-based and cooperative learning.

Thomas & Munge (2015) highlighted the challenges involved in outdoor environmental education fieldwork: growth in the size of student cohorts; student participation issues, sometimes related to fitness; safety management; reluctance of staff to spend long hours in the field; new technologies such as GPS and Google Earth that can reduce students' emotional ties to the environment; and mismatches between theory and practice, whereby teachers may fall back to traditional teacher-led strategies. In the context of Vanuatu, the size of student cohorts can impact on costs of travel to fieldwork sites, and safety issues are always relevant, particularly in coastal locations; yet staff and students are usually delighted to go on field trips as an escape from the classroom, and fitness issues are of minor importance.

Education in climate and disaster resilience is an ideal medium for fieldwork, particularly when dealing with vulnerability, mitigation and adaptation. If the goal of such education is to empower the learners to take action at community level to reduce the impacts of hazards and ongoing climate change, then fieldwork is not only desirable, but essential. Two examples of learner-centred fieldwork activities that can be conducted by small student groups are: investigating the sources of energy used in a local community; and learning then demonstrating a practical adaptation technique to people in a local community.

In summary, the nature of resilience education as a subset of environmental education means that it must provide students with the knowledge, understanding, skills and attributes needed to work and live in a way that safeguards their present and future environmental, social and economic well-being (Leal & Pace, 2016). As such, students must be actively involved in their own learning through constructivist approaches such as experiential, enquiry-based and cooperative learning, and be given the opportunity to undertake fieldwork at community level. Active learning through exposure to field experiences and dialogue with other students can work well with vulnerability, mitigation and adaptation, but aspects such as causes and impacts may require a more teacher-centred approach. In other words, a variety of teaching and learning strategies is desirable.

2.7.3 Characteristics of a Proposed Educational Programme on Resilience

The above theories and concepts provide context for the methodology to be used in this thesis, as well as guiding investigations into whether or not key aspects of learning about resilience actually feature in formal courses in Vanuatu, and how participants react to them.

Figure 2.14 models a proposed educational programme on resilience in formal and non-formal settings, showing that there are four “influencing” factors – educational theory, educational practice, environmental education and the field of resilience itself. These factors appear at the top of the model, all given similar weighting. Elements of each that contribute towards learning about resilience are shown in the boxes below.

“Educational theory” includes some of the broad principles outlined in 2.7.1 – the development of moral qualities, nurturing the potentialities that lie within, building on the knowledge and capacities of individuals and groups, fostering an outward orientation, and service to others.

“Educational practice” refers to teaching and learning strategies that help participants build resilience to climate change and disasters for themselves, their families and communities: examples are student-centred, participatory learning; experiential learning and fieldwork; constructivism; and catering for individual learning needs.

Under “environmental education and education for sustainable development”, a key aspect to grasp is the reciprocal relationship between human and earth systems, with awareness that the balance between them has been compromised over the last few hundred years, leading to reduced biodiversity, changes in geophysical processes such as erosion and deposition, declining water supplies and the climate crisis. This links to an understanding of the socio-economic effects of inequitable resource consumption and the dangers of consumerism, and a realisation that solutions lie in promoting the dimensions of sustainable living, the conservation of biodiversity, ecosystems and resources, and pro-environmental behaviours.

Within this context, topics from the more specialised field of “resilience” can be covered – for example, the nature and causes of climate change and disasters.

Figure 2.14 Model of a proposed educational programme on resilience

The four influencing factors govern the desired outcomes of a resilience course in terms of knowledge, skills, attitudes and behaviour, as shown in the lower blue box. Cognitive awareness of climate change, disaster risk reduction, sustainable development and traditional knowledge will not be enough. Participants should acquire skills in communication, literacy, numeracy, observation and information technology, as well as the capacity to carry out risk mapping and vulnerability surveys, write project proposals, demonstrate adaptation and mitigation strategies and give public talks. Attitudes to be fostered include selfless service, inclusiveness, justice, gender equality, respect for the environment, and a distrust of consumerism. Desired patterns of behaviour should embrace recycling, tree planting, demonstrating empathy for the vulnerable and those affected by disasters, readiness to share one's knowledge, advocacy for action on climate change, adoption of environmentally-friendly eating habits, and taking action to prepare for disasters.

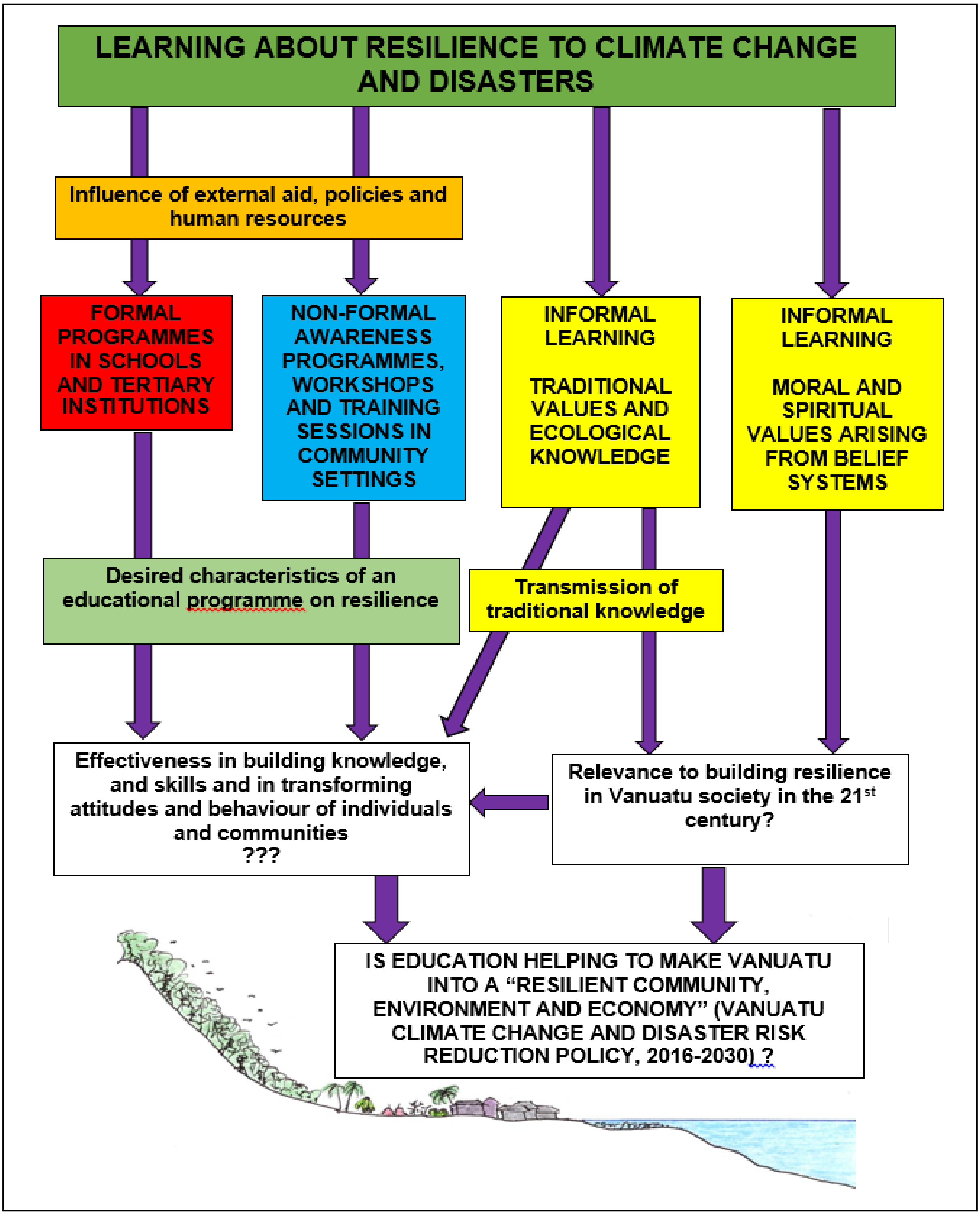
In summary, Figure 2.14 provides a set of criteria against which the effectiveness of a formal educational programme on resilience can be measured.

2.7.4 Overall Conceptual Framework

From my proposed criteria identified in Figure 2.14 for measuring the effectiveness of formal programmes in resilience, we can move to Figure 2.15, which summarises the overall conceptual framework within which the effectiveness of resilience education in all settings – formal, non-formal and informal – can be investigated.

The framework suggests that learning about resilience to climate change and disasters in Vanuatu is taking place through four main pathways. There are formal programmes in primary, secondary and tertiary establishments, largely for children, youth and young adults. These are complemented by short-term non-formal awareness programmes, workshops and training sessions, usually in community settings and offered to people of all ages. Then there is the influence of informal, life-long learning viewed from two perspectives: firstly, the intergenerational transmission of traditional ecological knowledge, skills and values that has been taking place over millennia and has enabled indigenous populations to adapt to a range of natural hazards and forms of environmental change; and secondly the acquisition of moral and spiritual values that occurs in families and communities through the influence of belief systems such as those associated with Christianity, the Baha'i Faith and other religions, as well as moral codes not linked to any faith.

Figure 2.15 Conceptual framework for examining the effectiveness of resilience education in Vanuatu



It will not be possible in this thesis to address non-formal education in resilience, nor the relevance to resilience of informal, faith-based moral and spiritual values. For formal courses, I will use the desired characteristics of a resilience programme (Figure 2.14) to evaluate their effectiveness in building knowledge and skills and transforming attitudes and behaviour of individuals and communities. For informal learning, the transmission of traditional ecological knowledge and values will be investigated, as well as their effectiveness and relevance in providing knowledge and skills and in changing attitudes and behaviour in the Vanuatu of the 21st century.

Collectively, these findings should lead to an assessment of the role of formal and informal education in helping to make the nation achieve the vision of the Vanuatu Climate Change and Disaster Risk Reduction Policy 2016-2030 (Figure 2.15) of being a “resilient community, environment and economy”.

Having used the literature review to formulate the overall conceptual framework for this thesis, we now turn to Chapter 3 to consider the methodology followed in evaluating the learning about resilience actually in place.

CHAPTER 3: METHODOLOGY

3.1 Overview

Chapter 1 identified the two research questions investigated in this thesis – the effectiveness of formal education on climate and disaster resilience in terms of changes in knowledge, skills, attitudes and behaviour, and the extent to which traditional knowledge, skills and values are relevant to climate and disaster resilience. Then in Chapter 2, I reviewed relevant literature and produced a conceptual framework for the research. In this Chapter, I consider my research methodology, showing how a mixed methods approach will be used and explaining the use of data collection tools, sampling and analysis.

I begin in 3.2 with an examination of the philosophical underpinnings of the research, moving from ontology to epistemology and then to the pragmatic research paradigm that will be adopted. The mixed methods approach to data collection, explained in Section 3.3, follows a transformative design type and permits the usage of both quantitative and qualitative tools. The instruments used in this research are specified and the phases of its mixed methods approach are outlined. In Section 3.4 I look at sampling, first clarifying the difference between probability and non-probability sampling, then illustrating how samples were selected for investigating the effectiveness of formal educational programmes on resilience at junior secondary, senior secondary and post-secondary levels. This is followed by sampling techniques for assessing the significance of traditional knowledge and values in building climate and disaster resilience in Vanuatu. Section 3.5 starts with background information on the researcher and his assistants, then gives details of data collection tools used in this research – questionnaires, semi-structured interviews, emails/messages/texts/online chats, and document search and analysis. The eight questionnaires used for Research Question 1 and the semi-structured interview technique used for Research Question 2 are summarized and their purpose justified. Section 3.6 discusses how the COVID-19 pandemic and Cyclone Harold have impacted upon this research, shaping methods of data collection, participant responses and the research questions themselves. Data analysis for responses to each Research Question is covered in Section 3.7, with an explanation of how the assessment criteria were determined for responses to questions on the CC Toolkit activity and how coding systems evolved for responses to questions on the transmission of traditional knowledge and values. Section 3.8 is on research rigour, distinguishing between the validity and reliability required in quantitative research and the trustworthiness and verification strategies for qualitative research. Efforts to obtain rigour in this particular research are analysed. Finally, Section 3.9 deals with ethical issues and positionality of the researcher and his assistants. Evidence of endorsement of the research by key government institutions in Vanuatu is offered. Details are given on how participants were informed about the research and their consent obtained, how their autonomy and anonymity was guaranteed, and how the confidentiality of their data was maintained. Ways in which the principal researcher and his assistants might have influenced the accuracy of data collection are discussed.

3.2 Philosophical Underpinnings of the Research

As a researcher into education about resilience, I must first examine my position in relation to reality, in other words to ontology. Ontology reflects an individual's interpretation of what constitutes a fact (BRM, 2022): do objects of enquiry actually exist, or are they are names that humans give to mental abstractions, created in the mind? (Cohen, Manion & Morrison, 2007; Noonan, 2008). A realist ontology posits that an object exists independently of the researcher, while a non-realist ontology argues that reality is subjective, subject to change and is 'constructed through the interaction between language and aspects of an independent world' (Scotland, 2012, p.11). The researcher must consider whether there is 'a singular, verifiable reality and truth … or socially constructed multiple realities' (Patton, 2002, p.134).

In this thesis, I can argue that I am dealing with real objects that exist independently of the researcher – cyclones, temperature change, damage done by ash falls, the COVID-19 pandemic that forces schools to close and reduces the number of flights. Yet because my focus is on the effectiveness of teaching and learning – socially-constructed realities that are subject to change over time – I must lean towards a more non-realist ontology.

Ontology leads on to epistemology, which can be defined as the philosophical study of the nature, origin and limits of human knowledge (Martinich, A. 2021). It is concerned with ‘the nature and forms of knowledge, how it can be acquired and how communicated to other human beings’ (Cohen et al, 2007, p.7). If ontology asks the question “what is reality?”, then epistemology asks “how do you know about it?” and “what is the relationship between the enquirer (you) and the knowable (the object of research)?”, while methodology asks “how will you go about finding out this knowledge?” (Guba & Lincoln, 1994; Perera, 2018). If knowledge of social behaviour is objective and tangible, then researchers must be observers; but if knowledge is subjective and unique, then researchers have an interpretative view and ‘an involvement with their subjects and a rejection of the ways of the natural scientist’ (Cohen et al, 2007, p.7).

Since my research is predominantly dealing with people’s perceptions – socially constructed multiple realities that can change over time – the epistemology to be adopted should be one in which I ‘get involved with the subjects and try and understand phenomena in their contexts’ (Rehman & Alharthi, 2016, p.52). As such, any new knowledge created by this research may have some utility to other island nations at the forefront of climate change impacts, but perhaps not universally.

The non-realist ontology and epistemology that influence my research suggest that an interpretivist approach should be adopted, using a methodology that is inductive – discovering patterns in the data that are used to understand a phenomenon and generate theory (Rahman & Alharthi, 2016). However, while this approach is suitable for investigating the nature and transmission of traditional knowledge, a more deductive, empirical approach may be appropriate for evaluating whether a course in resilience has had an impact on students’ knowledge, skills, attitudes and behaviours; at the same time, it may not be possible to deduce that a change has been due to any one independent variable, such as the teacher, since in education a multiplicity of variables are operating. In other words, statistical patterns that may appear through an empirical approach must be further investigated through an interpretative lens.

This consideration of approaches to be taken leads to the research paradigm that I will follow. A research paradigm refers to the philosophical assumptions or basic set of beliefs that guide the actions and define the worldview of the researcher (Lincoln et al, 2011), with “worldview” seen as ‘a way of thinking about and making sense of the complexities of the real world’ (Patton, 2002, p.69). Your research paradigm influences the way you carry out your research. It constitutes a mental model that structures how the members of a research community perceive their field of study (Kuhn, 1970; Orman, 2016), and constitutes the set of ontological and epistemological assumptions that guide the methodology to be adopted (Johannesson & Perjohns, 2014).

Three common paradigms are positivism, interpretivism and pragmatism.

Positivism arises from a realist ontology which proposes a single reality independent of humans that can be observed, measured and known, leading to an epistemology of knowable facts and truths and the use of objective, quantitative research methods that generate numerical data through experiments and surveys. Such methods can be applied to both the natural and the social world (Rehman & Alharthi, 2016). Interpretivism originates from an ontology that suggests that reality is constructed and interpreted in the human mind, so that there are multiple realities which may change over time. This favours the use of qualitative research methods, including interviews and observations (Rehman & Alharthi, 2016). Pragmatism focuses on the outcomes of the research – the actions, situations and consequences of the enquiry (Creswell, 2007): the important aspect of research is the problem being studied and the questions asked about this problem; truth is not based solely upon a reality independent of the mind (positivism) or within the mind (interpretivism). Pragmatism uses a variety of approaches, including both positivism and interpretivism, to provide answers to the research question (Okesina, 2020), and ‘recommends a balance between subjectivity and objectivity throughout the investigation’ (Shannon-Baker, 2016, p.331).

This thesis will follow a pragmatic paradigm, for the following reasons. Firstly, it aims to find out how resilience education impacts on a participant’s knowledge, skills, attitudes and behaviour – an investigation that requires both an objective and a subjective approach. Objective because the impacts of a course or programme of learning are measurable through empirical data that do not depend on the researcher. Subjective because participants’ perspectives on the effectiveness of this education must be sought, and in formulating questions and synthesizing diverse answers, the researcher's own mindset and interpretation will be involved. Thus a combination of research methods will be needed – both qualitative and quantitative – and this reflects a pragmatic approach whereby the enquirer selects whichever research design and methodology that is most appropriate for the research questions (Kaushik & Walsh, 2019). Secondly, the focus of this research is on its consequences. Its main purpose is to create knowledge that will be useful for decision-makers in Vanuatu, not only in the field of education, but also in the Ministry of Climate Change and Disaster Risk Reduction and at the level of village communities and urban neighbourhoods. As such, it exemplifies the principle of knowledge creation 'in the interest of change and improvement', and 'not only for what "is", but also for what "might be", an orientation towards a prospective, not yet realised world' (Goldkuhl, 2012, p.8). Thirdly, adopting a pragmatic paradigm means accepting that knowledge is based on experience: hence 'each person's knowledge is unique as it is created by her/his experiences, and is socially constructed rather than being a single reality' (Kaushik & Walsh, 2019, p.4). Thus in this thesis the knowledge created about resilience education in Vanuatu may only be applicable to the context of that nation, and is subject to constant change because it is constructed through human experience of changing environmental conditions and an evolving understanding of appropriate strategies. This reflects a non-realist ontology and epistemology. At the same time, I also need to adopt a realistic, empirical approach in measuring change in young people's knowledge, skills, attitudes and behaviour. A pragmatic paradigm enables me to embrace both a positivist and interpretivist approach to research.

3.3 Research Design

Adopting a pragmatic research paradigm naturally leads to the use of "mixed methods" as the design tool. Numerous definitions of mixed methods research have been offered, but nearly all refer to some form of integration of qualitative and quantitative research methods (Guest & Fleming, 2015). The advantage of a mixed methods approach is that in combining different methods of data collection, a fuller understanding of the research problem is obtained. According to Cresswell & Plano Clark (2011, p.12), mixed methods research is practical in that it 'permits the usage of multiple techniques and approaches that best address the research question'. Thus in answering research question 1 on the effectiveness of formal education on climate and disaster resilience in terms of changes in participants' knowledge, skills, attitudes and behaviour, there is a need to gather numerical data from "before" and "after " questionnaires about a particular course or programme. At the same time, qualitative data obtained through personal interactions with participants and teachers about their experiences can also contribute to understanding the "how" and "why" of a programme's effectiveness. For research question 2, qualitative data obtained through interviews with holders and receivers of customary wisdom about traditional warning and adaptation strategies can provide useful insights, and can be compared with quantitative data about recent disaster events.

Creswell & Plano Clark pointed out that there are six major design types for a mixed methods approach (Table 3.1)

Table 3.1 Creswell & Plano Clark's six major design types for a mixed methods approach

Convergent Parallel	Concurrent timing is used to implement quantitative and qualitative stands during the same phase of the research process. The researcher prioritizes the two methods equally, keeps the strands independent during analysis and mixes the results during the overall interpretation of the data
Explanatory Sequential 1	Research starts with the collection and analysis of quantitative dad, followed by the collection and analysis of qualitative data to help explain the quantitative results.
Explanatory Sequential 2	Research starts with the collection and analysis of qualitative data, followed by the collection and analysis of quantitative data to test or generalize the qualitative findings.
Embedded	The researcher collects and analyses both quantitative and qualitative data within a traditional quantitative or qualitative design to enhance the overall design in some way
Transformative	The researcher shapes this design within a transformative theoretical framework, seeking to address the needs of a specific population and to call for change
Multiphase	This design combines sequential and concurrent strands, collected over a period time, and the implementation of distinct projects or phases within an overall programme of study.

Source: Adapted from Table 19.4 of Guest & Fleming (2019, p. 587)

The design type appropriate for this thesis will be transformative. This is because I am addressing the needs of the population of Vanuatu and hoping to demonstrate that changes are needed in educational strategies for building greater individual and community resilience to climate change and disasters.

Mixed methods research attempts to fit together the insights provided by quantitative and qualitative methods of data collection that offer the best solution to the research question (Conway, 2009).

Quantitative methods involve the collection and analysis of numerical data. According to Queiros et al (2017, p.370):

> They are appropriate when there is the possibility of collecting quantifiable measures of variables and inferences from samples of a population. Data are collected objectively and systematically and analysis is performed through statistical procedures, often using software such as SPSS.

A common quantitative tool is the questionnaire, which can be representative of an entire population, but whose reliability is dependent on the survey structure and the accuracy of answers provided by respondents (Queiros et al, 2017). Quantitative methods normally allow you to gain insights from a larger sample than with qualitative methods, so providing data that that is more generalizable. Rahman (2016) claimed that quantitative data obtained from questionnaires is not affected by the subjectivity of the researcher, and does not normally capture the feelings of respondents. I would argue that on the contrary, the researcher devises the questions and in many cases interprets the answers, so is being subjective. Also a question could ask a respondent "How confident are you about your knowledge of …..", and so can indeed measure feelings.

If quantitative methods aim to capture facts, then qualitative methods find out opinions, feelings and reasons. Qualitative research applies to 'the collection of data in a natural setting, sensitive to the people and places under study, and data analysis that is inductive and establishes patterns or themes' (Creswell, 2007, p.37). As suggested by Creswell, the researcher uses inductive data analysis, building patterns, categories and themes from the responses of participants and allowing for an "emergent" research process in which forms of data collection and data analysis may change in response to the data collected. For example, when investigating traditional disaster signs, initial analysis of responses focused on all signs, grouping them as hydro-meteorological, biological and geological; later, when it became clear that the signs needed to be disaggregated by type of hazard (cyclones, droughts, ash falls, etc.) and by time (short-term and long-term), I revisited interviewees' responses and applied techniques of quantitative analysis to determine the most widely-known signs for each hazard according to category of respondent. Qualitative methods can be used to gain an initial understanding of an issue, followed by quantitative methods to obtain numerical data once factors or patterns have been identified. Alternatively, qualitative methods can 'follow up on quantitative data to find out why people responded as they did, the context in which they responded, and the deeper thoughts and behaviours that governed their responses' (ibid, p.40). This was done, for example, when in response to a survey question asking whether students had acquired certain skills regarding adaptation strategies, the students responded positively while their teachers responded negatively; subsequent email interviews were conducted with teachers to examine possible reasons for this divergence.

In investigating answers to my two research questions, I used a mix of quantitative and qualitative methods. For question 1, I used quantitative methods to obtain statistical data on changes occurring as a result to exposure to courses or programmes on resilience, then as far as was feasible, used qualitative methods to investigate reasons or anomalies in the patterns observed. For question 2, I used qualitative methods to obtain the raw data, then once patterns in hazard warnings, coping strategies and transmission pathways had been identified, applied quantitative tools to obtain numerical data on the relative importance of each. In this way, quantitative and qualitative techniques were complementary – a characteristic of the mixed methods approach.

Note that the data collection tools differed for research questions 1 and 2, reflecting the difference between formal and traditional learning. They also differed within question 1 in relation to the information available to me: thus while the same questionnaires could be used for students at senior secondary and post-secondary levels, this was not possible at junior secondary level. In 2020-2022 the lack of progress in curriculum development at that level meant that I had to focus on the effectiveness of one particular educational resource rather than that of a whole educational course or programme.

Table 3.2 shows the phases of my mixed methods research.

Table 3.2 Phases of my research using a transformative mixed methods design

Period	Activity	Quantitative or Qualitative?	Methods of data collection
October 2019 to March 2020	• Questionnaires are designed, pilot-tested and used for gathering objective data on formal courses in resilience.	Quantitative	Questionnaires
	• Potential research assistants (teachers) are trained in using the 16-picture Toolkit on climate change (CC) for evaluating student progress.	Quantitative	Questionnaires
	• Structured interview questions are designed, pilot-tested and used for gathering data on traditional environmental knowledge (TEK).	Qualitative	Semi-structured interviews
	• Potential research assistants are consulted and trained in the process of interviewing holders and recipients of TEK.	Qualitative	Semi-structured interviews
April 2020 to June 2021	• Teachers/facilitators collect data on formal courses on resilience at post-secondary level, using questionnaires.	Quantitative	Questionnaires
	• Teachers in 9 secondary schools carry out the CC Toolkit activity, with students completing "before" and "after" questionnaires.	Quantitative and Qualitative	Questionnaires and remote interviews
	• Semi-structured interview questions on TEK are refined in the light of field experience, then used by research assistants in Vanuatu and (mostly as questionnaires) with ni-Vanuatu students studying in Fiji.	Qualitative and Quantitative	Semi-structured interviews (Vanuatu) and questionnaires (Fiji)
	• Because of the COVID-19 pandemic and the impossibility of travel, information on resilience policies, Cyclone Harold and educational statistics are collected through the internet and by virtual dialogue with key personnel in Vanuatu.	Qualitative	Document search and semi-structured email interviews, messages and texting
	• Data on school curricula on CC and DRR are analysed.	Quantitative	Statistical analysis
	• Preliminary analysis on the effectiveness of the CC Toolkit resource is undertaken.	Quantitative	Statistical analysis
	• Data on TEK is coded and analysed	Qualitative	Coding and analysis
June 2021 to March 2022	• Continuation of data collection on the CC Toolkit activity	Quantitative	Questionnaires
	• Continuation of data collection on formal courses on Resilience (CC and DRR) at senior secondary and post-secondary levels	Quantitative	Questionnaires
	• Interviews are conducted via email or on-line face-to-face with teachers of formal courses/programmes	Qualitative	Semi-structured interviews
	• Continuation of data collection on TEK	Qualitative	Semi-structured interviews
	• Continuation of coding and analysis of all data	Quantitative and qualitative	Coding and analysis
March 2022 to October 2022	• Writing up, editing, revision and completion of thesis		

3.4 Sampling

3.4.1 Methods of Sampling

Data from every single person in a population can be obtained by conducting a census. However, most researchers must rely on a sample of a given population – a smaller group of individuals selected from that population to participate in the investigation. There are two broad methods for selecting this sample – probability and non-probability.

Probability sampling is most often used in quantitative research in order to test a hypothesis. Every member of a population has an equal chance of being selected, and the selection is commonly done at random. In this way, the results of studying the sample are representative of, and generalizable back to, the whole population. (Marshall, 1996; Taherdoost, 2016). The main forms of probability sampling are summarised in Table 3.3:

Table 3.3 Common forms of probability sampling

Simple random sample	Every individual in a population has an equal probability of inclusion in the sample, and selection is done at random.
Stratified random sample	Researcher divides the population into strata or subgroups and a random sample is taken from each subgroup. Used where there is considerable variation within a population.
Systematic sample	Researcher lists all elements of a population then selects a random starting point and selects every nth element on a regular basis.
Cluster sample	When a whole population is divided into clusters or groups (e.g. geographical regions), the researcher selects a random sample from each cluster, and puts them together to give the final sample.
Multi-stage sample	Researcher moves from a broad to a narrow sample, using a step-by-step process.

Source: Synthesized from Marshall (1996), Taherdoost (2016) & the author's own experience

Non-probability sampling is the preferred method in qualitative research. Each individual in a population does not have the same chance of being selected, and the survey results may not be representative of the whole population. Random sampling is inappropriate, since the aim is to focus on informants more likely to provide insight and understanding for the researcher rather than to generalize results to an entire population (Marshall, 1996). In some cases, non-probability sampling means simply using anyone who agrees to be involved. In others, it means selecting a specific population that is in the best position to answer the research question – for example, known holders of traditional knowledge or students at Year 10 level. Non-probability samples are often small in size so that the research can gain a deeper understanding of a real-life phenomenon (Taherdoost, 2016; DeCarlo, 2018). The main forms of non-probability sampling are shown in Table 3.4.

Table 3.4 Common forms of non-probability/non-random sampling

Purposeful sample	Researcher deliberately selects those who are in the best position to answer the research question, or because they have characteristics that the researcher desires - such as particular knowledge, availability, or ability to articulate experiences.
Convenience sample	Researcher selects the most accessible people – those who are willing and easily available, such as family and friends.
Quota sample	Researcher identifies categories of people that are important to the study and for which there is likely to be some variation, then decides how many to include from each sub-group.
Theoretical sample	Researcher builds theories from emerging data and selects a new sample to examine/elaborate on these theories.
Snowball sample	Researcher chooses a few participants and then they in turn encourage other people to participate.

Source: Synthesized from Marshall (1996), Palinkas et al (2015), Taherdoost (2016) & DeCarlo (2018)

3.4.2 Sampling for Formal Education on Resilience (RQ1)

In 2020 there were 23,943 students enrolled in secondary education, 2,051 in post-school education and training courses at diploma and certificate level in Vanuatu, 3,147 in pre-degree, degree and post-degree courses through the University of the South Pacific's (USP's) Emalus Campus, 57 in the Agence Universitaire de la Francophonie (AUF), and 318 in the National University of Vanuatu (NUV) (MoET, 2021). It would be impossible to conduct a survey of the entire student population of Vanuatu at secondary and at tertiary level in order to obtain quantitative data on experiences of resilience education in a formal setting. Instead, the target populations or cohorts must first be defined, and then samples selected from those cohorts.

It must be stressed that this research in formal education is conducted in order to assess the impact of specific educational programmes/courses on the students involved, and not to assess the students themselves. The students serve as agents for measuring the effectiveness of those courses or educational resources.

Table 3.5 explains how the sampling cohorts were identified for different levels of formal education.

Table 3.5 Sampling cohorts at different levels of formal education

Level	Characteristics of cohort	Method of sampling used	Questionnaires and/or email interviews completed
Junior secondary	Nineteen Year 9 or 10 Social Science or Science classes in 9 schools	Convenience and purposeful	Students completed QS6 before and after participating in the CC Toolkit activity. Some teachers responded to email interviews
Senior secondary	Twenty 11,12 & 13 classes taking Earth Science, Development Studies or Geography in 7 schools	Convenience and purposeful	At end of the school year, students completed QS1 & QS4. Teachers completed QC1, QC2, a subject questionnaire and email interviews
Post-secondary	Cohort taking TVET Certificates I & III in Resilience at VIT 2017-2018	All students willing to answer questionnaires and interviews	Students completed QS1, QS2, QS3 & QS4 and email interviews after graduating. Facilitators completed QC1 & QC2
Post-secondary	Cohort taking TVET Certificates I & III in Resilience at VIT 2019-2020	All students willing to answer questionnaires	Students completed QS1 and QS4 at start and end of Certificate III. Facilitators completed QC1 & QC2
Post-secondary	Cohort taking TVET Certificates I & III in Resilience at VIT 2020-2022	All students willing to answer questionnaires	Students completed QS1 & QS4 at start and end of Certificate I. Facilitator completed QC1 & QC2
Post-secondary	Cohort taking TVET Certificate IV in Resilience through USP during 2020	All students willing to answer questionnaires	Students completed QS1 & QS4 at end of Certificate IV. Facilitators completed QC1 and QC2
Post-secondary	Participants in PGDCC at USP prior to 2020	All students willing to answer questionnaires	Students completed QS1, QS4, QC1 & QC2 after course completion

Secondary level students

For students in Vanuatu’s 111 secondary schools, I did not make a random selection of schools, but relied on my long-standing contacts with teachers, especially those I helped to train during my 15 years of service at the Vanuatu Institute of Teacher Education (VITE), as well as those I previously taught at secondary school and in tertiary level courses at USP’s Emalus Campus in Port Vila. I identified possible English- and French-medium schools in urban and rural settings on several islands, then consulted with school principals and teachers to identify classes that could participate in the research. For teachers of Years 9 and 10 Basic Science and Social Science, and for teacher trainees graduating from VITE in December 2019, I ran a two-hour training session on the 16-picture Toolkit “*Learning about Climate Change the Pacific Way*”, encouraging them to carry this out as a discovery learning activity and seeking a uniform pedagogical approach among those concerned (Figures 3.1 and 3.2).

Figure 3.1 Teachers of Social Science and Earth Science at Mangrove College, prior to their training session on the Climate Change Toolkit. March 2020

Author, 2020

Figure 3.2 Teachers of Year 10 Social Science at Nagavika College participate in training on the Climate Change Toolkit. Here they are responding to questions on each picture as though they are students. March 2020.

Author, 2020

Nine schools had classes that carried out the CC Toolkit intervention, while seven had classes that participated in the survey of senior secondary students. In only two schools – Mangrove College and Hibiscus College – were students involved in both surveys. All schools have been given fictitious names to preserve anonymity.

In all schools, the questionnaires on course content and other pedagogic aspects were explained and discussed, including the “before” and “after” questionnaire for students on the CC Toolkit. Once a teacher had agreed to participate, he/she was expected to involve all students in his/her class.

Thus the sampling methods used for evaluating students’ participation in resilience education, both for the CC Toolkit activity in the junior secondary cycle and for courses in the senior cycle, are complex. Schools and teachers were selected through non-probability sampling. The researcher used methods that fit the definitions of convenience and purposeful sampling (Marshall,1996; DeCarlo, 2018), making deliberate choices to ensure participation from a range of schools in different settings. But once the schools and classes had been selected, then all students in each class were involved.

In relation to testing the CC Toolkit activity at Year 10 in the junior secondary cycle, students who reach that level have already passed a national examination at the end of Year 8, so that broadly speaking they are of similar academic ability, even though they vary in terms of family background, culture and gender. In that sense they constitute a uniform population regardless of the school they attend, since in my experience, the Vanuatu school system is relatively equitable. In 2020, there were 3,496 students in the whole of Vanuatu in Year 10 and 4,151 in Year 9. Of the 363 students participating in the CC Toolkit activity, 296 were at Year 9 or Year 10 level – approximately 8% of the average enrolment of 3,824 for Year 9/10. This may not have enough validity for generalising findings to the whole Year 9/10 student population of Vanuatu.

Completion of questionnaires by students and teachers in the senior secondary cycle involved a much smaller cohort (180 students and 12 teachers). As with the junior cycle students, classes were selected by non-probability sampling but the respondents can be considered as representing a random sample of all 5,228 students in Years 11-13. However, the number of participants for whom data has been obtained may not be sufficient to make valid generalisations.

Post-secondary students

The numbers of students involved were small enough to invite everyone to participate. Convenience sampling occurred in that only the willing responded.

3.4.3 Sampling for Traditional Ecological Knowledge (RQ2)

In addressing the extent to which traditional ecological knowledge and traditional values are relevant to climate and disaster resilience in Vanuatu, I identified two target populations. On one hand, there are "providers" – individuals, usually older people, who can call upon their inner store of memories, traditional ecological knowledge and values and share them with younger generations. Then there are the youthful recipients of such knowledge and wisdom, who will be known as "receivers". Of course, a provider has also been a receiver and is just one link in the long chain of transmission. In 2019, 3.6% of Vanuatu's population were aged 65 years and over (World Bank, 2019), equivalent to 10,796 persons. Some of these were providers, scattered in unknown locations throughout the archipelago and probably numbered in thousands. Thus it was impossible to interview them all, and a sample was selected. Likewise, sampling was also used with receivers, who could be of any age and were likely to outnumber the providers.

A qualitative methodology was appropriate for such respondents since it seeks in-depth answers to the "how" and "why" of a situation and assumes that behaviours change over time and are affected by context (Creswell, 2007; Yilmaz, 2013; Rahman, 2016). Purposeful, convenience and snowball sampling were used, with interviews conducted in different islands in order to research spatial variations. The semi-structured interviews were based on questionnaires QTK1 and QTK2.

For providers, all rural communities contain older people recognized as having a greater awareness of traditional environmental knowledge and/or traditional values, with many of them having the status of chief, elder or *"kleva"*[2], and it is these persons who constitute the desired target group. However, their identity as providers may only be knowable to insiders from that particular local community. I therefore drew upon my

[2] A Kleva is variously referred to as a traditional healer, specialist in the use of leaf medicine, medicine man, sorcerer or person will skills to deal with "black magic".

contacts at village level throughout the archipelago, and used the services of former students in Resilience courses at VIT who returned to their home communities in search of potential candidates to be interviewed in their own indigenous language. Sampling was purposeful in that a target cohort was identified and sought. It was convenience because the most accessible providers to the researcher and his assistants were interviewed. Snowball sampling was also used, in that once research assistants had identified one or two providers in their own home environments, they could ask them to suggest other suitable respondents.

Figure 3.3 Interviewing a provider of traditional knowledge from Unakap village, Nguna island, North Efate, Vanuatu. March 2020.

Author, 2020

For receivers, the initial plan was to find a person who had received traditional knowledge from a provider already interviewed, and ascertain just how much knowledge had been transmitted. When such people proved hard to find, I accepted the suggestion from my assistant at USP in Fiji to find ni-Vanuatu students who might be willing to be interviewed about their traditional knowledge. Initially, he carried out semi-structured interviews using QTK1 and QTK2, but then found that most respondents wanted to complete the questionnaires unaided. Thus sampling was by convenience, but also purposive in that a deliberate effort was made to find respondents from a variety of islands.

In all, 48 participants were interviewed in Vanuatu, and 74 in Fiji. Of the 122 respondents, 29 classified themselves as providers, 22 as receivers and 71 as both providers and receivers.

3.5 Data Collection

3.5.1 The Researcher and Research Assistants

I lived continuously in Vanuatu between 1971 and 2013 - a period of 42 years. During this time I worked for the Condominium Bureau of Statistics and was a teacher at primary, secondary and tertiary levels. I had the opportunity to travel extensively to and within almost all the 65 inhabited islands of the archipelago, often staying in villages and gaining an intimate knowledge of indigenous customs and social mores. Many of my former students from secondary school, the Vanuatu Institute of Teacher Education, the Vanuatu Institute of Technology and the USP's Emalus Campus occupy positions of authority and responsibility at national, provincial and local levels – teachers, school principals, government ministers and heads of government departments. I am totally fluent in the three official languages of Vanuatu – English, French and Bislama – and have rudimentary communication skills in four of Vanuatu's 106 indigenous languages[3]. My friendships and wide range of contacts have undoubtedly facilitated the collection of data for this research, and I am acknowledged as an 'insider" who has contributed to the overall development of Vanuatu as an independent nation.

My research assistants were all recruited by direct personal invitation, mostly between December 2019 and March 2020. They did not sign any contract, but assisted on a purely voluntary basis. They were required to read the Participant Information Sheet and complete the Participant Consent Form (Appendix B). After March 2020, when I left Vanuatu and could no longer return, I communicated with these assistants through email and texts, with quick messages about progress exchanged through social media. Completed questionnaires were scanned and returned as email attachments. Assistants collecting data on formal education were based in their schools or training institutions. Those collecting data on traditional knowledge had the latitude to work in locations of their choice, except for the one based at USP in Fiji.

The research assistants fall into six categories. All in the first four categories were my former students, as were half of those in category 5.

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[3] Lynch and Crowley (2001, p. 4) estimate the number of indigenous languages in Vanuatu to be 106, of which 81 are "living languages still actively spoken".

1. Those who were among the cohort that completed the first-ever accredited TVET courses in Resilience at VIT in 2017 and 2018 – Certificate I in Climate Change and Disaster Risk Reduction, and Certificate III in Resilience. Aged between 21 and 30, they had an understanding of all key aspects of climate change and disaster risk reduction, as well as skills in interviewing people at community level in relation to traditional knowledge. Two volunteers from this group, as well as one of the Assistant Trainers involved, conducted interviews on the transmission of traditional knowledge and values on the islands of Santo and Ambae.
2. Three former teacher trainees at VITE who agreed to interview providers and receivers of traditional knowledge on the islands of Pentecost, Epi and Tanna.
3. A doctoral candidate at the University of the South Pacific (USP) who offered to conduct a survey among ni-Vanuatu undergraduates currently studying at the main USP Campus in Suva, Fiji, in order to assess their awareness of traditional knowledge and values. Eight of the 74 volunteers were interviewed face-to-face using QTK1 and QTK2, while the remainder asked to complete these two questionnaires by themselves.
4. Teachers of Social Science (9) and Basic Science (1) in the junior secondary cycle of education, and of English (1), Geography (1) and Earth Science (2) in the senior secondary cycle of education, who agreed to conduct the Climate Change Toolkit activity with all students in their classes. All these teachers had previously learnt about climate change with myself, either at VITE or USP or during an initial training session on the Toolkit.
5. Teachers of Earth Science (5), Development Studies (4) and Geography (3) in seven senior secondary schools. They accepted my email invitations requesting that they and their students participate in surveys towards the end of 2021.
6. A mature English female teacher, married to a ni-Vanuatu resident of North Efate and living there for four decades, who agreed to work with a family member to conduct interviews on traditional knowledge in her village.

3.5.2 Data Collection Tools – General

Each of the two research questions required quantitative and qualitative methodologies, using data collection tools such as questionnaires, semi-structured interviews, on-line communication and document search (Table 3.6).

Table 3.6 Research questions by variables of interest, data collection tools and forms of analysis

Research question	Variables of interest	Data collection tools	Analysis
How effective is formal education on climate and disaster resilience in Vanuatu in terms of knowledge and skills gained, changes in attitude and behaviour and impacts on individuals and their communities?	• Age/level e.g. Year 9,10, 11,12, TVET, degree • Language of instruction • Location (urban/rural) • Gender (male/female) • Relative importance of teacher, student and pedagogy/course • Effectiveness of the CC Toolkit (16 pictures) • Erosion of knowledge, skills, etc. over time • Content of syllabi on resilience compared to official policies • Proportion of students experiencing resilience education	• Questionnaires for students and teachers • Structured and semi-structured email interviews with participants (teachers, students, MOET staff) • Messages, texts and online chats • Document search	• Quantitative analysis, using SPSS to check validity of changes in knowledge, skills, attitudes, and behaviour • Qualitative analysis • Triangul-ation of data
To what extent are traditional knowledge and values relevant to climate and disaster resilience in Vanuatu?	• Methods of transmission of TK/TEK • Types of TK transmitted • Values transmitted • Variation according to age and island • Effect of TK/TEK on resilience of communities	• Semi-structured interviews with TK providers and receivers • Questionnaires • Documents from respondents	• Qualitative analysis • Quantitative analysis based on themes

3.5.3 Questionnaires

A questionnaire is a form containing a series of written questions that appear in a logical order and are to be answered by the respondent. The form is either sent or manually given to the respondent, who is supposed to read, comprehend and indicate his/her responses in the spaces provided (Key Differences, 2018).

Questionnaires provide a cost-effective and reliable means for gathering both quantitative and qualitative information (McClelland, 1994). If quantitative data is collected, statistical analysis becomes possible (Kuter & Yilmaz, 2001), especially when questions are closed rather than open-ended. To be effective, questionnaires must be pilot-tested with a small number of participants prior to conducting the actual research – a process that helps the researcher to see whether participants understand the meaning of the questions in the way that he/she does, and then make the necessary adjustments (Phellas et al, 2011; Kuter & Yilmaz, 2001).

Research Question 1

For this question, which examines the effectiveness of a formal resilience course on students, two advantages of using questionnaires are that they can be used in geographically dispersed schools and preserve the anonymity of respondents. Disadvantages are that the language of the questionnaire may not be fully understood, the time allocated for its completion may be too short, leading to false or thoughtless answers, and student responses may be influenced by the presence of the teacher. Also, it will not be possible to ask a respondent why an answer has been given.

Most self-completed questionnaires for Research Question 1 rely on a five-point Likert scale in which the individual expresses the extent of his/her agreement with each statement on a continuum ranging from strongly disagree to strongly agree (Mcleod, 2019). Such statements cover knowledge, skills, attitudes and behaviour. The questionnaires appear in Appendix A, but a summary is given in Table 3.7.

Table 3.7 Questionnaires for measuring the effectiveness of formal educational courses on climate and disaster resilience

Code & language*	Purpose	Description	Completed by
QC1 (E,F)	Course characteristics	Aspects of resilience education promoted (pedagogy, knowledge, skills, attitudes and behaviour)	Teachers or course designers
QC2 (E,F)	Teaching and learning techniques	Teaching, learning and evaluation techniques used (Likert scale)	
QS1 (E,F,B)	Materials and delivery	Evaluation of teacher, course & lesson delivery (Likert scale)	Students or course participants
QS2 (E,F)	Student/participant characteristics	Achievement, motivation, academic level, fees, learning style (Likert scale)	
QS3 (E,F)	Comparison of factors	Pair-wise comparison: importance of course, student and teacher	
QS4 (E,F)	Changes in domains of learning through CCDRR courses	Changes in knowledge, skills, attitudes and behaviour through CCDRR courses (Likert scale)	
QS5 (E,F,B)	Changes in domains of learning through DRR courses	Changes in knowledge, skills, attitudes and behaviour through DRR courses (Likert scale)	
QS6 (E,F)	Effectiveness of CC Toolkit activity	Diagnostic questions asked before and after the CC Toolkit activity (part Likert)	Students (Yrs 9,10,11)

* QC = Questionnaire on the course, for completion by teacher/course designer
QS = Questionnaire to be completed by the student/participant in the course
Language of the questionnaire: E = English F = French B = Bislama

QC1 and QC2 are intended for teachers, facilitators or course designers, but could also be completed by post-secondary students if no teacher is available. In QC1, the respondent records his/her perception of aspects of resilience education promoted by the course – overall attitudes, pedagogy, knowledge, skills, attitudes and behaviour. The 42 aspects are those identified in my model of a proposed educational programme on resilience (Figure 2.14). The respondent indicates whether each aspect is of high, low, or of no importance, or whether he/she doesn't know. Responses can be in English or French, the official languages of education. Following experience in the field, clarification of three aspects is provided at the base of the form.

QC2 asks teachers or facilitators about the teaching, learning and evaluation techniques they are using in their classes, and their approaches to evaluation – for example class exercises, reflection, homework and measuring oral contributions. This is in order to further elaborate on aspects of pedagogy that are mentioned in QC1 and to gauge the extent to which learning is student-centred. Each aspect is assessed on a five-point Likert scale that measures frequency of use, from "never" to "always".

Questionnaires QS1, 2, 3, 4 and 6 are provided in both English and French because at secondary level, these are the languages spoken in the classroom, and teachers expect students to respond in one of them.

QS1 seeks feedback from the student about important factors influencing learning in resilience courses – qualities of the teacher, materials used, course delivery, and changes to the student's knowledge, skills, attitudes and behaviour. There are 30 statements to be assessed on a five-point Likert scale that extends from "strongly agree" to "strongly disagree", as well as three additional questions requiring longer answers.

QS2 focuses on characteristics of the student him/herself. Statements about the student's own sense of progress, motivation, and academic level are mostly assessed on a five-point Likert scale measuring intensity of agreement/disagreement. There are two further questions on course fees and learning styles in which the student selects relevant responses. This questionnaire enables a student to analyse influences on learning that originate within the individual.

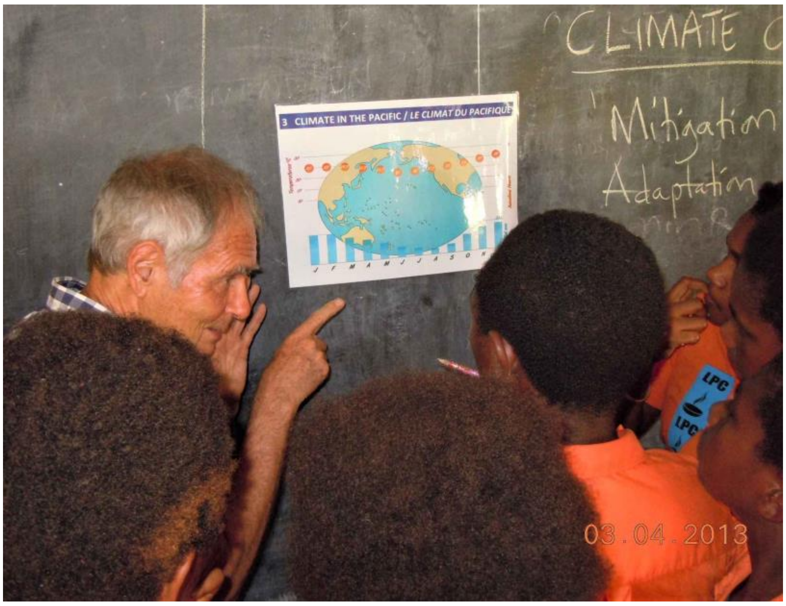
QS3 invites a student to indicate the relative importance of three factors in helping him/her to learn about resilience – the teacher/facilitator, the student and the course. The questionnaire is based on the analytical hierarchy process, whereby pair-wise comparisons are made between the three factors or criteria. A student is given information about the characteristics or sub-criteria associated with each factor, and instructions on how to compare each pair of factors. The questionnaire also asks the respondent about their preferred learning style - visual, aural, verbal or physical.

QS4 investigates whether a particular course or programme in climate change and disaster risk reduction effects a change in participants' knowledge, skills, attitudes and behaviour. Similar questionnaires were used by Salter (2013), Fletcher et al (2014), Erzt & Sarigöllü (2019) and Mamon et al (2017). A five-point Likert scale measures the extent to which a respondent agrees with statements covering knowledge, skills and attitudes, while behaviour is measured on another five-point Likert scale based on the frequency of the respondent's pro-environmental actions. As with other QS questionnaires, the personal details at the top of the form enable analysis by institution, language, gender and academic year. Where possible, this form is given to students at the start of a course and then again at its end.

QS5 was designed for use with non-formal courses on disaster risk reduction at community level, and is therefore written in Bislama. Because it proved impossible to research such courses, it was not used.

QS6 measures the impact of a teaching and learning intervention based upon the CC Toolkit. Students in Year 9 or 10 are asked to participate in a discovery learning activity that involves visiting each picture in pairs or small groups and answering the questions linked to that picture. These questions (QS7 in large format and QS8 in small format) were originally created by myself when testing the Toolkit with Year 10 students during 2013 (Figure 3.4), and had been refined as a result of field experience. Thus they had been pilot-tested and shown to elicit valid responses. These prior experiences with the Toolkit inform its use in my current research (Figure 3.5).

Figure 3.4 **Trialling the CC Toolkit at a secondary school on Tanna, April 2013**



Author, 2013

Figure 3.5 Year 10 students at Acacia Secondary School studying picture 2 of the CC Toolkit, September 2020.

Social Science teacher, 2020

QS6 was designed to diagnose students' knowledge, skills, attitudes and behaviour in relation to climate change before undertaking the CC Toolkit activity and then again after completing the task and discussing answers with their teacher.   In the first section of the form, the respondent gives an opinion on 20 statements about climate change that cover knowledge, skills and attitudes using a three-point Likert scale ("agree", "disagree" and "don't know"). The second section consists of 6 short answer questions on knowledge and one on behaviour. The "before" and "after" QS6 forms completed by each student are those used to evaluate the effectiveness of the Toolkit resource, and not the answers to QS7/8, which remain in the school.

Figure 3.6 Year 10 students at Pandanus Junior Secondary School, complete the "after" questionnaire for a second time in February 2021, 11 months after the intervention

Social Science teacher, 2021

Although the original plan was to only carry out the Toolkit activity with Year 10 students, some teachers asked to do it with their Year 9 or Year 11 classes, and this was accepted as it would enable comparisons to be made across academic levels. QS6 has therefore been completed by students at all three Year levels.

Research Question 2

This question examines the relevance of traditional knowledge to climate and disaster resilience. A series of open-ended questions for use in a semi-structured interview situation were designed by myself and refined in the light of pilot-testing and consultation with research assistants between December 2019 and March 2020. Each question written in Bislama and English on forms QTK1 (for providers) and QTK2 (for receivers) was to be asked in the same way, so that the form became a de facto questionnaire (Appendix A10/11). The aim was to ensure a uniformity of approach, but the interviewer could vary question order as the conversation unfolded, as explained in 3.5.3. Answers were to be written down on the form by the interviewer, not recorded nor video-taped.

While this procedure was followed for interviews in Vanuatu, it did not work in Fiji. Most of the ni-Vanuatu students at USP who volunteered to share their awareness of traditional knowledge preferred to treat the interview forms as self-completed questionnaires. Of the 74 respondents, 66 completed both QTK1 and QTK2, and this proved advantageous in that more data was obtained than if just one questionnaire had been answered. Otherwise, it was not apparent that there had been any misinterpretation of questions.

3.5.4 Structured and Semi-Structured Interviews

An interview is a method of data collection that involves a direct conversation between interviewer and respondent. It is generally applicable to qualitative research, but can also be used as a quantitative tool, especially if questions are closed (McCleod, 2014). According to Rowley (2012, p.261), the interview is a face-to-face verbal exchange in which the interviewer attempts to acquire information from, and obtain an understanding of, another person, hoping to gain 'insights into opinions, attitudes, experiences, processes, behaviour or predictions'.

For Research Question 1, interviews were to be conducted with teachers as a follow-up to the quantitative data obtained from student questionnaires QS1-QS6, seeking explanations of the patterns observed. For Research Question 2, interviews were essential to explore the extent of respondents' consciousness of traditional knowledge, skills, values and transmission pathways, enabling the collection of qualitative data necessary for 'understanding experience, opinions, attitudes, values and processes' (Rowley, 2012, p.262) related to resilience.

For my research, the semi-structured interview was most appropriate. There were specific questions to be posed, rather than asking the respondent to talk freely about one or two themes, as in an unstructured interview. Neither did I want a rigid set of questions that would be asked in the same way in a set order, as in a structured interview. Rather, for both Research Questions I preferred a few pre-planned standard questions, all of them open-ended, with the interviewer having flexibility to pursue a free-flowing format and adapt question order to accommodate the interviewee (ibid, p. 262) – as in a semi-structured interview. The advantage is that the open-ended questions allow an interviewer to probe and perhaps search for reasons. A potential disadvantage, inherent in any form of interview, is that responses may be influenced by the characteristics of the interviewer (Phellas et al, 2011).

One unanticipated factor in conducting interviews was the COVID-19 pandemic, which prevented my return to Vanuatu for almost the entire three year period of research. Denied the possibility of direct face-to-face contact, I had to rely on the efforts of teachers and other research assistants in data collection, conducting interviews with them by email, texts and social media in order to clarify individual responses or general patterns and trends observed. Such interviews usually followed the semi-structured model in that I had specific questions or issues to be resolved.

Interviews on traditional knowledge and values

As explained in 3.5.2, questions for providers and recipients of traditional knowledge were written down on forms QTK1 and QTK2 for use in semi-structured interviews in the field. A set of detailed instructions was compiled to guide all interviewers, based upon my own experiences in trialling the questions. One set was for providers and the other for receivers, and in each case, the exact wording in Bislama was provided to explain to the respondent why his/her participation was being sought (Appendix A12-15). Those serving as research assistants – my former students – were given face-to-face training in how to approach potential respondents and ask the questions on the two forms, and this same guidance is summarized in the instruction documents. These training sessions drew upon the local knowledge and wisdom of the assistants. For example, question 8 in both QTK1 and QTK2 was added as a consequence of such discussion, and has elicited much valuable information.

Tables 3.8 and 3.9 summarize the reasons for asking each question in QTK1/QTK2.

Table 3.8 Questions for TK providers and why they are asked

Question	Justification for asking the question
1	To determine the respondent's awareness of traditional signs of an approaching disaster, e.g. unusual movements of animals, cloud formations, flowering and fruiting times of certain plants.
2	To determine the respondent's awareness of traditional ways in which people have prepared for disasters in the past, e.g. through food preservation, house design, specific methods of agriculture or fishing, full-community planning.
3	To find out if the respondent keeps this information to himself/herself or whether it is transmitted to others. If so, to whom is it passed and when?
4	To find out whether the traditional knowledge (TK) is passed by talking, or by demonstrating certain techniques, or both.
5	To ask the respondent to state the last time he transmitted his TK to another person, and to whom, thereby helping to clarify transmission pathways.
6	To determine whether the transmission pathway is following the customary way, or whether it follows the provider's own preferences. For example, is the transmission from father to first-born son, or mother to first-born daughter?
7	To find out if and why the transmission of TK has changed, assessing factors that are preventing TK from being passed to others as it was done in the past.
8	To see whether there are any traditional values that help people in the community to become more resilient to disasters, e.g. unity, care for others, sharing of resources.

Table 3.9 Questions for TK receivers and why they are asked

Question	Justification for asking the question
1	To ask the respondent to name the person from whom he/she received the TK, and then confirm this by answering "yes". The purpose is to obtain information about transmission pathways.
2	To confirm that the person named in Question 1 transmitted traditional knowledge about being resilient to disasters and climate change.
3	To find out what specific information was received about weather, climate and resilience to disasters and climate change. This data is to be listed, and if possible to be classified into three groups – knowledge, skills and attitudes.
4	To determine the method of transmission - whether by talking (as with knowledge and attitudes) or by demonstration (as with skills), or both.
5	To check whether the recipient of TK has actually made use of such knowledge, and to give specific examples of what and when.
6	To determine whether the transmission pathway is following the customary way, or whether it follows the provider's own preferences. For example, is the transmission from father to first-born son, or mother to first-born daughter?
7	To assess how much knowledge the recipient remembers receiving from the provider - everything, quite a lot, a little, or none (all forgotten).
8	To assess how many skills the recipient remembers receiving from the provider - all of them, quite a lot, a few, or none (all forgotten).
9	To find out whether traditional advice, skills or knowledge are repeatedly transmitted to the same person, or just once. It is an attempt to measure the effectiveness of the transmission.

The method of conducting these interviews initially conformed to the structured model, with a pre-determined set of questions posed by the interviewer in Bislama in a set order. In that sense, the form containing the questions could also be used as a questionnaire if the respondent was literate and preferred to answer the questions by him/herself. But in practice, most interviewers found that older, often illiterate, respondents needed prompting to give more specific details, and sometimes gave answers that referred to other questions on the form, so that the standard sequence was not always followed. Also, many research assistants translated the questions into the local language in order to clarify meaning. In other words, there was a degree of flexibility that is more characteristic of a semi-structured interview technique. Fig. 3.7 provides an example of a questionnaire for providers completed during an interview between myself and a male resident with chiefly status from a village on the island of Nguna, North Efate.

Figure 3.7 Example of a questionnaire for providers completed by one respondent

QTK 1 Age group 50-59

Questions to be asked of a provider of traditional knowledge

NAME: (Name removed) VILLAGE: Rewoka ISLAND: Nguna
INTERVIEWER: Charles Pierce DATE: 2nd March 2020

1. **Wanem samfala saen we i soem se weta/klaemet i stap jenis o wan disasta i stap kam (saeklon, drae taem, etkwek, tsunami, volkeno...) ?**
What are some signs that show that our weather or climate is changing or that a disaster is coming (cyclone, drought, earthquake, tsunami, volcanic eruption)
   - Hornets build nest on ground = hurricane D
   - Flowers of nakatambol, nawele, namambe trees are plentiful = hurricane B
   - New shoots of bananas do not open, but hanging down = hurr. C
   - Sky turns red after sunset = hurr. A
   - Alignment of clouds — long clouds with 3-forks
2. **Yu save eni kastom fasin blo stanap strong lo fes blo ol disasta we i kamaot (saeklon, drae taem, etkwek, tsunami) ?**
Do you know of any traditional ways of being resilient to disasters such as cyclones, droughts, earthquakes, tsunamis, volcanic eruptions?
   - House design — wild cane, bamboo strapped
   - Preservation of taro — dig up then bury roots; also strong yams
   - Harvesting of sweet wild yam in the bush.
3. **Ol save ia yu holem yu wan o yu stap pasem? Mo yu pasem lo huia?**
Do you hold on to your traditional knowledge about weather and climate, or do you pass it on to others? If so, to whom?
I share it with others in the nakamal
The only thing I share only with my son is my chiefly title
4. **Hao nao yu stap pasem?**
How do you pass on such knowledge?
Conversation (toktok)
5. **Yu save givim wan eksampol blo las taem we yu bin pasem savo ia, mo lo hu?**
Can you give an example of the last time when you transmitted this traditional knowledge, and to whom?
Gelone Pan (2019)
6. **Long kastom blo yu, yu sud pasem ol tradisonal save blo yu lo huia? Fasbon boe blo yu, ol pikinini blo yu, bubu blo yu, o hu?**
According to your custom, to whom should you transmit your traditional knowledge? Your first-born son, your children, your grandchildren or who?
To all my children
To spokesman of chief ("Tosingan") who shares with everyone
7. **Tedei, fasin we yu stap pasem save blo yu lo narafala man i stap jenis, o no?**
These days, are there any changes in the way that you are transmitting your knowledge to others?
It is changing. For example, I encourage people to build strong houses rather than wild cane.
No changes in env. — done in the same way as in past
8. **Wanem nao ol impotan valiu lo kastom we mekem se wan komuniti i save kam risilient (stanap strong) lo fes blo wan disasta?**
What are some important traditional values that make a community more resilient in the face of a disaster
   - Working together

In that interview (Figure 3.7), the entire conversation was conducted in Bislama, but answers were written down on QTK1 in English by the interviewer. Letters A, B, C and D were added during coding. The respondent was easily able to answer questions 1 and 2, with little prompting. Answers to questions 3 and 6 were slightly conflicting, but accepted as stated. Information requested in question 5 was incomplete. Questions 7 and 8 are open-ended questions to which a respondent is encouraged to respond freely, and in the case of question 7, the first answer was unexpected. Figure 3.7 shows the initial version of QTK1. Further amendments were made as a result of experience (Appendix A10).

In addition to these interviews based on QTK1 and QTK2, semi-structured email interviews on the importance of traditional knowledge for resilience were conducted with a research assistant living in West Coast Santo, the senior research officer in Vanuatu's NDMO, and the first graduates to complete courses in Resilience at VIT in 2018 (Figure 6.12)

Interviews related to formal education on resilience
Semi-structured interviews through emails, texts, messages and on-line chats were conducted with individual teachers in relation to Research Question 1. In most cases, I asked for updates on tasks completed. Also, when anomalies had been observed in the quantitative data, a teacher was asked to suggest why this had happened – for example when senior secondary students in a school said that they had conducted awareness talks on climate change in a local community, whereas their teacher denied this. These exchanges with teachers were nearly always in written rather than in oral form, with statements that could be used as evidence.

Another example is when I reached out to 13 teachers of classes that had undertaken the CC Toolkit activity, seeking their opinions on how their students had coped with the activity, whether there had been small group discussion, questions that had caused difficulty, and their views on the Toolkit's usefulness.

Requests for information were sent via email to officers in Vanuatu's Department of Education, including the Head of the Curriculum Development Unit and the Deputy

Principal Academic of Nagavika College, in order to collect statistics on national curricula, school enrolments and subject choices.

3.5.5 Document Search and Analysis

In order to assess the relationship between official policies on resilience and the content of formal resilience education courses at secondary and post-secondary level (for Research Question 1), three sets of documents were required: those containing policies at international, regional and national level; those providing details of educational curricula on resilience at primary, secondary and tertiary levels; and statistics on student enrolment by year level.

To search for policy documents, I used on-line sources, entering key words such as resilience, UNFCC, COP 2015, Paris Committee on Capacity-Building, Sendai Framework, UN Office for DRR, Framework for Resilient Development in the Pacific, Vanuatu Climate Change and Disaster Risk Reduction Policy, Vanuatu 2020: the People's Plan, Vanuatu Ministry of Climate Change, 2030 Agenda for Sustainable Development, Vanuatu Education Statistics, and Vanuatu National Curriculum Statement. During initial visits to Vanuatu, I collected hard copies of national syllabi for Primary 4-6 and senior cycle Earth Science, Development Studies and Geography, and Teacher's Guides for Primary 5 Science and Social Science. Appendix C provides a full list of these documents.

3.6 External Factors Affecting Research: the COVID-19 Pandemic and Cyclone Harold

No account of methodology would be complete without discussion of the myriad ways in which this research has been impacted by the COVID-19 pandemic and Tropical Cyclone (TC) Harold.

The virus responsible for the pandemic is "severe acute respiratory syndrome coronavirus 2", or SARS-CoV-2 (CMOS, 2021), while the disease it produces is COVID-19 or "coronavirus disease 2019". On 9th January 2020, the World Health Organisation announced that an outbreak of acute respiratory infections in Wuhan had been reported by the Chinese authorities as caused by a "novel coronavirus". On 11th March 2020, WHO made the assessment that COVID-19 could be characterized as a pandemic, and called on countries to take urgent and aggressive action (WHO, 2020). Impacts on international travel were immediate. On 18th March 2020, after conducting field research, I caught one of the last flights out of Port Vila to Australia before all air travel was suspended in and out of Vanuatu. I was unable to return until July 2022.

The Vanuatu Government announced a State of Emergency (SOE) in response to the COVID-19 pandemic on 26th March 2020 (Kenni & Wijewickrama, 2020), with the imposition of travel restrictions and measures such as social distancing and school closures. On 4th April, just nine days later, the provinces of SANMA, PENAMA and MALAMPA were ravaged by TC Harold, a situation that greatly exacerbated the SOE in those areas. Initially the SOE was to last until 31st July, but was extended until 31st December 2020.

Because of these stringent measures, Vanuatu remained COVID-free for two years, until March 2022, when the Omicron variant entered the country and community transmission began. Immediate steps taken to restrict transmission included a ban on all inter-island travel, mandatory mask wearing, lock-downs, school closures and even a night-time curfew in Port Vila and Luganville. Schools re-opened in May 2022.

Impacts of these factors on my research relate to methods of data collection, participant responses, and changes in research questions.

3.6.1 Impact on Methods of Data Collection

My physical absence from Vanuatu meant that I could not conduct further fieldwork in person, and this affected data collection for all three modes of resilience education – formal, non-formal and informal – in varying ways.

In formal education, teachers' collection of data on the use of the CC Toolkit at junior secondary level had been set in motion in six schools, and could continue. However, this process could not be monitored through face-to-face consultations; instead, encouragement had to be offered through emails, messages, texts and the occasional phone call, and responses were often slow. Contact with teachers in the senior cycle of secondary education to ask that they and their students complete questionnaires on course evaluation proved challenging. At post-secondary level, monitoring of progress in resilience courses at the Vanuatu Institute of Technology was sustained through virtual means, with questionnaires completed by teachers and students. On-line communication with lecturers and students taking higher level courses on resilience at university level was established, but few student responses were forthcoming and only limited data could be obtained.

For non-formal education, a successful start had been made to the collection of field data during February-March 2020. But when the SOE was declared on 26th March, NGOs shifted their priorities to fostering preventative measures for coronavirus, then to response and recovery from category 5 TC Harold. For me to have actively pursued NGOs to gather data using the questionnaires already left in their hands would have been insensitive: no further information was obtained.

Collection of data on resilience education through informal means – the transmission of traditional knowledge – proceeded in a somewhat erratic manner after mid-March 2020. Six research assistants, already in their home villages when Vanuatu's SOE was announced, were able to interview providers and receivers of traditional knowledge as planned. Others, based in Port Vila, were unable to return to their home islands for many months because of travel restrictions imposed by the pandemic, and, with the exception of one assistant who used her telephone, did not conduct their interviews. I could not pursue direct interviews with respondents, but managed to contact another two suitable assistants and encourage them to interview people in their own villages on my behalf.

One challenge faced after March 2020 was how to receive completed questionnaires from teachers and research assistants. Initially, a trusted friend removed the documents from my Post Office box in Port Vila, scanned and forwarded them to me as email attachments. Over time, however, teachers and assistants found ways of scanning and sending questionnaires directly to me via email.

3.6.2 Impact on Participant Responses

An immediate impact of the overlapping COVID-19 and TC Harold emergencies on participant responses was seen in the CC Toolkit activity for Year 10 students. Only one teacher managed to get her students to carry out the activity and then complete both "before" and "after" questionnaires before the SOE was announced and all 1,453 schools closed down until permitted to resume in June 2020 (UNESCO, 2020). One teacher on Malekula reported that his students were literally in the middle of the Toolkit intervention when his school was struck by Cyclone Harold on 6th April: those students never finished the activity and no questionnaires were ever submitted. Two teachers arranged for their students to answer the "before" questionnaire and carry out the activity before the SOE, but then had to wait four months until the "after" questionnaire could be completed. All other teachers waited until July or later to carry out the activity and ask their students to complete questionnaires. Several teachers sent messages to explain how school closures had affected student performance in the CC Toolkit activity during the SOE. In an atmosphere of fear and uncertainty, and with parents unsure of the wisdom of their children returning to class, many schools reported erratic attendance. Witness this example from Hibiscus College from a teacher responsible for four classes:

> Regarding student absences from each of my Year 10 classes, some pupils were absent when I distributed the "before" questionnaires, while others were absent for the "after" questionnaire. You will see that some responses to the "after" questionnaire are very different because students were not in class when we studied the pictures and carried out the activity that I had prepared.
>
> (Social Science teacher, personal communication, 23rd September 2021, translated from the French)

As a result of the absences in this school, 98 students completed the "consent" form, 77 the "before" questionnaire, and 81 the "after" questionnaire. Those who completed both "before" and "after" totalled 59, so it was only for those students that questionnaires were analysed.

Other teachers reported that when students did return to face-to-face classes, pressures of catching up with the syllabus and completing internal assessments meant that either the CC Toolkit activity was put on hold or implemented over a short time-frame, causing students to rush and not give enough reflective thought. In at least three schools, photocopying of questionnaires was prohibited because of school policies or mechanical breakdowns: thus the teacher had to use creative measures for questionnaire completion – in one case asking all students to do the entire activity and form completion individually using the Moodle on-line learning platform.

Regarding participant responses to other lines of research in formal educational settings, the COVID-19 pandemic had a variable effect. Teachers and senior secondary students from just 20 classes in seven schools completed questionnaires; the remainder did not respond, either because they had not gained enough immersion in courses or because of giving priority to other end-of-year tasks. Those at the Vanuatu Institute of Technology were able to adjust more readily to studying on-line during the lack of face-to-face teaching, and completed the required forms. Responses from university students were disappointing, perhaps because while studying on-line they did not benefit from personal contact with course coordinators.

For informal education, interviews have continued throughout the SOE, and there do not appear to have been any negative impacts on participant responses.

3.6.3 Impact on Research Questions

In May 2021, it became apparent that some 20 months into this research project, the on-going COVID-19 pandemic negated the likelihood of my return to Vanuatu to collect further data on the effectiveness of non-formal education on resilience. On the other hand, a considerable volume of data had already been gathered on formal courses and programmes, on policies and frameworks on resilience, and on the informal transmission of traditional knowledge; furthermore, additional data on these aspects would still be obtainable through existing contacts and pathways, as well as from on-line sources, even if first-hand fieldwork by the author might be impossible for the duration of the research.

Accordingly, I decided to amend the original research questions that had given direction to this research (Table 3.10). The main change was to remove the original research question 4 on the effectiveness of non-formal, community-based education on DRR and CCA and to give greater focus to evaluating the effectiveness of formal educational channels. Also removed would be research question 1, since details could be absorbed within the Introduction, and question 2 on the significance of funding agencies in the promotion of education on resilience. Finally, research question 5 on traditional knowledge would be amended to reflect a more pragmatic approach to its usefulness.

The major part of my research has been on RQ1, the effectiveness of formal education on climate and disaster resilience, and will be covered at three levels of education in Chapters 4, 5 and 6. RQ2 will be encompassed in Chapter 7.

Table 3.10 Original and revised research questions

	Original research questions		Revised research questions
1.	How is education on resilience being carried out in Vanuatu?	Included in the Introduction (Chapter 1 of thesis)	
2.	How significant are funding agencies in the promotion of education on resilience, and what are these agencies looking for in order to provide funds?	1.	How effective is formal education on climate and disaster resilience in Vanuatu in terms of knowledge gained, changes in attitude and behaviour and impacts on individuals and their communities?
3.	How effective is formal education on DRR and CCA in Vanuatu in terms of knowledge gained, changes in attitude and behaviour and impacts on individuals and their communities?	2.	To what extent are traditional knowledge and values relevant to climate and disaster resilience in Vanuatu?
4.	How effective is public, community-based education on DRR and CCA in Vanuatu in terms of knowledge gained, changes in attitude and behaviour and impacts on the community?		
5.	How effective is traditional education on DRR and environmental change in Vanuatu in terms of knowledge gained, changes in attitude and behaviour and impacts on the individual and community?		

3.7 Data Analysis

3.7.1 Relevant Literature

Research on aspects of resilience education involving qualitative and quantitative data generally indicates the methods of data analysis used (e.g. Salter, 2013; Fletcher et al, 2015; Scott-Parker & Kumar, 2018; Bernhardsdottir et al, 2015; Mamon et al, 2017; Keles et al, 2016; Tuladhar et al, 2014; Apronti et al, 2015; Ertz & Sargöllü, 2019). Such methods are relevant to my thesis – for example, using SPSS to determine the validity of quantitative data for Research Question 1. For Research Question 2, the six steps proposed by Creswell (2007) for analysing qualitative data – data managing, reading and code creation, describing, classifying, interpreting, representing / visualising – can be applied to information and opinions on traditional knowledge.

Also relevant are examples of the analytical hierarchy process (AHP), particularly in relation to education (e.g. Badri et al, 2016; Ahmad & Hussain, 2017). Most pertinent is the paper by Thanassoulis et al (2017), who used the AHP to measure students' assessments of the relative importance of course and teacher: teachers were analysed according to preparation, professionalism, attendance and supporting material, while course was analysed by interest and usefulness. This approach has been adapted for my evaluation of formal resilience education in Vanuatu, but with learner characteristics added to the other two criteria, since students' motivation, academic level and ability to pay fees could impact on their performance in the course.

3.7.2 Research Question 1

Quantitative data from surveys on the impact of the CC Toolkit on junior secondary students, and on the effectiveness of courses on climate and disaster resilience at senior secondary and post-secondary levels was collated, coded and tabulated. Totals, percentages and means were calculated, enabling comparisons across courses and over time. IBM's Statistical Package for the Social Sciences (SPSS) was used to determine the statistical significance of differences between mean scores of two different groups. For example, to compare the average scores for all 27 questions for all 363 students before and the CC Toolkit intervention, I created a data set showing the scores for each question before and after. Then I went to "Compare Means" in the "Analyse" facility, selected "Paired Sample T-Test", entered the two variables, ensured that "Standard deviation of the difference" was selected, then asked the software to effect the calculation. For a 95% confidence level, a significant difference between two means would be demonstrated by a 2-tailed significance (p-value) of less than 0.05, by a t-value exceeding the critical value (cv) of 2.056, and by the range between lower and upper limits of the 95% confidence interval not crossing 0.

For the process of coding, an example relates to longer answers required for questions 21-27 in the "before/after" questionnaire for the CC Toolkit activity. Strictly speaking, this was not coding, but rather the application of level descriptors to student answers. Each response was judged according to four levels of understanding – accurate/high (5 points), satisfactory (3 points), limited (1 point) and none/irrelevant (0 points). In rare cases that did not fit the criteria for each level, a score of 4 or 2 could be given. These level descriptors served as criteria for assessment. The only person to carry out this assessment was myself, so that variations that might have occurred with two or more markers were avoided. Table 3.11 is an example of how these assessment criteria were applied to answers to one question from one school:

Table 3.11 Assessment of responses from one school to CC Toolkit Q 24 ("after" form)

Q.	Level descriptors	Application of level descriptors to student responses
24.	What causes ocean acidification? **5: Accurate explanation of the process involved** (e.g. absorption of more and more CO_2 by the oceans; oceans acting as carbon sinks; absorption of CO_2 by oceans causes weak carbonic acid; increase of CO_2 in the oceans, which lowers pH value) **3: Satisfactory level of understanding of the processes involved** (e.g. carbon dioxide is absorbed by the oceans) **1: Limited level of understanding** (e.g. carbon dioxide; carbonic acid; methane, ozone, CO_2; warmer temperatures; pollution by oil/fuel/chemicals/sewage) **0**: Irrelevant, unclear, don't know TOTAL SCORE: 23 AV. SCORE: 23 ÷ 32 = 0.72	• No answer (1,1,1,1) 0 • Earthquakes or droughts 0 • Warmer temperatures / When it is too warm coral reefs break down 1 • Cutting off trees along the sea coast 0 • Pollution / pollution made by humans (1,1) 0 • Humans throwing rubbish to the land 0 • Polluting on the sea 0 • Using chemicals for fishing & littering the ocean with rubbish 1 • Coral reefs being destroyed 0 • Dumping oil in the ocean / spillage of ship's oil into the sea (1,1,1,1) 1 • Climate change, pollution 0 • Too much CO_2 in the ocean and pollution being disposed into the ocean, corals dying 3 • Dumping toxic liquid into the ocean 1 • Caused by chemicals and rubbish that's dumped into the ocean, so the sea becomes more acidic 1 • Oceans only need a small amount of CO_2 and also warmer temperatures 2 • Throwing poisonous gases or things into the sea 0 • High temperature or sea floods 1 • When we produce a lot of bad gases and is absorbed by the ocean but it contains a lot of carbon dioxide 3 • When coral reef die because of too much CO_2 and pollution 1 • Pollution from the factory goes up in the clouds and the rain goes through it and becomes polluted 0 • Farmers apply fertilizers on their crops then rain washes them to the sea 1 • When chemicals are released into the ocean or ocean temperature rises 1 • We throw rubbish in the ocean & create CO_2 that kills sea creatures 1 • When we poison our ocean with plastic or poisonous liquid 1

Quantitative data for Research Question 1 was supplemented by qualitative data obtained through interviews with teachers and students, mainly to investigate reasons for patterns observed. In this sense, a degree of triangulation has been attempted (see Section 3.8.4).

3.7.3 Research Question 2

Data on the transmission of traditional knowledge was gathered through qualitative methods, using semi-structured interviews based on questionnaires. I judge that although a group of ni-Vanuatu students in Fiji completed the questionnaires by themselves, the information can still be considered as qualitative since most questions were open-ended and elicited subjective responses.

Coding of responses on traditional knowledge arose out of the information provided by interviewees. This contrasts with the application of level descriptors to short-answer responses in the “before/after” questionnaires used for evaluating the CC Toolkit – a process based on pre-determined standards for measuring the accuracy of answers. Let us consider one example of how coding of responses for RQ2 was derived and subsequently evolved.

Question 1 for “providers” and Question 3 for “receivers” ask the respondent whether he/she knows of any traditional signs that show that weather or climate is changing or that a hazard/disaster is coming. As a prompt, the interviewer gives examples of hazards – cyclone, drought, earthquake, tsunami and volcanic eruption. As a result of the answers provided by the initial group of respondents interviewed in Vanuatu, I decided to classify the answer by type of hazard (Table 3.12). Later, I realized that these signs had differing time-scales, with some observable weeks or months before the hazard, and others just days or hours before it arrived. Also, a distinction could be made between signs relating to the atmosphere, to flora, to animals and birds, and to other environmental signs. Accordingly, the coding system was revised to incorporate these new groupings: hazards were divided into cyclone, drought, heat wave, geological and other, and then within each type, a distinction was made between signs relating to the atmosphere (short-term and long-term), changes in flora, changes in fauna, and other environmental changes. Table 3.13 shows the modified coding system for traditional cyclone signs.

Table 3.12 Initial coding of provider and receiver responses on traditional hazard signs

A. Cyclone

- A1 Abnormally high production of flowers and fruit on fruit trees - breadfruit, nakatambol, navele, namambe
- A2 Hornets and birds build their nests close to the ground
- A3 New banana shoots don't open, but leaves drop down
- A4 Red skies at sunset/sunrise, with abundant red clouds - sign of rain or cyclone
- A5 Alignment of long clouds, with some showing three forks
- A6 Frigate birds fly in from the sea
- A7 Unusually hot at night
- A8 Very hot weather, with showers and high black clouds moving quickly across the sky
- A9 Yam vines reluctant to climb up the yam stake, coiling back to the ground
- A10 Short rainbow just above the horizon - sign of rain or cyclone
- A11 White/yellow/green cloud along the horizon at sunset indicates rain and wind or a cyclone
- A12 At the start of the cyclone season, a storm with rain but without thunder indicates a cyclone
- A13 If tiny streams dry up, this is an indicator of heavy rain
- A14 Ajaja trees bear a lot of flowers, then they all fall down - sign of rain
- A15 Northerly winds indicate rain or a cyclone
- A16 Our body temperature becomes hotter
- A17 We experience a strong earthquake
- A18 Moon is like an oven with stars inside/ halo round moon - signs of a long rainy season
- A19 Broken clouds in the sky (similar to how pigs dig up the ground) - sign of rain
- A20 Heavy rain and abundant cloud during October-April - sign of a cyclone
- A21 Evidence from the traditional calendar
- A22 Cyclone indicator not described clearly

B. Drought

- B1 Clear skies by day but small showers at night
- B2 Rats eat pawpaw and *Jejea* leaves and the young shoots, vines and branches of other trees, so causing them to litter the ground
- B3 The Ajaja tree bears flowers without leaves
- B4 Today, a cyclone is immediately followed by drought, which destroys food production
- B5 If fowl cry out during heavy rain, then a dry period will follow
- B6 Clear oven-like shape/halo around the sun indicates a long period of drought
- B7 Narua kara birds crying at high altitudes
- B8 Red sunset with a special cloud / red cloud along the horizon is a sign of forthcoming drought or fine weather
- B9 Yellowing leaves on trees indicate an impending drought
- B10 Evidence from the traditional calendar

C. Heat wave/high temperatures

- C1 Glue tree has abundant red fruit in bunches
- C2 Wild cane swells and has thicker stems (during January and February)

D. Geological hazard

E. Unspecified disaster

- E1 Clear sky at night with line of stars following the axis of Tutuba island
- E2 Moon appears in the form of a oven/with halo (means cyclone or drought)
- E3 Dogs barking more than usual
- E4 Unspecified changes in the environment

Table 3.13 Revised coding system for traditional cyclone signs

A1. Atmospheric signs during previous weeks or days: unusual cloud formations, unusually hot days and nights, halo around moon, etc.
A2: Atmospheric signs hours before arrival of cyclone: increasing wind speed, heavy rainfall, etc.
B. Changes in flora: abnormally high production of flowers and fruit on fruit trees – breadfruit, nakatambol, navel, mango
C. Other changes in flora: yam vines coil back down the yam stake; new banana shoots remain closed but leaves fall to ground; withering of windiwindi grass; red yam grows under nabanga tree; nalumlum (algal bloom) on sea surface, etc.
D. Changes in fauna: hornets /birds build nests close to the ground; fowl roost under houses; turtles lay eggs in bush; mangrove crabs leave habitat; unusual movements of animals/insects.
E. Changes in fauna: bird flight : frigate birds fly in from the sea; birds fly in unusual patterns/movements
F. Other environmental signs - rough seas, dirty seas, use of traditional calendar, etc.
G. No traditional signs stated

3.8 Research Rigour – testing validity and reliability of instruments used

3.8.1 Relevant Literature

Rigour is defined as "the quality of being extremely thorough and careful" (Lexico, 2021), but is interpreted in different ways by quantitative and qualitative research.

In quantitative research, rigour refers to the extent to which the researcher enhances the quality of the work by testing for its validity and reliability. Validity is the extent to which the results really measure what they are supposed to measure, while reliability refers to the extent to which the results can be reproduced when the research is repeated under the same conditions (Middleton, 2020). Heale & Twycross (2015) distinguished between: content validity, which assesses whether the research instrument measures all aspects of a variable or construct; construct validity, which assesses whether inferences can be drawn about test scores related to the construct; and criterion validity, which assesses the extent to which the research instrument is related to other instruments measuring the same variable. Reliability relates to the consistency of a measure. Heale & Twycross (2015) suggested that reliability has three attributes: homogeneity, stability and equivalence. Homogeneity measures the internal consistency of an instrument, or the extent to which all the items on a scale measure one construct. Stability refers to the consistency of results when an instrument is given to the same participants more than once under similar circumstances. Equivalence measures consistency among responses of several users of an instrument, as when there are more than one markers of responses to a test.

In qualitative research, Guba & Lincoln (1986) proposed that "trustworthiness" and "authenticity" should be used instead of "rigour", and that criteria to ensure trustworthiness would be credibility, transferability, dependability and confirmability. Thus strategies for establishing trustworthiness take place at the end of the research, rather than through processes of verification during the study, as takes place in quantitative research. Morse et al (2002) questioned the use of post-research evaluation of trustworthiness and suggested that the terms "reliability" and "validity" remain pertinent in qualitative enquiry. They argued that the researcher must use verification strategies during the research process to ensure this reliability and validity. Such strategies include 'ensuring methodological coherence, sampling sufficiency, developing a dynamic relationship between sampling, data collection and analysis, thinking theoretically, and theory development' (ibid, p.18). Methodological coherence ensures congruence between the research question and the components of the method. An appropriate sample will consist of participants who best represent or have knowledge of the research topic. Collecting and analysing data concurrently forms a 'mutual interaction between what is known and what one needs to know'.

3.8.2 Rigour in this Research: Quantitative Approaches

Because this is mixed methods research, both quantitative and qualitative approaches are used to collect and analyse data, so the interpretation of "rigour" will encompass the validity and reliability of questionnaires as well as qualitative verification strategies to determine the trustworthiness of interviews, methodological coherence, appropriate sampling, and theory as an outcome of the research process.

To illustrate the validity and reliability of questionnaires, I first refer to the "before/after" instrument QS6 used with the CC Toolkit (Appendix A8). This questionnaire was designed to measure the impact of the resource on students' knowledge, skills, attitudes and behaviour. But once it was in use, it became clear that skills were not being assessed at all. Changes in knowledge could be evaluated through questions 1-16 and 21-26, attitudes through questions 17-20, and pro-environmental behaviours through question 27. For knowledge, the questions tested aspects such as the nature, causes and impacts of climate change as well as mitigation and adaptation, thus covering important elements but omitting vulnerability and resilience. Attitude questions focused on a student's awareness of the dangers of anthropogenic climate change and his/her willingness to do something about it. The behaviour question tried to elicit actions that a student might take to protect family and community in the face of disasters and the climate emergency, but these would be intended actions rather than actual steps already implemented. It was anticipated that exposure to the CC Toolkit would lead to an increased awareness of such actions. In summary, the questionnaire measures most, but not all, aspects of climate change and disasters, so its content validity is partial.

In terms of construct validity, scores for student performance before and after the CC Toolkit activity were determined through a marking scheme based on information in the pictures and from the Teacher's Guide supplied to all schools. For the 20 Agree/Disagree questions, one mark was awarded if an answer was correct and subtracted if incorrect. Each of the 7 short answer questions was marked on a scale of 0 to 5. Scores for each question were aggregated for all students in a class before and after participating in the intervention, and I feel that this provided a valid indication of change, so measuring the intended construct. Also, by separating questions into three groups (knowledge, attitudes, behaviour) a comparison could be made of change in each category – offset by the fact that there are 22 questions on knowledge, but only four on attitudes and one on behaviour. Another factor that might reduce construct validity is that for most of questions 1 to 20, the "correct" answer was in fact the Agree box, and there is evidence that some students were thus misled into thinking that all Agree boxes should be ticked.

Criterion validity for the questionnaire could not be assessed, since there is no other instrument in use to measure the impact of the CC Toolkit in Vanuatu.

Regarding the reliability of the "before/after" questionnaire, there is internal consistency in that all items measure different aspects of one construct – resilience education. Stability is not relevant, because students' scores are not expected to be consistent before and after participating in the CC Toolkit activity – an intervention that is supposed to be reflected in different results. In terms of equivalence, there was only one marker of the questionnaires, myself, so that there should be consistency in adjudicating responses.

In terms of the validity of other questionnaires used to evaluate the effectiveness of formal educational courses in resilience at senior secondary and post-secondary level, we can consider that these questionnaires taken together were designed to measure all aspects of resilience education as conceived in my model of a proposed educational programme on resilience (Figure 2.14). In that sense, there was content validity. However, each individual questionnaire focused on different aspects, as shown in Table 3.7. For construct validity, the scoring scheme for responses to each questionnaire was based on a five-point Likert scale in QC2, QS1, QS2 (8 out of 10 items) and QS4, and a three-point Likert scale in QC1. QS3 involved a pair-wise comparison of the relative importance of student, course and teacher in resilience education. The intention of QS1 and 4 was to measure change in a student's knowledge, skills, attitudes and behaviour as a result of taking a course in resilience, and this implied asking a student to complete the questionnaire at the start and end of a course. In most cases, it only proved possible to use these two questionnaires at the end of the course, so construct validity was limited. It was also affected by the "acquiescence factor", whereby the respondent tends to tick the agree box by default (Krosnik, 1991; Saris et al, 2010). Questionnaires QC1, QC2, QS2 and QS3 were not time specific, so can be considered to have construct validity. For criterion validity, this is not assessable, since no other instruments are in use to evaluate the effectiveness of formal resilience education in Vanuatu.

As for the reliability of questionnaires QC1, QC2, QS1, QS2, QS3 and QS4, homogeneity, or internal consistency, was achieved if all six questionnaires are considered as a whole: all items in the questionnaires are designed to measure the extent to which a course on climate and disaster resilience is effective, acknowledging that aspects of this effectiveness are overall values, pedagogy, knowledge, skills, attitudes and behaviours. Also, evidence from QC1 and 2, completed by teachers, can be triangulated against information from QS1-4, completed by students. Stability was not measured in the sense that QC1 & 2 and QS1-4 were only completed once, except in the case of two TVET cohorts at VIT that were able to respond at the start and end of a Certificate course – and here, stability was not relevant because the course had effected changes in students' responses. Equivalence did not apply since there was only one person involved in scoring and analysing the questionnaires.

3.8.3 Rigour in this Research: Qualitative Approaches

Qualitative methods were used to evaluate the contribution of traditional knowledge and values to climate and disaster resilience in Vanuatu (RQ2). The main instrument was the semi-structured interview, conducted with the aid of pre-determined but largely open-ended questions, and allowing for the possibility that a respondent might also wish to complete these questions unaided.

Measuring the trustworthiness of interviews is complex. I can vouch for the trustworthiness of the small number of interviews that I conducted myself, since I knew all interviewees and their answers appeared to be honest and reflect their reality. Moreover, the initial guiding questions were modified in light of these interviews. Regarding my research assistants, all were carefully selected and then given detailed guidelines on how to approach a potential interviewee, how to ask each question and deal with unexpected responses (Appendix A12-15). At the outset of the research, it was also possible for a few assistants to participate in face-to-face consultations with myself that reinforced these written guidelines. Nevertheless, once out in the field, my physical absence from Vanuatu meant that I could only gauge the effectiveness of my assistants through the quality of the answers recorded and, wherever possible, try to ask for further elucidation through emails, texts and phone calls. In short, the trustworthiness of interviews conducted by research assistants has to be assumed, but cannot be proven. One way of checking the accuracy of an interview would be for the respondent to read through a transcript of the conversation. However, interviewers were not asked to do this, since most interviews were conducted in an indigenous language, but answers were recorded in Bislama or English: it would not be practical to ask the respondent to check the transcript because in most cases he/she would not have the necessary literacy skills.

Another aspect of trustworthiness is whether the respondent shared all his/her relevant traditional knowledge with the interviewer, who in most cases was much younger. Evidence from the majority of forms suggests that full, truthful answers were provided. However, a few respondents from North Pentecost would only reveal detailed knowledge of traditional weather signs and resilience strategies in exchange for payment, and although a token sum was subsequently sent to the research assistant for use in negotiations for further information, this did not happen, and the original, but generalized, answers had to suffice.

Methodological coherence between research question 2 and the instrument selected to investigate the answer is clear. The global question is to determine the extent to which traditional knowledge and values are relevant to climate and disaster resilience in Vanuatu. To assess this, questions must be asked to find out what kind of traditional knowledge and values relating to climate and disasters exist, and whether such knowledge is being transmitted between generations. Hence there is one questionnaire for providers and another for receivers. On the provider form, questions 1, 2 and 8 ask the respondent to share his/her knowledge of traditional weather and disaster signs, resilience strategies and values, while questions 3 to 7 refer to the transmission of such information. On the receiver form, questions 1 to 3 ask about the respondent's knowledge of weather and disaster signs, resilience strategies and basic values, while questions 4 to 9 refer to the transmission of knowledge, skills and values. Thus it can be argued that there is congruence between the research question and components of the method.

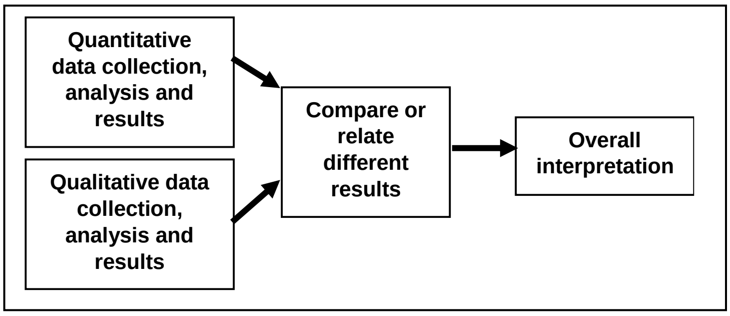
Regarding sampling, providers were selected on a purposive basis, comprising those in a community respected for their traditional environmental knowledge. Communities selected were the home communities of research assistants, who were themselves chosen in a manner that would represent as many different Vanuatu islands as possible. In this sense the verification criterion for sampling proposed by Morse et al (2002) was fulfilled.

Another verification technique for qualitative research is that it is iterative, in other words, repeated again and again in order to improve its accuracy. Morse et al (2002, pp 17-18) explained that this happens when 'data is collected and analysed concurrently' as the researcher 'moves back and forth between design and implementation to ensure congruence among question formulation, literature, recruitment, data collection strategies and analysis'. In researching traditional knowledge for this thesis, this iterative pattern was certainly followed at the start, with question formulation being refined as more interviews were conducted, new assistants recruited in order to widen the geographic spread of responses, and analysis of results suggesting how further questions needed to be asked. In other words, learning about how to improve the research was an outcome of experience. An example is Question 8 on both provider and receiver forms, which was added later on at the suggestion of a research assistant. However, as research became impacted by COVID-19 and I could no longer guide field interviews in the intended manner, the concurrent collection and analysis of data slowed down, and this aspect of verification declined in importance.

3.8.4 Rigour in this Research: Use of Triangulation

Triangulation refers to the combination of several research methods to cast light on a topic. It is a common feature of mixed methods research because it combines the collection and analysis of quantitative and qualitative data, aimed not only at providing validity but also a deepening of understanding (Olsen, 2004). Quantitative and qualitative data can be collected and analysed during the same phase of the research process and merged together into one interpretation (Cresswell & Plano Clark, 2007) (Figure 3.8).

Figure 3.8 Triangulation of data



Source: Creswell & Plano Clark (2007)

An example of this form of triangulation comes from the CC Toolkit intervention. As mentioned in Chapter 4 Section 4.3.10, quantitative data on performance by gender showed that females scored significantly higher scores than males when the activity was conducted in urban schools, but this was not true for rural schools (Tables 4.27 and 4.28) . When I conducted email interviews with seven teachers and three school principals, the majority confirmed that in an urban setting, Year 9/10 boys are more easily distracted from their studies than girls, and suggested reasons for this. Thus in this case, triangulation enabled an overall interpretation of the pattern observed.

Another form of triangulation is when quantitative data on the same topic is obtained from two different sources – for example, when quantitative data on senior secondary and post-secondary courses on resilience obtained from students is compared with quantitative data received from their teachers. For question 3 at the bottom of QS1, which asked how the resilience course could be improved, a common response from school students was that teachers should take them out on fieldwork and ensure that they conduct practical activities (Chapter 5 Section 5.2.3 – QS1, Figure 5.9). Then when teachers completed QC1, one of the lowest average scores (Tables 5.20 and 5.21) was for the use of fieldwork (ranked 38 out of 41 aspects of resilience education promoted), while for QC2, “field experiential” (undertaking practical activities outside the classroom) was the only teaching and learning technique to achieve a negative score (Table 5.22) – both statistics confirming the lack of field and practical work at senior secondary school level. Quantitative data from students matched quantitative data from teachers: triangulation had demonstrated this correspondence and justified the conclusion that fieldwork is lacking.

3.9 Ethical Issues and Positionality of the Researcher

3.9.1 Informed Consent: Institutions

At the outset of this research, authorisation was required from three key national institutions in Vanuatu – the National Advisory Board on Climate Change and Disaster Risk Reduction (NAB), the Vanuatu Cultural Centre (VCC), and the Vanuatu Institute of Teacher Education (VITE).

NAB is the supreme policy-making and advisory body for all disaster risk reduction and climate change programmes, projects, initiatives and activities (NAB, 2021). It operates within the Ministry of Climate Change Adaptation, Meteorology, Geo-Hazards, Environment, Energy and Disaster Management. All research projects related to climate change and disasters must receive endorsement from this body before work can proceed (Appendix B)

VCC has detailed regulations to cover any research work undertaken in Vanuatu, with approval conditional on payment of an authorization fee of 100,000 vatu (651.00 GBP) and compliance with other stipulations (Appendix B). My research fee was waived.

One of VCC's requirements was for the researcher to complete and sign a "research agreement" between himself and the National Cultural Council (representing the Government of the Republic of Vanuatu and the local community). He should also be affiliated with a local institution that would guarantee the researcher's compliance with VCC rules. VITE, where I was a lecturer from 1999 to 2013, agreed to be my official Vanuatu partner and provide the required support letter (Appendix B).

3.9.2 Informed Consent: Participants

All participants in this research, whether research assistants or informants, were invited to complete a consent form indicating their willingness to take part. Prior to signing the form, the participant was provided with a written statement in English, French and/or Bislama (or all three) explaining the proposed research project and the role of participants. This statement was read out to the participant by myself or a research assistant in English, French or Bislama, or where feasible, translated into an indigenous language of Vanuatu. Appendix B provides details of the three consent forms and six information sheets.

The autonomy of participants was guaranteed through stating that they could withdraw from the project at any time up to one month after the date of their signature and also withdraw any information they provided. Further, all were assured of their anonymity, since names or identifying information would not be used. All participant information sheets summarized the purpose of the research and confirmed data confidentiality through its sole use and storage by the principal researcher.

Additional measures were taken to ensure compliance with ethical principles. No sensitive data was collected from respondents, since there were no interview or survey questions on ethnic origin, political or religious beliefs, trade union membership, genetic data, biometric data, health, sex life or sexual orientation. Regarding identity of respondents, research assistants working in schools or tertiary institutions were teachers who collected completed questionnaires from their own students, and such data was only made available to the principal researcher. Similarly, assistants who interviewed respondents for traditional knowledge recorded the name of the interviewee to avoid confusion, but such names were only known by that assistant and the principal researcher, and not shared with any other assistant. For the protection of young or otherwise vulnerable people, Vanuatu has no equivalent to the DBS check used in the United Kingdom, so a comparable verification of an assistant's criminal history could not be conducted. For myself, a "Working with Children" accreditation card issued by the Government of Western Australia was provided (Appendix B).

3.9.3 Maintaining Confidentiality

To ensure confidentiality of data received, names of teachers or students were not indicated, and schools were given anonymous names that correspond to common tree species in Vanuatu. Hard copies of data received were stored in files in my own home in Albany, Western Australia, while soft copies were kept on my desktop, laptop, a USB and One Drive. Any data transmitted from Vanuatu through the internet was immediately removed.

Where photographs of students under 18 years were to be included in the thesis, I obtained signed written consents from the students concerned; in cases where students had already left school or were uncontactable, I asked their teacher to sign this agreement on their behalf. Three such consent forms are provided in Appendix B.

3.9.4 Positionality of the Researcher and his Assistants

The term positionality describes 'the perspective shaped by the researcher's race, class, gender, nationality, sexuality and other identities' (Mullings, 1999, p.337). It reflects the position the researcher has taken within a given research study, and is informed by self-reflection on how his/her views and position might have influenced research design and process and how findings are interpreted (Manohar et al, 2017). The positionality of the researcher as perceived by the research participants is impacted by the researcher's race, culture and ethnicity and life experiences, and influences whether he/she is seen as an "insider" or an "outsider" (Manohar et al, 2017). However, there is a sliding scale or "slippery slope" between an outsider and an insider (Latai-Niusulu et al, 2020; Bird, 2017; Merriam et al, 2001), while Mullings (1999) argued that the boundary between the two is dynamic and may change over time and space.

In this thesis, I suggest that for interviews on traditional knowledge, I as principal researcher was seen as an "insider" since my linguistic capacity, cultural sensitivity and life experiences in Vanuatu offset the influence of my educational level and skin colour, while my assistants were naturally “insiders” because of sharing the same social, cultural and linguistic characteristics as their respondents (Merriam et al, 2001). In all cases, the interviewers were seen as trustworthy, with interviewees feeling free to share their knowledge and views because the interviewer was known and in most cases communicating in the local language.

However, with surveys conducted through formal educational channels, it is possible that myself and my assistants, known to students as their teachers, could have influenced the accuracy of data collection.

In terms of the survey on the CC Toolkit activity, almost all teachers involved were my former students, and the bonds of friendship already established may have led to a teacher trying to do his/her utmost to cooperate and ensure that their students performed well. However, this would be impossible to assess without directly asking the teacher concerned, which would not be ethical. Moreover, despite teachers wanting to ensure that their students were fully engaged in the activity, there is no evidence that any teacher provided them with answers to questions in the before and after questionnaire. As evidence of a teacher feeling responsible for the performance of her class, this email came from a young female teacher in a rural school:

> This year my school was fortunate that another year level of education (Year 9) was added to the school. However, most of these students are of low grade and are the most struggling students … to continue their studies here. I have observed that most of them struggle with expressing their opinions through writing and are a bit slow to understand a broad topic such as “climate change”. These students are a bit far off and slow, therefore their responses to the before and after questionnaire may not be easily understood.
>
> (Social Science teacher, personal communication, 24th March 2020)

For surveys on the effectiveness of resilience courses at senior secondary school and tertiary level, it is possible that teachers would want to demonstrate that they and their students were coping well with a course, and therefore be over-positive in their responses to questions on course content and pedagogy. The students, similarly, would be influenced by their relationship with that teacher, especially in answering questions on course content and teacher effectiveness. There is a power dynamic involved when a teacher asks his/her own students to complete a questionnaire, with a student aware that the teacher might read and judge the responses. Thus some students might, even unconsciously, try to please the teacher, while in cases of fraught student-teacher relationships, others might knowingly provide inadequate responses.

This problem is particularly pertinent to questionnaires completed by participants in the first-ever Resilience courses (Certificates I and III) at the Vanuatu Institute of Technology, since their facilitator was myself. We must ask whether these students felt completely free to respond truthfully to the questions, or whether they were influenced by feelings of loyalty, even gratitude, to their former teacher. Fortunately, a measure of the authenticity of their responses can be obtained by comparing them with the results of an independent survey with these same students shortly after course completion. This neutral "Graduate Tracer Study" was commissioned by the Australia-Pacific Climate Partnership to capture the experiences of Cert III graduates as they transitioned from their studies into the local labour market (APCP, 2019). There is sufficient overlap between Tracer Study questions and questions posed in the present thesis to be able to surmise the extent of bias when Cert III students answered the principal researcher's questions (see Chapter 6, Sections 6.3.4 and 6.3.5).

In summary, it is possible that the positionality of the researcher and his assistants could have exerted a minor effect on responses to questionnaires used in a formal educational setting, but only minimal impact on the accuracy of data collected through interviews on traditional knowledge.

CHAPTER 4: RESULTS AND DISCUSSION - RQ1: PRIMARY & JUNIOR SECONDARY EDUCATION

4.1 Scope of the Chapter

This chapter addresses Research Question 1:

How effective is formal education on climate and disaster resilience in Vanuatu in terms of knowledge and skills gained, changes in attitude and behaviour and impacts on individuals and their communities?

I will present and discuss results at two levels of formal education –primary and junior secondary – with a focus on the latter.

For primary education (Years 1 to 6), I did not attempt to carry out any fieldwork with students or teachers, but will demonstrate how the new primary curricula in Social Science and Science, introduced after 2012, provide basic concepts and practical activities on environmental stewardship that orientate students for further learning.

In junior secondary education (Years 7 to 10), new curricula are still in process of development, so that schools continue to rely on curricula created in the closing decades of the 20th century, with little emphasis on climate change or disaster risk reduction. For this reason, I will concentrate on the use by students in Years 9 or 10 of a more recently developed educational resource on climate change and disasters (*Learning About Climate Change the Pacific Way)*. Quantitative research has been carried out on the effectiveness of this resource by analysing responses from 363 students from 19 classes in nine different schools across Vanuatu, and is supplemented by qualitative data from interviews with teachers.

4.2 Primary Education (Years 1 to 6)

The official age range for primary education in Vanuatu is 6-11 years, but in reality, extends from 3-21 years, with, for example, the majority of students at Year 6 level in 2020 being aged 12 or 13 (MOET, 2021). The presence of over-age students in primary classes is largely because they are asked by teachers and parents to repeat a year in order to achieve desired levels of literacy and numeracy. In 2018, the average repetition rate across all six primary grades was 14.5% (EPDC, 2018)

In the revised curricula for primary schools (Years 1 to 6), aspects of resilience are covered in Social Science and Science during Years 4 to 6 (CDU, 2013). Total teaching hours for each of these two subjects over the three-year period are 198 (two hours per week x 33 weeks of class time per year x 3). By 2022, syllabi for Years 5 and 6 are already being implemented with the aid of Teacher's Guides developed by the Curriculum Development Unit (CDU) (Nilwo, 2022).

In Social Science, CC and DRR are included in the sub-strand Environmental Studies, principally in Years 5-6, but total teaching hours are just 16 (8%) of Social Science's 198 hours in Years 4-6. Tables 4.1 and 4.2 show how resilience issues are taught in Years 5 and 6 respectively (MOET, 2019 & 2020).

Table 4.1 Content and activities in Unit 4: Environmental Studies, Year 5

Week	Content	Suggested activities
Term 2, Week 7	The natural environment (ecosystem) – definition and examples	Field excursion, drawing food chain, creating poster on conserving an ecosystem
Term 2, Week 8	Environmental modification by humans – how and why, including pollution and climate change	Tree planting, comparing pictures of an environment past & present, discussion of human activities
Term 2, Week 9	Climate change - definition, causes, impacts, mitigation and adaptation	Discussing causes of climate change, prepared talks on local impacts, role plays on adaptation
Term 2, Week 10	Natural activities/hazards that damage our environment – examples, impacts, preparation and minimizing damage	Interviewing community members about traditional signs of disasters, creating posters on preparations for a cyclone
Term 2, Week 11	Solutions to reducing damage to our environment – traditional and modern methods of conservation, agro-forestry, personal actions	Tree planting, clean-up campaign, posters on minimizing CC impacts, awareness campaign, discussion on reef conservation

Source: Adapted from Teacher's Guide for Year 5 Social Science, MOET, 2019, pp.73-76

Table 4.2 Content and activities in Unit 4: Environmental Studies, Year 6

Week	Content	Suggested activities
Term 2, Week 4	Climate change and disaster risk	Field visits to local disaster risk sites, interviewing elderly members of community, guest speaker, making disaster management plan for the community
Term 2, Week 5	Preserving the environment	Survey of local ecosystems, identifying endangered species of plants and animals, finding out traditional methods of preserving the environment, guest speaker
Term 2, Week 6	Designing plans for actions	Discussion of modern and traditional methods of reducing impacts of climate change, interviewing community members about actions to preserve ecosystems and reduce impacts of climate change, making evacuation plans

Source: Adapted from Teacher's Guide for Year 6 Social Science, MOET, 2020, pp.51-58

In Science, CC topics (causes, adaptation and mitigation) and DRR are taught in the sub-strand Changing Earth (CDU, 2013, pp.132 & 144), with total teaching hours only 6 (3%) of Science's 198 hours in Years 4-6. Tables 4.3 and 4.4 show how the Teachers' Guides for Years 5 and 6 cover resilience issues (MOET, 2019 & 2020).

Table 4.3 Content and activities in Changing Earth, Year 5

Week	Content	Suggested activities
Term 3, Week 5	Man-made and natural hazards – definition of disasters, types of disaster (cyclone, drought, earthquake, tsunami, flood, tornado).	Brainstorm student experiences of disasters, make a natural disaster book, create a disaster model using soil, wood, water, etc. , cause and effect chart
Term 3, Week 6	Adaptation to climate change and natural disasters – nature of climate change, rules to follow before, during and after a disaster	Making a plan to stay safe in a disaster, make a disaster poster, brainstorm what to do to slow down climate change.

Source: Adapted from MOET, 2019, pp.120-124

Table 4.4 Content and activities in Changing Earth, Year 6

Week	Content	Suggested activities
Term 3, Week 11	Human activities and climate change, adaptive measures to climate change and natural hazards (agriculture and food security, water sector, health sector, education, early warning systems, development planning.	Create murals on the effects of human activities on the environment, create and implement rules for protecting wild life, habitats, water resources, etc., conduct awareness on limiting vehicle use, perform role plays on limiting the use of plastic, etc.

Source: Adapted from MOET, 2020, pp.212-219

Both syllabi engage students in learning about the embeddedness of humans in the natural environment through practical activities – tree planting, poster and mural creation, clean-up campaigns, safety plans for disasters, implementing rules for protecting habitats and water resources, role plays – and drawing upon their own experiences of climate change and disasters. Interviewing community members about traditional disaster signs, actions to preserve ecosystems and reduction of climate change impacts help to locate them within their own community and introduce an element of informal learning.

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Yet although important issues about CC and DRR are raised at upper primary level, with stimulating practical activities for learners, the allotted teaching hours over Years 4 to 6 are minimal – 8% of total Social Science time and 3% of total Science time. The Ministry of Education and Training (MOET) requires schools to provide primary students with 28 hours of "contact time" per week over three 11-week terms per year (MOET, 2015, p.6). Thus total teaching time for all subjects amounts to 2,772 hours over a three-year period. Teaching about resilience takes up just 22 hours, or 0.8% of this time. I submit that this is not enough.

4.3 Junior Secondary Education (Years 7-10)

4.3.1 Why Focus on the Resource "Learning About Climate Change the Pacific Way"?

In October 2019, at outset of my research, new curricula for the junior secondary cycle of education, already formulated in 2012, had not yet been finalised for use in Vanuatu schools. By April 2022, new syllabi have only been produced for use at Year 7 level, as confirmed by the Chief Executive Officer of the CDU:

> We have developed five syllabi in English and French (Social Science, E/F as Second Language, E/F as Foreign Language, Mathematics and Science). But due to the COVID situation in the country, teacher training is put on hold until we find some alternatives …. However, schools should be using the new syllabi.
> (Felicity Rogers Nilwo, 29th April 2022)

Hence the spiral curriculum envisaged for environmental issues, through which key concepts gained at primary level are developed with deepening complexity at junior secondary level, is still not realized.

Existing syllabi in Basic Science and in Social Science, devised before 2000, have only limited coverage of climate change and disasters. In Social Science, for example, global warming and cyclonic disasters appear at the end of the last unit of the four year course – Our Changing Society – with a total time allocation of perhaps five hours, depending on the teacher. It was the author of this thesis who created the learning textbooks for Year 9 and 10 Social Science courses while teaching at secondary level in Vanuatu. However, with the exponential growth of knowledge and a more prominent focus on climate change during the last two decades, this material is out of date and needs to be supplemented by other resources.

One such educational resource was developed between 2011 and 2013 under the auspices of the Secretariat of the Pacific Community (SPC) for use in five Pacific island nations – Fiji, Tonga, Samoa, Vanuatu and Kiribati – with funding provided by the SPC and the German aid agency Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) through their Coping with Climate Change in the Pacific

Island Region (CCCPIR) Programme. It was produced for use at junior secondary level to address the gap in learning materials that address adaptation measures specific to Pacific islands (SPC & GIZ, 2013). The Teacher's Guide for this resource acknowledges the minimal contribution made by Pacific islands to global warming, stressing that the focus of learning is on 'the effects of changes in air and sea-surface temperature, rainfall, sea-level rise and extreme weather events on environments, economies and people' and the need to 'enhance individual and community skills to adapt to these changes.' (ibid, p. 1). Hence the emphasis on adaptation rather than mitigation.

The resource itself consists of 16 large pictures for classroom display (Figures. 4.1 and 4.2) that deliver nationally prioritised key messages relevant to climate change science, the effects of climate change on the Pacific and options to mitigate its causes and adapt to expected changes. A contributor from each nation was appointed to ensure that the material would reflect the reality of that nation, and then coordinate the pilot-testing of the resource. For Vanuatu, that person was myself.

Once finalised and published, sets of the 16 pictures, known as the "CC Toolkit", were distributed by Vanuatu's CDU to junior secondary schools throughout the nation, with short training courses held for teachers on its deployment. However, by 2019, when I began research for this thesis, enquiries through the CDU and the MOET's Schools-based Management Unit revealed that the Toolkit was no longer being used. One reason given was the widespread destruction of learning materials as a result of category 5 TC Pam in March 2015. Another was the frequent transfer of teachers between schools, with those who had received training moved into new posts, often asked to teach other subjects.

I therefore set out to examine whether this resource does have intrinsic value in changing students' understanding of climate change and disasters, as well as attitudes and pro-environmental behaviours. At the same time, the aim was to increase awareness among new and existing teachers of the resource's existence, and how it might advance learning about climate and disaster resilience in the current absence of other learning materials for students at junior secondary level.

Figure 4.1 The Climate Change Toolkit – pictures 1 to 8

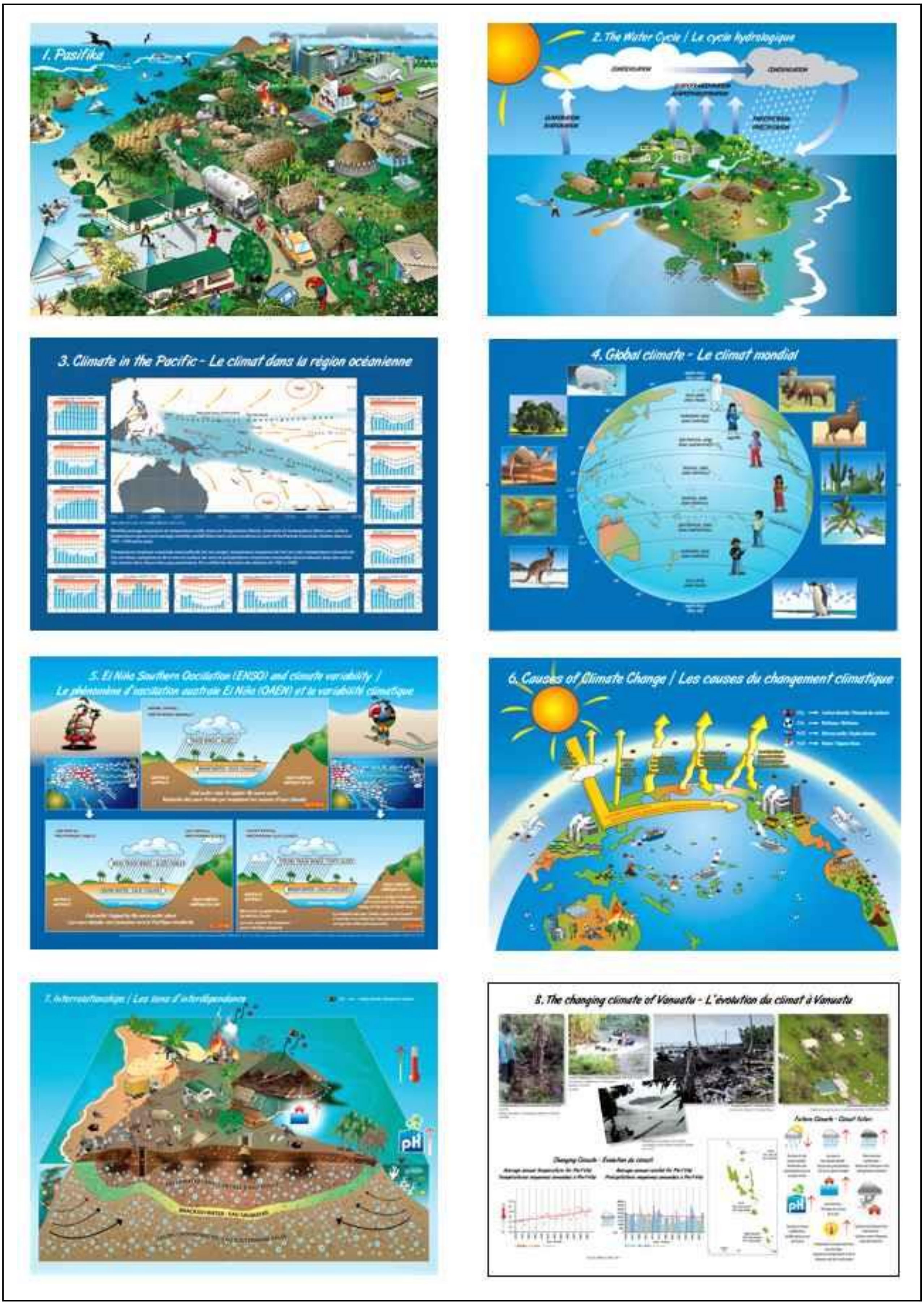


Figure 4.2 The Climate Change Toolkit – pictures 9 to 16

As mentioned in the Introduction, before the COVID pandemic and Cyclone Harold caused a State of Emergency to be declared in Vanuatu in April 2020, I conducted a series of short training sessions on the Toolkit for 17 teachers of Basic Science and Social Science in six schools, as well as for 13 trainees graduating from the Vanuatu Institute of Teacher Education (VITE), encouraging them to carry out this intervention using a common pedagogical approach. Later, three teachers in another three schools agreed to participate: two of these had been in the group of VITE trainees, while the third received training through emails and texting.

In all, 363 students from 19 classes in nine schools participated in the activity and completed “before” and “after” questionnaires associated with the CC Toolkit. Note that some teachers asked to use the activity with their students at senior secondary level, and 67 such students were involved (18% of the total).

The administration of this activity is briefly described in Section 3.5.3 of Methodology. Before undertaking the activity students individually complete a diagnostic questionnaire (QS6) that enables an assessment of their existing knowledge, attitudes and behaviours regarding climate change and disasters – to serve as baseline data in the survey. They then carry out the activity by visiting each picture and answering its associated questions (QS7/8: Tables 4.5 and 4.6). After completing the activity, and with the assistance of their teacher, there is discussion of answers to those questions. Finally, each student individually completes another copy of the same diagnostic questionnaire (QS6) used before the activity. The aim is to measure changes in knowledge, attitudes and behaviours and hence evaluate the effectiveness of the CC Toolkit on learning.

Questions in QS6 are not the same as those in QS7/8, but attempt to elicit key aspects of learning generated by the Toolkit as a whole.

Table 4.5 Questions associated with pictures 1 to 8, completed during the activity

Picture	Questions
1 **The imaginary island of "Pacifica"**	1. State 10 things that people are doing in this picture. 2. Can you see a town in the picture? What are three differences between the town and the village? 3. What can you see in the picture that reminds you of Vanuatu? 4. What do you think this village might be like in 10 years' time?
2 **The water cycle**	1. What does "evaporation" mean, and why does it happen? 2. What does "condensation" mean? 3. What are clouds made of? 4. What is "precipitation", and what happens when it reaches the ground? 5. What is the "water cycle"?
3 **Climate in the Pacific (climatic graphs)**	1. Name three things that "climate" measures. 2. What do the letters J, F, M, A,…. stand for? 3. Most islands in the South Pacific have two seasons - one that is hot and wet, and one that is cooler and drier. Which months have the hot, wet season? Which months have the cooler, drier season?
4 **Global climatic zones**	1. Place the zones in order of decreasing temperature, starting with the Tropical Zone. 2. What happens to temperature as you move away from the Equator? Why do you think this happens? 3. Name the climate zone in which these countries are found: a) VANUATU b) NEW ZEALAND c) RUSSIA
5 **Climate variability, El Nino and La Nina**	1. What do you think the word "variability" means? 2. Normally, which side of the Pacific Ocean is wetter - the west or the east? 3. During an "El Nino" period, what is the climate like in Vanuatu? 4. During a "La Nina" period, what is the climate like in Vanuatu?
6 **Causes of climate change (natural and human factors)**	1. What happens when the sun's rays reach the earth? 2. After the ground is heated, it sends this heat back into the atmosphere. But there are some gases in the atmosphere that absorb this heat, so keeping the atmosphere warm. These are called Greenhouse Gases (GHGs). Name five of them. 3. So what do you think will happen if extra GHGs are put into the atmosphere? 4. What activities are people doing that put extra amounts of GHGs into the atmosphere? State five of them.
7 **Rising air and sea temperatures and ocean acidification**	1. If the temperature of the air is increasing, how will this affect the water in the seas and oceans? 2. As temperatures rise, will more CO_2 enter the sea? How will this affect coral reefs? 3. How will rising sea levels affect people living in coastal areas? 4. Name two human activities that put extra GHGs into the atmosphere.
8 **Changing climate of Vanuatu**	1. Find the climate graph for Port Vila. State the average temperature in January and in July? 2. Look at the straight black line in the graph in the bottom right-hand corner. Are Vanuatu's temperatures increasing? 3. What two climatic dangers does Vanuatu face? Which of them may occur during an "El Nino" year?

Table 4.6 Questions associated with pictures 9 to 16, completed during the activity

9 Pasifika after a cyclone	1. State five changes that have occurred in the village because of the cyclone. 2. How are old people, children and the disabled affected by a cyclone? 3. What steps can be taken to reduce risks of damage to food supplies and human lives during a cyclone? State five.
10 Pasifika during a drought	1. State five changes that have occurred in the village because of the drought. 2. How are old people, children and the disabled affected by a drought? 3. What steps can be taken to reduce the problems caused by a long period of drought? Suggest five.
11 Mitigation and adaptation activities	1. What actions can we take to reduce the levels of GHGs in the atmosphere? (Called “mitigation”) 2. What actions can be taken to change our way of life so that it fits a climate that is warmer, with stronger cyclones and more droughts? (Called “adaptation”) 3. What are the actions shown in the middle of the diagram?
12 Farming and gardening practices	1. From this picture, describe five kinds of farming or gardening practices that we should use in order to adapt to future climate change. We can call these practices “sustainable”, since they will give us sufficient healthy food. 2. Which of these could you do in your own village or in your school?
13 Forestry and agro-forestry	1. From the picture, describe some of the forestry practices that we should use in order to adapt to future climate change. 2. Could you do any of these actions in your village or your school? 3. Why is forestry (planting and caring for trees) important as a way of a) mitigating climate change and b) adapting to climate change?
14 Sustainable and unsustainable fishing practices	1. From the picture, state three bad fishing practices that we should avoid. 2. From the picture, state three good fishing practices that will help us to adapt to climate change. 3. Could you carry out any sustainable fishing practices in your community? Which ones?
15 The town (sustainable practices in an urban setting)	1. In the bottom part of the picture, find three ways in which people who live in a town produce extra greenhouse gases and so contribute towards climate change. 2. From the top part of the picture, explain three ways in which human actions are mitigating climate change. 3. Could any of these actions be done in your local town?
16 Pacifica with adaptation measures in place	1. Compare Picture 16 with Picture 1. State five differences between the two pictures. 2. In which village would you prefer to live - the one in Picture 16 or the one in Picture 1? Why? 3. Which picture looks most like your own village? 4. How could you help to bring about these changes?

4.3.2 Collation and Quantification of Student Responses

For each class of participating students, Table 4.7 (pp.133-135) shows how responses were assigned numerical values. For each statement 1 to 20 in the diagnostic questionnaire, a score of +1 was given if the answer was correct, -1 if incorrect, and 0 for “don’t know”. For the longer answers required in questions 21 to 27, a five-point scale was used to measure degrees of competence, with descriptors at four levels (accurate, satisfactory, limited and irrelevant/no answer). Total scores for each item for all students in the class were calculated, and then an average obtained for each item by dividing total score by total number of students. Table 4.8 provides an example of how scores for each school were summarized for subsequent entry into an Excel worksheet.

Table 4.7 Form for tabulating numerical scores for student **responses to QS6**

Name of school and class: Date:
Number of students participating (n): Name of teacher:
Questions asked before or after use of Toolkit pictures? (Encircle): BEFORE AFTER

	Statement + 1 (correct) - 1 (incorrect)	My opinion				
		Agree	Disagree	Don't know	Total score(T)	Av score (T ÷ n)
1.	1. Weather refers to the way that atmospheric conditions such as temperature, rainfall, pressure and wind are always changing.					
2.	2. Climate refers to average conditions of temperature, rainfall, etc. over a long period of time.					
3.	3. Our climate changes because of both natural and human factors					
4.	4. Evaporation occurs when water vapour in the air changes back to tiny droplets of water.					
5.	5. Climate variability means that the climate of a place may change from year to year.					
6.	6. During an El Niño period, Vanuatu experiences droughts.					
7.	7. The greenhouse effect means that certain gases in the atmosphere absorb the heat being radiated back from the Earth, so keeping the atmosphere warm.					
8.	8. Greenhouse gases include carbon dioxide, methane, nitrous oxide and water vapour.					
9.	9. For the past 200 years, human activities are putting extra greenhouse gases into the atmosphere.					
10.	10. Carbon dioxide is absorbed by forests and the oceans					
11.	11. Coral reefs are being damaged by warmer temperatures and ocean acidification.					
12.	12. Vanuatu's greatest climatic dangers are cyclones and droughts.					
13.	13. Adaptation refers to the actions we can take to reduce the levels of greenhouse gases in the atmosphere.					
14.	14. Using compost is a sustainable form of gardening.					
15.	15. Catching fish with nets that have very small holes is a sustainable form of fishing.					
16.	16. Vanuatu is one of the most vulnerable countries in the world to natural disasters.					
17.	17. I am worried that climate change will bring great dangers to the world in the future.					
18.	18. I want to join a student strike to show my concern about climate change.					
19.	19. I know a lot about the causes and impacts of climate change.					
20.	20. I want to help my community prepare for climate change and disasters.					

	Question	Answers
21.	What does “climate change” mean? **5**: **Accurate explanation of the concept and processes involved** (e.g. significant long-term change in global climate or average weather patterns) **3**: **Satisfactory level of understanding of the processes involved** (e.g. change in climate or change in average weather conditions or patterns) **1**: **Limited level of understanding** (e.g. change over a period of time; it is getting hotter; there are longer droughts) **0**: Irrelevant, unclear, don’t know TOTAL SCORE: AVERAGE SCORE: ÷ =	*(Student answers are recorded here, then a score of 0-5 given to each one and all scores totalled for the question)*
22.	What is the enhanced greenhouse effect? **5**: **Accurate explanation of the concept and processes involved** (e.g. an increase in greenhouse gases in the atmosphere due to human activities, which leads to greater atmospheric heating) **3**: **Satisfactory level of understanding of the processes involved** (e.g. an increase in dangerous gases in the atmosphere; increase in gases that absorb/trap heat radiated back from the earth) **1**: **Limited level of understanding** (e.g. gases that cause global warming; gases absorbing the heat radiated back from earth; effects caused by GHG such as CO_2, methane, etc; effects such as melting ice, sea level rise, destruction of plants and animals, warmer temperatures) **0**: Irrelevant, unclear, don’t know TOTAL SCORE: AVERAGE SCORE: ÷ =	
23.	What are three human activities that are putting extra greenhouse gases into the atmosphere, so causing the enhanced greenhouse effect? Valid activities are: • Burning of fossil fuels in vehicles/ships/ aircraft • Burning of fossil fuels in industry/ factories • Deforestation • Cattle rearing • Rice cultivation. • Garbage/rubbish tips, burning of rubbish/plastic **5**: **Accurate**: Three valid activities identified **3**: **Satisfactory**: Two valid activities identified **1**: **Limited**: One valid activity identified **0**: Irrelevant, unclear, don’t know TOTAL SCORE: AVERAGE SCORE: ÷ =	
24.	What causes ocean acidification? **5**: **Accurate explanation of the process involved** (e.g. absorption of more and more CO_2 by the oceans; oceans acting as carbon sinks; absorption of CO_2 by oceans causes weak carbonic acid; increase of CO_2 in the oceans, which lowers pH value) **3**: **Satisfactory level of understanding of the processes involved** (e.g. carbon dioxide is absorbed by the oceans) **1**: **Limited level of understanding** (e.g. carbon dioxide; carbonic acid; methane, ozone, CO_2; warmer temperatures; pollution by oil/fuel/chemicals/sewage) **0**: Irrelevant, unclear, don’t know TOTAL SCORE: AVERAGE SCORE: ÷ =	

25.	Why is forestry (planting and caring for trees) important for mitigating climate change? **5**: **Accurate explanation of the concepts and processes involved** (e.g. trees absorb carbon dioxide from the atmosphere, so reducing atmospheric CO_2 content, so slowing/ lessening global warming and climate change.) **3**: **Satisfactory level of understanding of the processes involved** (e.g. trees absorb carbon dioxide [and give out oxygen]; trees reduce the amount of CO_2 in the atmosphere) **1**: **Limited level of understanding** (e.g. adaptation measures: reduce soil erosion; provide habitat for living organisms; provide shade; provide materials for house construction and medicines; protect the environment; support livelihoods, etc.) **0**: Irrelevant, unclear, don't know TOTAL SCORE: AVERAGE SCORE: ÷ =	*(Student answers are recorded here, then a score of 0-5 given to each one and all scores totalled for the question)*
26.	What are some of the main impacts of climate change in Vanuatu? Valid impacts are: • Sea level rise • Coastal erosion • Damage to coral reefs/aquatic life • Ocean acidification • Longer periods of drought • Loss of crops due to drought or higher temperatures • Higher temperatures / hot temperatures • More extreme weather events, e.g. stronger cyclones, more floods • Change in fruiting/flowering seasons of trees and plants • Other, e.g. distress, increase in diseases such as malaria & dengue **5**: **Accurate**: At least 3 valid impacts **3**: **Satisfactory**: Two valid impacts **1**: **Limited**: One valid impact **0**: Irrelevant, unclear, don't know TOTAL SCORE: AVERAGE SCORE: ÷ =	
27.	What kinds of actions can I take to help my family and community become better prepared for the impacts of climate change and more intense disasters? List 3. Answer should give **adaptation** strategies appropriate at **family or community level** for preparing for CC / more intense disasters, e.g. plant more trees/reafforestation, build stronger houses, get larger water tanks, re-locate buildings away from the shoreline or a river, plant mangroves, use composting and mulching, use solar energy/panels, plant and eat more aelan kakae, plant crop varieties that are resilient to CC and disasters, encourage more gardening, establish community conservation areas/ marine conservation areas, use environmentally-friendly fishing methods (e.g. canoes), conserve/save water, conduct CC awareness, encourage greater unity in the community. **Mitigation measures** can be mentioned, e.g. use of renewable resources, use public transport rather than private vehicles, recycling, avoid burning rubbish/plastic, etc. **Preparations for disasters** can also be given, e.g. food preservation, gathering food and water, cyclone-proof housing, etc. **5: Accurate:** Three valid actions identified **3: Satisfactory:** Two valid actions identified **1: Limited:** One valid action identified **0**: Irrelevant, unclear, don't know TOTAL SCORE: AVERAGE SCORE: ÷ =	

Table 4.8 Example of a summary data form for QS6 for one class

Name of school and class: Sandalwood JSS Years 9/10 Science Date: 22 March 2021
Number of students participating (n): 21 Name of teacher:
Questions asked before or after use of Toolkit pictures? (Encircle): BEFORE AFTER

	Statement + 1 (correct) - 1	Agree	Disagree	Don't know	Total score (T)	Av score (T ÷ n)	
1.	1. Weather refers to the way that atmospheric conditions such as temperature, rainfall, pressure and wind are always changing.	14	2	5	**12**	0.57	*Knowledge*
2.	2. Climate refers to average conditions of temperature, rainfall, etc. over a long period of time.	16	2	3	**14**	0.67	
3.	3. Our climate changes because of both natural and human factors	9	5	7	**4**	0.19	
4.	4. Evaporation occurs when water vapour in the air changes back to tiny droplets of water.	3	10	8	**7**	0.33	
5.	5. Climate variability means that the climate of a place may change from year to year.	8	5	8	**3**	0.14	
6.	6. During an El Niño period, Vanuatu experiences droughts.	11	3	7	**8**	0.38	
7.	7. The greenhouse effect means that certain gases in the atmosphere absorb the heat being radiated back from the Earth, so keeping the atmosphere warm.	7	6	8	**1**	0.05	
8.	8. Greenhouse gases include carbon dioxide, methane, nitrous oxide and water vapour.	9	4	8	**5**	0.24	
9.	9. For the past 200 years, human activities are putting extra greenhouse gases into the atmosphere.	4	5	12	**-1**	-0.05	
10.	10. Carbon dioxide is absorbed by forests and the oceans	9	5	7	**4**	0.19	
11.	11. Coral reefs are being damaged by warmer temperatures and ocean acidification.	6	2	13	**4**	0.19	
12.	12. Vanuatu's greatest climatic dangers are cyclones and droughts.	5	7	9	**-2**	-0.10	
13.	13. Adaptation refers to the actions we can take to reduce the levels of greenhouse gases in the atmosphere.	4	4	13	**0**	0.00	
14.	14. Using compost is a sustainable form of gardening.	8	6	7	**2**	0.10	
15.	15. Catching fish with nets that have very small holes is a sustainable form of fishing.	4	10	7	**6**	0.29	
16.	16. Vanuatu is one of the most vulnerable countries in the world to natural disasters.	8	5	8	**3**	0.14	
17.	17. I am worried that climate change will bring great dangers to the world in the future.	8	6	7	**2**	0.10	*Attitudes*
18.	18. I want to join a student strike to show my concern about climate change.	7	6	8	**7**	0.33	
19.	19. I know a lot about the causes and impacts of climate change.	3	10	8	**-7**	-0.33	
20.	20. I want to help my community prepare for climate change and disasters.	6	7	8	**-1**	-0.05	

	Total score (T)	Av score (T ÷ n)	
21. What does "climate change" mean?	**2**	0.10	*Knowledge*
22. What is the enhanced greenhouse effect?	**6**	0.29	
23. What are 3 human activities putting extra GHGs into the atmosphere?	**16**	0.76	
24. What causes ocean acidification?	**5**	0.24	
25. Why is forestry important for mitigating climate change?	**19**	0.90	
26. What are some of the main impacts of climate change in Vanuatu?	**14**	0.67	
27. What kinds of actions can I take to help my family and community become better prepared for the impacts of climate change and more intense disasters? List 3.	**27**	1.29	*Behaviour*

Tables 4.7 and 4.8 show that while statements 1-20 carry a maximum of 1 point each, questions 21-27 can each score a maximum of 5 points.

For purposes of analysis, items 1-16 and 21-26 were considered as indicators of knowledge, items 17-20 of attitudes and item 27 of behaviour. The purpose of statement 18 was to measure the strength of a student's passion for taking action on climate change; however, a respondent was not penalized for disagreeing with joining a student strike because there are other ways in which concern can be expressed. Statement 19 was considered as an attitude as it reflects a student's level of confidence in his/her own ability.

4.3.3 Baseline Data for All Students

Table 4.9 and Figure 4.3 show responses to the diagnostic statements/questions aggregated for all students before undertaking the Toolkit activity. We can consider them as reflecting the baseline knowledge, attitudes and pro-environmental behaviours characteristic of Vanuatu students at Year 9 to 11 level before being exposed to an intervention designed to enhance these attributes.

For statements relating to knowledge, students already had a reasonable grasp of the following concepts, with scores of over +0.5 within a range of -1 to +1 points: weather, the role of both human and natural factors as causes of climate change, El Niño periods as a cause of drought, cyclones and droughts as Vanuatu's greatest climatic hazards, and using compost as a sustainable form of gardening. However, they recorded negative scores for three statements, reflecting a misunderstanding of evaporation, adaptation and sustainable fishing. This could also be because these are the only three out of 16 where "disagree" is in fact the correct answer. Short answers to the six knowledge questions revealed limited understanding: the only response to score over 1 out of a possible 5 points was that for Q23, which asks for three human activities responsible for extra greenhouse emissions. Questions 22 and 24, which require comprehension of the physical processes involved in global warming and ocean acidification, had the lowest scores.

With attitudes, students scored over +0.5 within a range of -1 to +1 points in three of the four categories, with the only low score showing, unsurprisingly, that students assessed themselves as having weak knowledge about the causes and impacts of climate change. The highest score was for willingness to help one's community prepare for climate change and disasters.

Table 4.9 Responses of all students before exposure to the intervention (n = 363)

Statement / Question	Total score (T)	Av score (T ÷ n)
1. Weather refers to the way that atmospheric conditions such as temperature, rainfall, pressure and wind are always changing.	317	**0.87**
2. Climate refers to average conditions of temperature, rainfall, etc. over a long period of time.	178	**0.49**
3. Our climate changes because of both natural and human factors	246	**0.68**
4. Evaporation occurs when water vapour in the air changes back to tiny droplets of water.	-79	**-0.22**
5. Climate variability means that the climate of a place may change from year to year.	94	**0.26**
6. During an El Niño period, Vanuatu experiences droughts.	213	**0.59**
7. The greenhouse effect means that certain gases in the atmosphere absorb the heat being radiated back from the Earth, so keeping the atmosphere warm.	144	**0.40**
8. Greenhouse gases include carbon dioxide, methane, nitrous oxide and water vapour.	125	**0.34**
9. For the past 200 years, human activities are putting extra greenhouse gases into the atmosphere.	77	**0.21**
10. Carbon dioxide is absorbed by forests and the oceans	134	**0.37**
11. Coral reefs are being damaged by warmer temperatures and ocean acidification.	158	**0.44**
12. Vanuatu's greatest climatic dangers are cyclones and droughts.	275	**0.76**
13. Adaptation refers to the actions we can take to reduce the levels of greenhouse gases in the atmosphere.	-53	**-0.15**
14. Using compost is a sustainable form of gardening.	275	**0.76**
15. Catching fish with nets that have very small holes is a sustainable form of fishing.	-16	**-0.04**
16. Vanuatu is one of the most vulnerable countries in the world to natural disasters.	187	**0.52**
17. I am worried that climate change will bring great dangers to the world in the future.	249	**0.69**
18. I want to join a student strike to show my concern about climate change.	259	**0.71**
19. I know a lot about the causes and impacts of climate change.	67	**0.18**
20. I want to help my community prepare for climate change and disasters.	293	**0.81**
21. What does "climate change" mean?	237	**0.65**
22. What is the enhanced greenhouse effect?	211	**0.58**
23. What are 3 human activities putting extra GHGs into the atmosphere?	524	**1.44**
24. What causes ocean acidification?	184	**0.51**
25. Why is forestry important for mitigating climate change?	277	**0.76**
26. What are some of the main impacts of climate change in Vanuatu?	302	**0.83**
27. What kinds of actions can I take to help my family and community become better prepared for the impacts of climate change and more intense disasters? List 3.	584	**1.61**

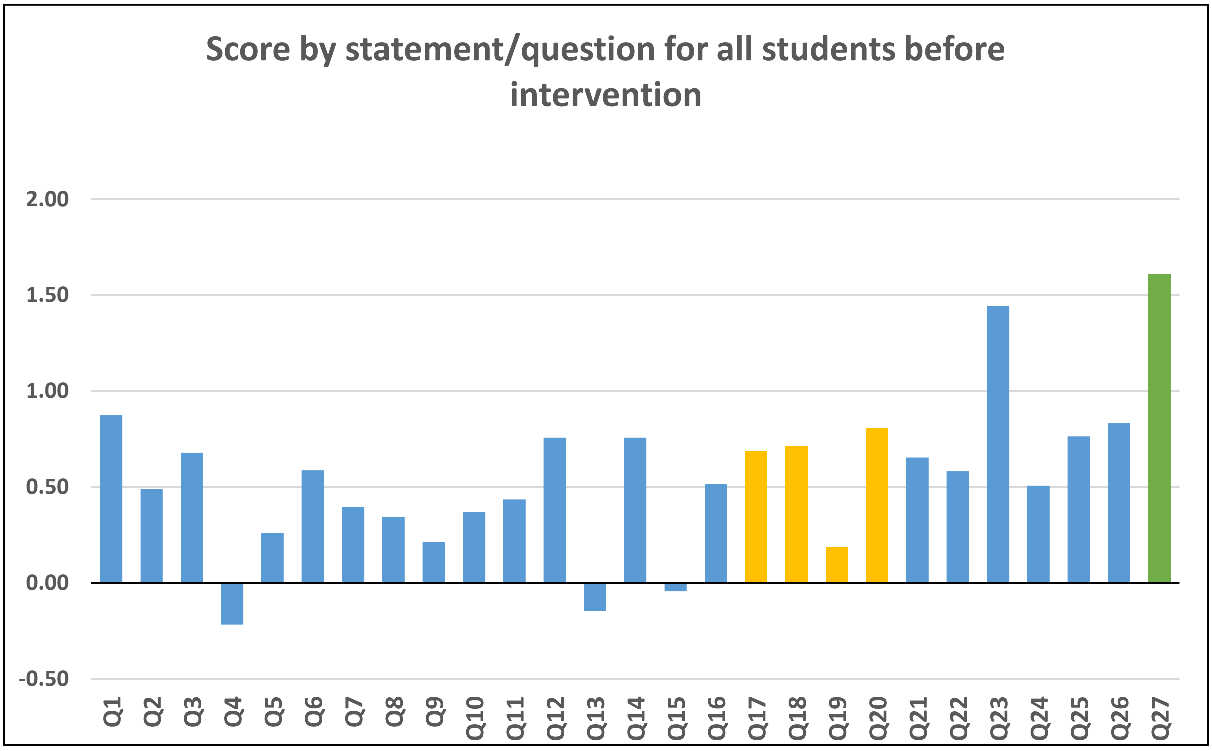
Knowledge	**0.50**
Attitudes	**0.60**
Behaviour	**1.61**
All	**0.56**

The score of over 1.5 out of a possible 5 points for pro-environmental behaviours indicated students' awareness of actions to take before, during and after disasters and reflects personal experience of hazards, particularly severe cyclones, as well as public education diffused through the media by the National Disaster Management Office. A closer examination of responses reveals that while many students also referred to proper rubbish disposal and avoidance of burning plastics, behaviours such as tree planting, recycling and using renewable energy were hardly mentioned.

The average score for all students for all items was +0.56. The maximum possible average score would be +2.04, calculated as follows: $\frac{(20 \times 1) + (7 \times 5)}{\text{no. of questions}} = \frac{55}{27}$

A crude interpretation is that their overall achievement was approximately 25% of the level indicating a high degree of resilience to disasters and climate change.

Figure 4.3 Graph of responses of all students before exposure to the intervention



4.3.4 Data for All Students After Completing the CC Toolkit Activity

Table 4.10 and Figure 4.4 show responses to the diagnostic statements/questions aggregated for all students after completing the CC Toolkit activity and discussing their findings.

After participating in the CC Toolkit activity, students had improved their average scores in 26 out of 27 items. The exception is for statement 13, whose score further decreased from -0.15 to -0.34. Thus students were still confused between adaptation and mitigation, despite visiting picture 11 when carrying out the activity and responding to the associated questions that provided definitions of both terms.

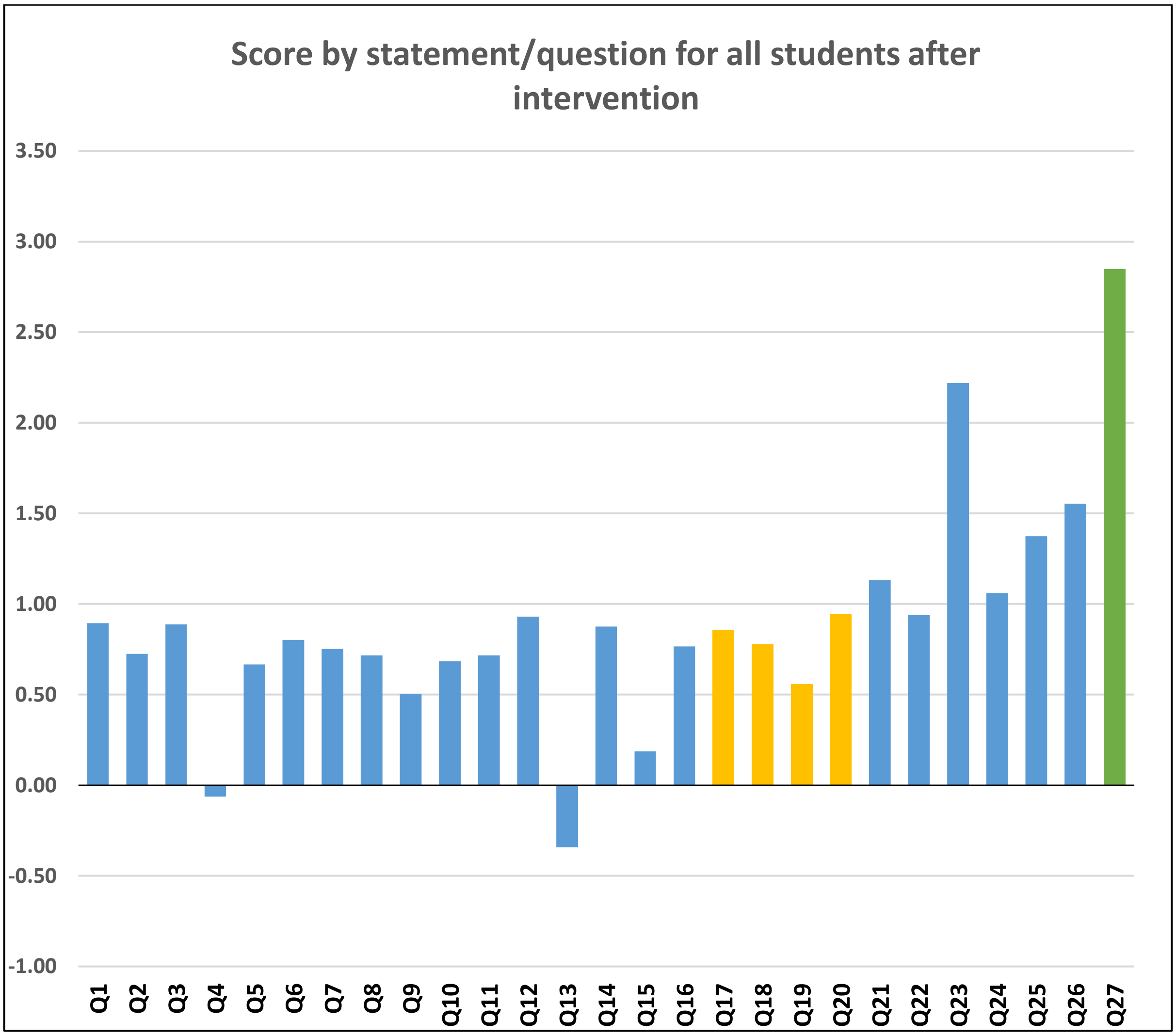
A possible explanation is that students saw all the strategies in picture 11 as being useful responses to climate change, but there was not enough discussion or clarification that mitigation addresses causes, while adaptation addresses impacts.

Table 4.10 Responses of all students after the intervention (n = 363)

Statement / Question	Total score (T)	Av score (T ÷ n)
1. Weather refers to the way that atmospheric conditions such as temperature, rainfall, pressure and wind are always changing.	325	**0.90**
2. Climate refers to average conditions of temperature, rainfall, etc. over a long period of time.	263	**0.72**
3. Our climate changes because of both natural and human factors	322	**0.89**
4. Evaporation occurs when water vapour in the air changes back to tiny droplets of water.	-23	**-0.06**
5. Climate variability means that the climate of a place may change from year to year.	242	**0.67**
6. During an El Niño period, Vanuatu experiences droughts.	291	**0.80**
7. The greenhouse effect means that certain gases in the atmosphere absorb the heat being radiated back from the Earth, so keeping the atmosphere warm.	273	**0.75**
8. Greenhouse gases include carbon dioxide, methane, nitrous oxide and water vapour.	260	**0.72**
9. For the past 200 years, human activities are putting extra greenhouse gases into the atmosphere.	183	**0.50**
10. Carbon dioxide is absorbed by forests and the oceans	248	**0.68**
11. Coral reefs are being damaged by warmer temperatures and ocean acidification.	260	**0.72**
12. Vanuatu's greatest climatic dangers are cyclones and droughts.	338	**0.93**
13. Adaptation refers to the actions we can take to reduce the levels of greenhouse gases in the atmosphere.	-124	**-0.34**
14. Using compost is a sustainable form of gardening.	318	**0.88**
15. Catching fish with nets that have very small holes is a sustainable form of fishing.	68	**0.19**
16. Vanuatu is one of the most vulnerable countries in the world to natural disasters.	278	**0.77**
17. I am worried that climate change will bring great dangers to the world in the future.	311	**0.86**
18. I want to join a student strike to show my concern about climate change.	282	**0.78**
19. I know a lot about the causes and impacts of climate change.	202	**0.56**
20. I want to help my community prepare for climate change and disasters.	342	**0.94**
21. What does "climate change" mean?	411	**1.13**
22. What is the enhanced greenhouse effect?	341	**0.94**
23. What are 3 human activities putting extra GHGs into the atmosphere?	806	**2.22**
24. What causes ocean acidification?	385	**1.06**
25. Why is forestry important for mitigating climate change?	499	**1.37**
26. What are some of the main impacts of climate change in Vanuatu?	564	**1.55**
27. What kinds of actions can I take to help my family and community become better prepared for the impacts of climate change and more intense disasters? List 3.	1034	**2.85**

Knowledge	**0.82**
Attitudes	**0.78**
Behaviour	**2.85**
All	**0.89**

Figure 4.4 Graph of responses of all students after the intervention



For knowledge statements, all except three now showed average scores of +0.5 or more on a scale of -1 to +1, with the exceptions being those that required respondents to indicate “disagree” rather than “agree”. The highest score was for statement 12, suggesting that as a result of Toolkit pictures 9 and 10, students had gained a deeper appreciation of cyclones and droughts as Vanuatu’s greatest climatic dangers. Among responses to knowledge questions 21 to 26, the strongest average score (2.22 out of 5) was still for identifying three human activities that contribute to the enhanced greenhouse effect and hence global heating (Q23), but there was now greater awareness of carbon dioxide (CO_2) as the major factor causing ocean acidification (Q24), and of the role of forests in absorbing CO_2 and so helping to mitigate climate change (Q25). This increased perception could relate to the influence of Toolkit pictures 7, 11 and 13.

Scores for the four attitude statements had also increased, with all now greater than 0.5 in a range of -1 to +1. Students appeared to be more confident about their knowledge of the causes and impacts of climate change (Q19), while more students expressed their readiness to help their communities prepare for climate change and disasters (Q20).

Regarding behaviour (Q27), the average score was now 2.85 out of 5, a marked increase from a score of 1.61 before undertaking the Toolkit activity. To help their family and community become better prepared for climate change and disasters, students were now listing actions such as the use of sustainable fishing methods, conservation of mangroves and forests, reafforestation, expansion of food gardens, building sea walls, construction of stronger houses and water tanks, awareness programmes in the community, greater use of solar power, relocation of houses to higher ground away from coastlines and rivers, burial of waste, and greater use of public transport. Such strategies are illustrated in Toolkit pictures 11-16. However, there was little mention of community or marine conservation areas, biogas, agroforestry, techniques of food preservation, using woven baskets rather than plastic bags, rearing honey-bees or aquaculture (pictures 10-14 and 16), nor of the importance of unity in the community. Nevertheless, it is clear that the practical adaptation and mitigation measures presented in the Toolkit had exposed students to a much wider range of behavioural strategies than might otherwise be known.

The average score for all students for all items was now 0.89, representing approximately 44% of the level that would reflect a high resilience to disasters and climate change.

4.3.5 Comparison of "Before" and "After" Data, and Change in Average Scores

Having looked at students' knowledge, attitudes and behaviours before and after participating in the Toolkit activity, we will now compare scores and determine whether the differences are significant.

Figure 4.5 and Table 4.11 provide total and average scores for all 363 students for each of the 27 statements/questions before and after the intervention, together with the difference between average scores. Because the Excel worksheet calculated average scores to two decimal places, the rounding process means that there were occasional discrepancies between the digits in the right-hand column and those obtained by subtracting the before average score from the after average score, as exemplified by items 1,4 and 7.   This also occurs in later tables featuring change in average scores.

Figure 4.5 Graph of change in average scores for all students before and after the intervention

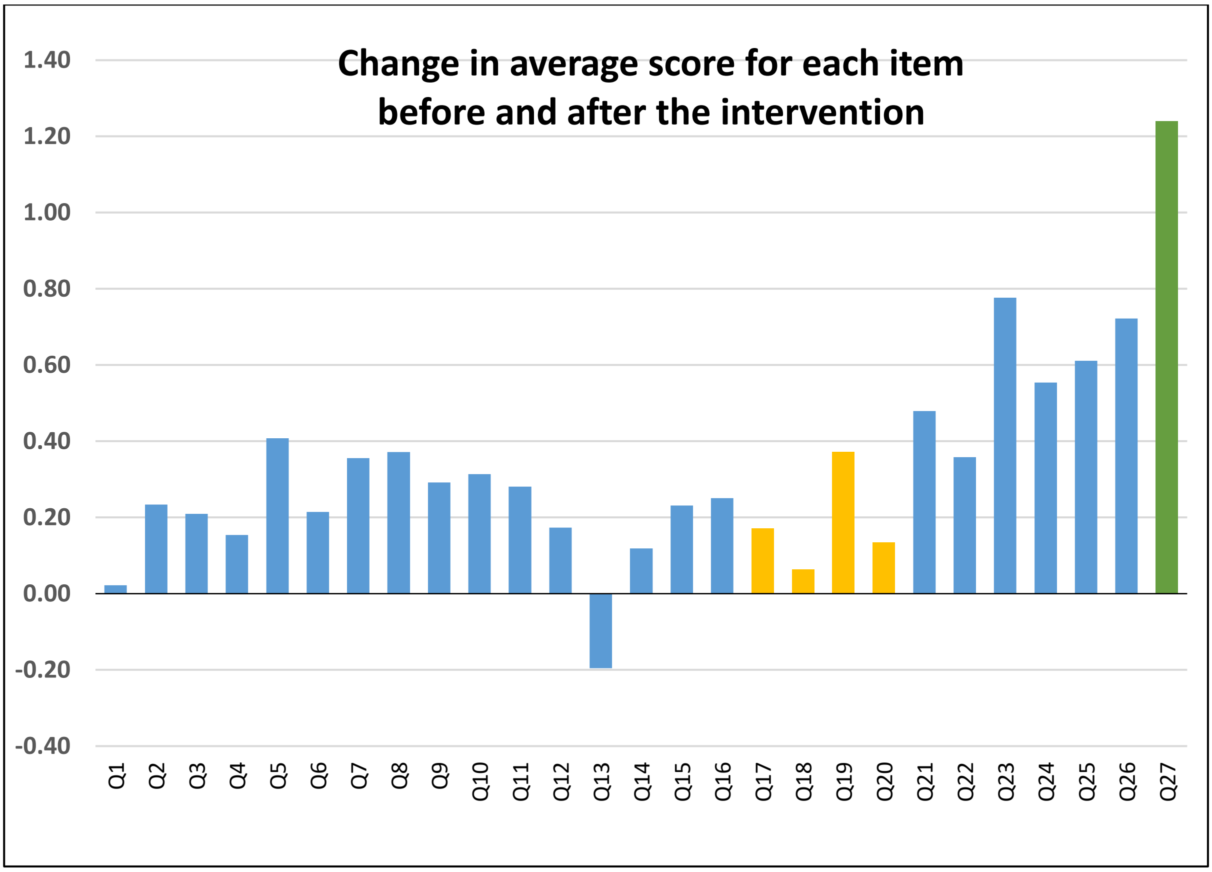
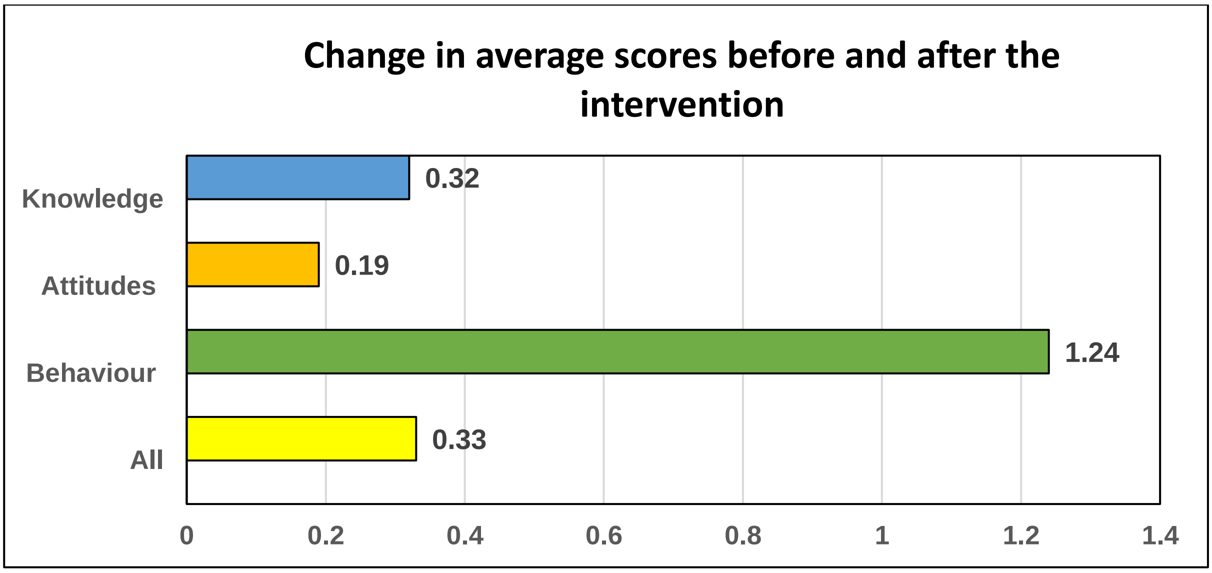


Table 4.11 Comparison of student responses before and after the intervention (n = 363)

Item	Before		After		Change in av.score
	Total score	Av.score (T ÷ n)	Total score	Av.score (T ÷ n)	
1. Weather refers to the way that atmospheric conditions such as temperature, rainfall, pressure and wind are always changing.	317	0.87	325	0.90	**+ 0.02**
2. Climate refers to average conditions of temperature, rainfall, etc. over a long period of time.	178	0.49	263	0.72	**+ 0.23**
3. Our climate changes because of both natural and human factors	246	0.68	322	0.89	**+ 0.21**
4. Evaporation occurs when water vapour in the air changes back to tiny droplets of water.	-79	-0.22	-23	-0.06	**+ 0.15**
5. Climate variability means that the climate of a place may change from year to year.	94	0.26	242	0.67	**+ 0.41**
6. During an El Niño period, Vanuatu experiences droughts.	213	0.59	291	0.80	**+ 0.21**
7. The greenhouse effect means that certain gases in the atmosphere absorb the heat being radiated back from the Earth, so keeping the atmosphere warm.	144	0.40	273	0.75	**+ 0.36**
8. Greenhouse gases include carbon dioxide, methane, nitrous oxide and water vapour.	125	0.34	260	0.72	**+ 0.37**
9. For the past 200 years, human activities are putting extra greenhouse gases into the atmosphere.	77	0.21	183	0.50	**+ 0.29**
10. Carbon dioxide is absorbed by forests and the oceans	134	0.37	248	0.68	**+ 0.31**
11. Coral reefs are being damaged by warmer temperatures and ocean acidification.14	158	0.44	260	0.72	**+ 0.28**
12. Vanuatu's greatest climatic dangers are cyclones and droughts.	275	0.76	338	0.93	**+ 0.17**
13. Adaptation refers to the actions we can take to reduce the levels of greenhouse gases in the atmosphere.	-53	-0.15	-124	-0.34	**- 0.20**
14. Using compost is a sustainable form of gardening.	275	0.76	318	0.88	**+ 0.12**
15. Catching fish with nets that have very small holes is a sustainable form of fishing.	-16	-0.04	68	0.19	**+ 0.23**
16. Vanuatu is one of the most vulnerable countries in the world to natural disasters.	187	0.52	278	0.77	**+ 0.25**
17. I am worried that climate change will bring great dangers to the world in the future.	249	0.69	311	0.86	**+ 0.17**
18. I want to join a student strike to show my concern about climate change.	259	0.71	282	0.78	**+ 0.06**
19. I know a lot about the causes and impacts of climate change.	67	0.18	202	0.56	**+ 0.37**
20. I want to help my community prepare for climate change and disasters.	293	0.81	342	0.94	**+ 0.13**
21. What does "climate change" mean?	237	0.65	411	1.13	**+ 0.48**
22. What is the enhanced greenhouse effect?	211	0.58	341	0.94	**+ 0.36**
23. What are 3 human activities putting extra GHGs into the atmosphere?	524	1.44	806	2.22	**+ 0.78**
24. What causes ocean acidification?	184	0.51	385	1.06	**+ 0.55**
25. Why is forestry important for mitigating climate change?	277	0.76	499	1.37	**+ 0.61**
26. What are some of the main impacts of climate change in Vanuatu?	302	0.83	564	1.55	**+ 0.72**
27. What kinds of actions can I take to help my family and community become better prepared for the impacts of climate change and more intense disasters? List 3.	584	1.61	1034	2.85	**+ 1.24**
Knowledge		**0.50**		**0.82**	**+ 0.32**
Attitudes		**0.60**		**0.78**	**+ 0.19**
Behaviour		**1.61**		**2.85**	**+ 1.24**
All		**0.56**		**0.89**	**+ 0.33**

Figure 4.6 compares the increase in average scores for all 363 students for each of the learning attributes

Figure 4.6 Graph of change in average scores for all students for knowledge, attitudes, behaviour and all categories before and after the intervention



When analysing Table 4.11 and Figure 4.6, we must bear in mind that each of items 1 to 20 scores a maximum of just 1 point, while each of items 21 to 27 scores a maximum of 5. Thus a change in average score of, say, + 0.4 in any of items 1 to 20 will be more significant than a change of + 0.4 in any item 21 to 27. Hence it may not be helpful to compare the magnitude of change for items 1 to 20 with that for items 21 to 27.

Regarding knowledge, items 1 to 16 are statements with which a student is asked to agree or disagree. Thirteen of these statements are true, and three (Qs 4, 13 and 15) are false. If a respondent correctly identifies the statement as true or false, 1 point is scored, but if she/he is incorrect, then the score is -1. Thus it is possible for the aggregated and average scores for all students to have negative values, and this was the case for the three false statements 4, 13 and 15 before the intervention (Figure 4.3). After the intervention, the average score for Q13 had further decreased to -0.34, while that for Q4 had increased, but was still negative. When considering overall changes for items 1 to 16 (Figure 4.5), all except one were positive, implying that the Toolkit exercise had increased the accuracy of students' knowledge. For

Q13, the inability to distinguish adaptation from mitigation could be due to a lack of discussion or clarification of terms when students were analysing picture 11. Another factor might be that a student was confused by having to tick the box in the "disagree" column when most of his/her other responses would be in the "agree" column. However, this did not apply so much to the change in average scores for Qs 4 and 15, which both showed an increase.

For other knowledge statements, the change in average scores was smallest for those items in which students' baseline knowledge was already relatively high, such as for the definition of weather (Q1), and compost as a sustainable form of gardening (Q14). The three items that showed the greatest improvement in average scores were for the definitions of climate variability (Q5) and the greenhouse effect (Q7), and for the identification of the four main greenhouse gases (Q8). Learning about these aspects of climate science would have been gained through studying Toolkit pictures 5 and 6. Other items recording notable increases were those relevant to the role of CO_2 (Qs 9, 10 and 11), related to pictures 6, 7 and 13; to sustainable fishing (Q15), linked to picture 14; and to the status of Vanuatu as one of the world's most vulnerable countries to natural disasters (Q16), associated with pictures 9 and 10.

Changes in average scores for statements referring to attitude (Qs17-20) were more modest, with the exception of the response to Q19, where the larger increase of 0.37 points reflected increased confidence felt by students in their understanding of climate change. In contrast, there was little change in students' willingness to participate in a climate change strike (Q18), or their readiness to help their community to prepare for disasters (Q20), with the latter reflecting a relatively high level of social consciousness already existing before they undertook the CC Toolkit activity.

We must acknowledge that another influence on all responses to the 20 agree/disagree items, both for the 16 knowledge and the 4 attitude statements, could be the "acquiescence response bias" (Saris et al, 2010), or more simply "acquiescence" (Billiet & McClendon, 2000). This means that when asked to agree or disagree with a given statement, respondents have a tendency to agree. Krosnick (1991) called this the "theory of satisficing", with respondents showing a bias towards the confirmation rather than disconfirmation of a statement. In terms of my “before” and “after” questionnaire, satisficing would mean that students were more inclined to tick each left hand box, perhaps thinking that this reflects the answer favoured by the researcher. Indeed, I did find completed questionnaires where a student had simply ticked every box in the left-hand column. Yet this was not the overall pattern in the majority of cases, either before or after. On the other hand, even if there was an acquiescence response bias, this would probably have the same effect on student answers both before and after the intervention, and so its influence on changes in scores would have been neutral. The fact that average scores in 19 out of 20 items did show an upward movement suggests that the use of the CC Toolkit had a positive impact on student learning.

Turning now to changes in responses to the questions requiring short answers, six of these (Qs 21 to 26) refer to knowledge, while one (Q27) deals with behaviour.

For items 21 to 26, the greatest improvement in average scores was in knowledge of human activities responsible for increased concentrations of atmospheric greenhouse gases (Q23) and some of the main impacts of climate change in Vanuatu (Q26). Knowledge of forestry’s role in mitigating climate change through the absorption of CO_2 also showed a marked increase. The least improvement was recorded for understanding the enhanced greenhouse effect (Q22), with students still confusing this with the natural greenhouse effect.

For behaviour, the rise of 1.24 in the average score for Q27, an increase of + 77%, suggests that the Toolkit had a noticeable impact on students’ readiness to improve the adaptive and coping capacities of their families and communities, thus fulfilling the learning outcomes specified in the LACCPW Teacher Guide:

- To discuss some possible adaptation and mitigation activities suitable for their community.
- To make a commitment to a personal adaptation and mitigation action.

(SPC & GIZ, 2013, p. 3)

The overall change between the before and after average score for all items for all students (Table 4.11 and Figure 4.6) was 0.33 points, an increase of + 59%. This compared with + 0.32 points for knowledge items (+ 64%), + 0.19 for attitude items (+ 30%) and + 1.24 for the behaviour item (+ 77%). The implication is that the Toolkit's effectiveness was greatest in changing students' behaviour, less in changing knowledge, and least in changing attitudes. However, these increases are not strictly comparable, since the knowledge value is based on 16 items worth 1 point each plus six items worth 5 points each, while the attitudes value is calculated from four items of 1 point each, and the behaviour value from just one item worth 5 points.

The validity of the change in overall average scores was measured using the Paired Samples Test in the statistical package SPSS (Table 4.12).

Table 4.12 Determination of validity of change between before and after average scores for all items for all 363 students

Average score	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
Before	0.5574	27	0.40451					
After	0.8881	27	0.61301					
Before - After	-0.3307	27	0.27711	-0.4404	-0.2211	-6.202	26	0.000

N: number of items; Conf.Int: confidence interval; t: t-value; df: degrees of freedom

There was a significant difference between the average scores for all items, measured before and after the intervention. This was demonstrated by a 2-tailed significance (p-value) of less than 0.05, by a t-value exceeding the critical value (cv) of 2.056 for a 95% confidence level, and by the range between lower and upper limits of the 95% confidence interval not crossing 0.

Similarly, there was a significant difference between the average scores for all knowledge items (Qs1-16 + Qs 21-26), as shown in Table 4.13 and using the criteria mentioned above. In this case, the t-value exceeded the critical value of 2.074 for a 95% confidence level.

Table 4.13 Determination of validity of change between before and after average scores for knowledge items for all 363 students

Average score	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
Before	0.5023	22	0.36725					
After	0.8177	22	0.52051					
Before - After	-0.3154	22	0.22127	-0.4136	-0.2174	-6.687	21	0.000

N: number of items; Conf.Int: confidence interval; t: t-value; df: degrees of freedom

Evaluating the significance of the change in average scores for attitude items (Qs 17-20) or for the behaviour item (Q27) could be done through the Paired Samples Test on SPSS because n was too small (4 for attitudes and 1 for behaviour). When a One Sample t Test was used for attitude items (Table 4.14), there did appear to be a significant difference between before and after average scores: the 2-tailed significance was less than 0.05, t-value exceeded a cv of 3.182 for a df of 3 at a 95% confidence level, and the range between lower and upper limits of the 95% confidence interval remained above 0.

Table 4.14 Determination of validity of change between before and after average scores for attitude items for all 363 students

Average score	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
Before	0.5975	3	0.28324	0.1468	1.0482	4.219	3	0.024
After	0.7850	3	0.16361	0.5247	1.0453	9.596	3	0.002

N: number of items; Conf.Int: confidence interval; t: t-value; df: degrees of freedom

In summary, t-testing showed that there was a significant change between students' average scores before and after the intervention in terms of all items and knowledge items. There was evidence that scores for attitudes also changed significantly, but to a lesser extent, since they were already relatively high beforehand. The one behaviour item showed the greatest change of all, at 1.24 points, but it was not possible to measure whether this was statistically significant.

4.3.6 Further Comparison of "Before" and "After" Data for Individual Items

Table 4.15 analyses students' performance in each item by indicating the rank of the item in descending order of achievement before and after the CC Toolkit activity, as well as by descending order of the change in average scores. Ranking has been calculated for three groups - 16 knowledge items requiring agree/disagree (A/D) answers; four attitude items requiring A/D answers; and the six knowledge and one behaviour items requiring short answers, each worth 5 points.

Table 4.15 Ranking of all 27 items according to average scores before and after the intervention and by change in average scores

Statement / Question no.	Before		After			Change	
	Av. score	Rank	Av. score	Rank		Av. score	Rank
1. Weather refers to the way that atmospheric conditions such as temperature, rainfall, pressure and wind are always changing.	0.87	**1**	0.90	**2**		+ 0.02*	**15**
2. Climate refers to average conditions of temperature, rainfall, etc. over a long period of time.	0.49	**7**	0.72	**8**		+ 0.23	**8**
3. Our climate changes because of both natural and human factors	0.68	**4**	0.89	**3**		+ 0.21	**10**
4. Evaporation occurs when water vapour in the air changes back to tiny droplets of water.	-0.22	**16**	-0.06	**15**		+ 0.15	**13**
5. Climate variability means that the climate of a place may change from year to year.	0.26	**12**	0.67	**12**		+ 0.41	**1**
6. During an El Niño period, Vanuatu experiences droughts.	0.59	**5**	0.80	**5**		+ 0.21	**10**
7. The greenhouse effect means that certain gases in the atmosphere absorb the heat being radiated back from the Earth, so keeping the atmosphere warm.	0.40	**9**	0.75	**7**		+ 0.36	**3**
8. Greenhouse gases include carbon dioxide, methane, nitrous oxide and water vapour.	0.34	**11**	0.72	**9**		+ 0.37	**2**
9. For the past 200 years, human activities are putting extra greenhouse gases into the atmosphere.	0.21	**13**	0.50	**13**		+ 0.29	**5**
10. Carbon dioxide is absorbed by forests and the oceans	0.37	**10**	0.68	**11**		+ 0.31	**4**
11. Coral reefs are being damaged by warmer temperatures and ocean acidification.	0.44	**8**	0.72	**10**		+ 0.28	**6**
12. Vanuatu's greatest climatic dangers are cyclones and droughts.	0.76	**2**	0.93	**1**		+ 0.17	**12**
13. Adaptation refers to the actions we can take to reduce the levels of greenhouse gases in the atmosphere.	-0.15	**15**	-0.34	**16**		- 0.20	**16**
14. Using compost is a sustainable form of gardening.	0.76	**2**	0.88	**4**		+ 0.12	**14**
15. Catching fish with nets that have very small holes is a sustainable form of fishing.	-0.04	**14**	0.19	**14**		+ 0.23	**8**
16. Vanuatu is one of the most vulnerable countries in the world to natural disasters.	0.52	**6**	0.77	**6**		+ 0.25	**7**
17. I am worried that climate change will bring great dangers to the world in the future.	0.69	**3**	0.86	**2**		+ 0.17	**2**
18. I want to join a student strike to show my concern about climate change.	0.71	**2**	0.78	**3**		+ 0.06	**4**
19. I know a lot about the causes and impacts of climate change.	0.18	**4**	0.56	**4**		+ 0.37	**1**
20. I want to help my community prepare for climate change and disasters.	0.81	**1**	0.94	**1**		+ 0.13	**3**
21. What does "climate change" mean?	0.65	**5**	1.13	**5**		+ 0.48	**6**
22. What is the enhanced greenhouse effect?	0.58	**6**	0.94	**7**		+ 0.36	**7**
23. What are 3 human activities putting extra GHGs into the atmosphere?	1.44	**2**	2.22	**2**		+ 0.78	**2**
24. What causes ocean acidification?	0.51	**7**	1.06	**6**		+ 0.55	**5**
25. Why is forestry important for mitigating climate change?	0.76	**4**	1.37	**4**		+ 0.61	**4**
26. What are some of the main impacts of climate change in Vanuatu?	0.83	**3**	1.55	**3**		+ 0.72	**3**
27. What kinds of actions can I take to help my family and community become better prepared for the impacts of climate change and more intense disasters? List 3.	1.61	**1**	2.85	**1**		+ 1.24	**1**

* In this and succeeding tables, minor discrepancies between before and after average scores and the change between them are due to rounding of decimals to two places.

For example, statement no.1 was ranked first before the intervention because out of all 16 A/D knowledge items, it was in this that students achieved the highest score. After the intervention, it was ranked in second position out of all A/D knowledge items. But as the score changed little between before and after, the item was ranked 15th out of 16 in the change (right-hand) column.

In general, Table 4.15 shows that average scores for nearly all items increased between before and after, but the rank order of items by average score remained very similar: thus the rank of 8 out of 27 items was identical, and that of all others did not change by more than two positions. However, the rank order according to magnitude of change (right-hand column) is measuring a different entity and is not comparable with the other two rankings. It provides an indication of how effective the Toolkit has been in raising students' performance in each question/item, demonstrating that it has increased learning in some items more than others.

Among knowledge A/D items (Qs 1-16), the highest ranked improvements in average scores were for defining climate variability (Q5: + 0.41), identifying greenhouse gases (Q8: + 0.37) and defining the greenhouse effect (Q7: 0.36).

The lowest scores and improvement rates were for items 4, 13 and 15. For Q4, the terms condensation, evaporation and precipitation are clearly shown in Toolkit picture 2, and have been in students' vocabularies since primary level, so the weak performance in this questions could be due to factors such as acquiescence or language. For the vast majority of secondary students in Vanuatu, English or French is their second language, only spoken in class. In the Tourangeau model of cognitive processes involved in answering questions (Kamoen et al, 2011, p.6; Tourangeau et al, 2000, p.8), there are four steps: firstly, interpretation or comprehension of the question; secondly, retrieval of relevant memories of facts, attitudes, etc.; thirdly, making a judgement from all the information retrieved; and fourthly, mapping this judgement on to the response options available for the question. A respondent may not necessarily use all of these processes for each question. I have no direct evidence, but surmise that the errors that occurred with Q4 could be due to the first and third processes, with students' linguistic inadequacies causing confusion over definitions of evaporation and condensation.

Q13, on the definition of adaptation, has already been highlighted as the only statement for which average scores were lower after the intervention than beforehand, with the magnitude of change (-0.20) ranked 16th out of the 16 knowledge items. Factors involved in this decline could be: the lack of sufficient clarification in class of the difference between adaptation and mitigation measures, despite the visual distinction made in picture 11; the influence of acquiescence, since this statement requires the student to tick the disagree column; and, as mentioned for Q4, errors in all four cognitive process involved in answering A/D questions that were exacerbated by inadequate language skills. Q15 required students to understand the implication of fishing nets with small holes and the definition of "sustainable". A student would need to reason that fine-meshed nets will capture both adult and baby fish, thus reducing the population that can grow into catch of suitable size, so resulting in overexploitation of marine resources. Cognitive processes 1 and 3 were involved here. Then after making the judgement, the answer had to be mapped (process 4) in the correct place, which in this case is the disagree column. If we add in the acquiescence factor, it is unsurprising that this item rated a negative score. After the intervention, the average score improved by 0.23 points, but its value was still low at 0.19. One reason for the gain could be that some students learned from picture 14 that fishing nets are a "bad" or unsustainable fishing strategy. However, the acquiescence factor could still be operating, so that the degree of change was only average, ranked 8th out of 16.

Turning now to the four attitude statements, students had already recorded high scores in Qs 17, 18 and 20 before participating in the Toolkit exercise, and the subsequent increases were slight. For Q18, which attempts to measure the extent of a student's concern about climate change issues, there was minimal increase in scores between before and after, with the degree of change (0.06) being the lowest of the attitude items and the third lowest among all 20 A/D items. During 2019 and early 2020, when there was world-wide student activism to address the unjust and devastating impacts of climate change and protest against ongoing emissions of greenhouse gases, the Vanuatu Climate Action Network (VCAN) encouraged individuals, including school students, to "strike for the climate emergency". Examples were the strikes of 17th March 2019 (Figure 4.7) and 20th September 2019 (NAB, 2019 & Figure 4.8), which had the full backing of the Ministry of Climate

Change, and implicitly, of the Government. This influenced the design of my "before/after" questionnaire for the CC Toolkit: Q18 was formulated to gauge the strength of a student's desire to do something about climate change, assuming that this would be shown by willingness to forgo lessons to go on a protest march. Later, I realized that disagreeing with the statement did not necessarily mean that a student was unconcerned about climate change, but might instead prefer to express concern in other ways, such as writing to the national newspaper, or contacting his/her local MP. Thus disagreement with the statement was counted as 0 rather than -1. As to why the intervention resulted in such a low increase in average scores for Q18, we must bear in mind that at the time when teachers were conducting the CC Toolkit activity with their classes (mostly between March and November 2020), Vanuatu was under the State of Emergency arising from the COVID-19 pandemic and TC Harold, and there was a general atmosphere of anxiety and uncertainty among school populations, with many schools suspending face-to-face classes for several weeks. Consequently, when asked to make a judgement about Q18, some students may have considered that they had already missed so much schooling that to absent themselves from further classes through strike action was unconscionable.

Figure 4.7 A group of school students in Port Vila participate in the World-Wide School Strike for Climate Action, 17th March 2019

Students for Climate Action Vanuatu FB page

Author, 2019

Figure 4.8 Poster at the front entrance of Nagavika College, Port Vila, advertising the student strike of 20th September 2019. Photograph taken 30th September 2019

Q19 had a different response pattern to the other three attitude questions, with an initial low average score of 0.18 and a subsequent rise of 0.37 points to reach 0.56 as a result of the intervention. The statement was intended to measure a student's self-confidence in his/her awareness of the causes and impacts of climate change, and was therefore classified as an attitude rather than as an indication of concrete knowledge. There is a link here to the "confidence heuristic" (Pulford et al.,2018) which suggests that people are more confident when they have more knowledge, and this confidence makes them more persuasive, especially in verbal communication. Exposure to the Toolkit seems to have made students become much more confident about their knowledge of climate change, with the increase in average score the second highest among all 20 A/D statements. In retrospect, perhaps the statement should have been worded as: "I feel confident in my ability to talk about the causes and impacts of climate change".

For the short answer questions (Qs 21-27), change in a question's average score must be seen in relation to a possible total of five, whereas for questions 1-20, it relates to a total of one. Table 4.15 shows that there was very little change in the rank order of achievement between before and after in these seven questions, with the rank remaining the same in five, and varying by just one position in the remaining two. The greatest magnitude of change was for Q27, on behaviour, and the least for

Q22, on the enhanced greenhouse effect. In general, those questions requiring more theoretical, scientific knowledge (Qs 21, 22, 24 and 25) had the lowest average scores and the lowest change in average scores, while the three that referred to more concrete concepts or practical actions (Qs 23, 26 and 27) scored more highly on both counts.

The Toolkit seems to have been least effective in helping students to understand the meaning of climate change (Q21: + 0.48), the enhanced greenhouse effect (Q22: + 0.36) and the cause of ocean acidification (Q24: + 0.55). Q21 was not well answered before the intervention, with an average score of only 0.65 out of 5. For many schools, scores after the intervention did not noticeably improve, and in those where there was an increase, the definitions appeared to come from internet sources. Perhaps the lack of improvement is not surprising, since the term “climate change” is not defined in any of the pictures, and would only emerge in class discussions if the teacher had consulted the Teacher’s Guide. Similarly, Q22 demonstrated that the enhanced greenhouse effect was the concept least grasped by students, ranked 6th before the intervention and 7th afterwards. Their misunderstanding may have arisen from the technical language used: even though picture 6 shows ways in which human activities are increasing the natural greenhouse effect, the word “enhanced” is absent, neither does it appear in the class questions provided with that picture. Unless the teacher ensured that the meaning of this term was clarified during class discussions about the Toolkit pictures, many students would not have understood the meaning of Q22 – an error at step 1 in Tourangeau’s cognitive processes. There was awareness that human activities are responsible for increased global heating, but not of the language used to express this process. Thus another factor explaining the low level of performance is related to a deficiency in Q22 itself – an oversight on the part of the researcher. For Q24, ocean acidification was the least understood concept before the intervention; afterwards, the average score doubled, but still ranked 6th in absolute performance and 5th for change. Picture 7 shows how extra CO_2 is being created by human activities and then absorbed by the ocean, but the term “acidification” is not present. The Toolkit increased students’ comprehension of the cause of ocean acidification, but details of the process itself, whereby absorption of CO_2 produces weak carbonic acid and lowers the pH of sea water, were grasped by very few: instead, many students were still listing factors such as waste disposal and fuel leakages from marine vessels.

The Toolkit was more effective in raising student awareness of human activities contributing to greenhouse gas emissions (Q23: +0.78) and of impacts of climate change in Vanuatu (Q26: +0.72). After the intervention, students could give more detailed responses to Q23, including mention of CO_2 and other fossil fuels, but agricultural practices such as cattle rearing and rice cultivation received scant attention, even though appearing in picture 6. For Q26, the Toolkit almost doubled average scores, helping students to move from simply mentioning cyclones, droughts, El Niño and La Niña to emphasizing sea level rise, coastal erosion, warmer temperatures and weather extremes, shortages of food and water, and changes in seasonal patterns of weather and harvesting times. But most answers lacked the breadth and precision that would score 3 or more points, so that the overall average score was 1.55 out of 5.

As already highlighted, the highest average score for any single question was for Q27, which deals with pro-environmental behaviours that the student is planning to adopt. This was already at 1.61 before the intervention, and increased by 1.24 to reach 2.85 points afterwards. The amount of change ranks first among all questions, suggesting that in this aspect the CC Toolkit was at its most effective. Pictures 11 to 16 undoubtedly gave students many more practical ideas for adapting to climate change than they had before the activity.

In summary, the ranking of questions by average scores for all Vanuatu students before and after the intervention, as well as by the magnitude of change, reveals that the Toolkit pictures have been at their most effective in improving students' intended behaviour in preparing for climate change and disasters. The pictures have also promoted better understanding of climate variability, greenhouse gases and their effects, the absorption of carbon dioxide by oceans and forests, and human activities contributing to climate change. But a deeper awareness of scientific processes may not have been gained, neither was there a significant advance in the understanding of key technical terms such as adaptation, mitigation, acidification and the enhanced greenhouse effect.

4.3.7 *Triangulating the Statistical Data Against Interviews with Teachers*

It is useful to see how the quantitative data on students' performance before and after participating in the CC Toolkit activity triangulated with information received through email interviews with some of the teachers involved.

In relation to student learning, these comments are relevant:

> The pictures aroused their interest and they eagerly engaged in the activities because the topic is an important issue in their lives. The scientific parts of the activity were where they usually needed my assistance in explaining the graphs and temperatures. The students were really excited about the impacts of CC and ways to adapt and mitigate to CC. This activity has helped me and the students to learn a lot intuitively in a cooperative way. Students have also become conscious of their actions relating to how their choices and actions contribute to CC.
>
> (Teacher of Year 10 Social Science, Banyan School)

> All students had the same reaction. They really enjoyed this activity. I think it was because … they were learning through investigating things and discussing things themselves, without the teacher telling them. In other words, they enjoyed the activity because it was discovery learning. … They particularly benefited from the pictures on agriculture and forestry, learning about methods of adaptation to the impacts of climate change and disasters. I feel that their behaviour towards the environment will change as a result of doing this activity. This was an effective activity because it uses a teaching style that engages the students.
>
> (Teacher of Year 10 Science, Tamanu College)

Teachers also confirmed that they themselves benefited from the activity:

> This activity has given me ideas of how to teach about the reality of things. It has expanded my knowledge. And as a Science teacher, I have learned more about how to use the technique of discovery learning, in which students use resources to find things out by themselves.
>
> (Teacher of Year 10 Science, Tamanu College)

> (Translation) Honestly, I would say that this activity has helped me in teaching Earth Science (Year 11) because the activities in the book* really help learning. The pictures are very clear, accompanied by questions that are simple, understandable and truly linked to reality. I don't have any resources, only the internet. Thank you for sending us the pictures and the book.
>
> (Teacher of Yr 11-13 Earth Science, Tamanu College)

* the book is the Teacher's Guide for LACCPW

In general, teachers perceived that students were engaged by the CC Toolkit intervention because the pictures were stimulating and students could use them to discuss and discover things for themselves. Awareness of the impacts of climate change increased and it is likely that students' pro-environmental behaviours were also strengthened – confirmed by the quantitative data for Q26 and Q27 in Tables 4.11 and 4.15. The notion that students had gained a better understanding of adaptation to climate change through pictures 12 and 13 on agriculture and forestry is exemplified by the sizeable rise in the average score for behaviour (Q27), even though comprehension of "adaptation" as a technical term (Q13) was not enhanced by the intervention.

Teachers also said that they themselves had benefited from the cooperative discovery learning approach fostered by the activity, since it clearly improved students' motivation to learn – so reducing any problems of classroom management. They liked the way the activity involved students in real-life situations and they valued the Toolkit pictures and accompanying Guide as important resources in the absence of any textbooks – not just at Year 9/10 level, but also for students studying Earth Science in Years 11-13. Interestingly, the difficulties that teachers observed relate to students' problems in interpreting pictures 3 and 8, which depict climatic graphs for Pacific towns, but only figure in an indirect way in Q26 of the "before/after" questionnaire. Students' misunderstandings of mitigation and adaptation, as well as of the scientific processes involved in the enhanced greenhouse effect and the absorption of CO_2 by forests and oceans, were not mentioned at all.

4.3.8 Comparison of Scores by Gender

Having analysed the results for the whole Vanuatu cohort of 363 students, I will now investigate variations within this cohort, making comparisons that explore the data in greater depth. I start with gender. In this context, note that "performance" is measured by scores achieved in the "before/after" diagnostic questionnaire for knowledge, attitudes, intended patterns of behaviour and all three aspects together.

The question of whether gender has an effect on students' academic performance is a subject of long-standing debate. Hyde (2004) proposed the "gender similarities hypothesis", arguing that boys/males and girls/females are more alike than they are different, being similar in most psychological variables. However, research carried out in both the global “North” and “South” suggests that although historically boys achieved higher educational levels than girls, both in participation (school attendance) and performance (academic achievements), this trend began to reverse during the closing decades of the 20th century as education expanded globally through initiatives such as the UN’s World Declaration on Education for All in 1990 (UNESCO, 1990). Since then, girls are shown to be outperforming boys academically at secondary level, both in the developed and the developing world (Van Houtte, 2004; Jha & Kelleher, 2006; Hadjar et al, 2014; Nnamani & Oyibe, 2016; Ullah & Ullah, 2019).

Among reasons given for boys’ underachievement at secondary level are that during adolescence, boys are less study-oriented, less motivated and more inclined to antisocial behaviours in a school environment (Hadjar et al, 2014). In developing countries, boys often have greater personal freedom and higher status than girls within the family, leading to their being over-indulged, and they are more likely to be engaged in family economic activities while still schooling (Ullah & Ullah, 2019.) In Samoa, Jha & Kelleher (2006) pointed out that boys are expected to show visible evidence of support to community welfare, and that this may negatively affect their academic achievements in school. In Vanuatu, Mahuri (2019) demonstrated through his interviews with 45 teachers in North Pentecost that certain socio-cultural practices jeopardize academic progress: excessive kava drinking, with male students often involved in nightly kava preparation and more interested in planting kava than attending school; external religious and cultural activities that take students away from their studies and make them tired during school-time; and parents more attentive to their customary responsibilities than to their children’s education. Mahuri considered how these practices hinder both participation and performance of all schoolchildren, but the implication was that boys are impacted to a greater extent than girls. Interestingly, the latest statistics from Vanuatu’s Ministry of Education reveal that at primary level (Years 1 to 6) males still outnumber females by 29,817 to 27,255, but the situation at secondary level (Years 7 to 14) is reversed, with 13,204 females and 12,516 males (MOET, 2022).

Literature on the particular influence of gender on students' performance in climate change education at secondary school level is limited. Numerous studies in the USA show how there is a consistent gender gap in perceptions of environmental problems, including climate change, with women's greater environmental concerns largely due to their heightened risk perception (Bord & O'Connor, 1997; McCright, 2010; Xiao & McCright, 2012; Ballew et al, 2018) and their greater propensity to show compassion and express an 'ethic of care' (Tzelezny et al, 2000, p.445). Women are more likely than men to express more knowledge about climate change and worry about its effects (McCright, 2010). Ballew et al (2018) found that women scored lower than men in a test on scientific knowledge about climate change and were more likely to express uncertainty about the factors contributing to global warming. However, all these studies relate to adult perceptions of climate change acquired through public communications rather than perceptions of school students gained in the classroom through climate change education. More relevant to my research is a study in Tanzania, where Kira & Komba (2015) collected information from 480 secondary school students and found that boys were significantly more knowledgeable than girls in their understanding of climate change: they had greater awareness, for example, of the role played by CO_2 in global warming and of industries and automobiles as the most important contributors to greenhouse gas emissions.

At the outset, I did not plan to seek differences in performance in the CC Toolkit activity by gender, considering that the focus should be on measuring the effectiveness of the resource itself when used in mixed-gender classrooms where students would theoretically have equal status and treatment. Therefore no provision was made on the "before/after" questionnaire for indicating gender. Later, when analysing completed forms and observing student names, I suspected that boys might be performing better in items such as Q15 (on fishing nets) and that many of the more accurate responses to the short-answer questions were coming from girls. Also, in nearly all schools, more females than males were completing the activity. I therefore decided to disaggregate scores by male/female for a selection of schools that included those in both urban and rural locations, contacting the teachers concerned to confirm their students' gender. Overall, data was disaggregated by gender for 112 girls and 97 boys from eight classes in five schools. The classes taught by female teachers had 74 female and 53 male students, while those taught by male teachers comprised 38 females and 44 males. Thus in terms of participation, classes with female teachers had higher proportions of females than males, while classes with male teachers had higher proportions of males than females. This may simply be co-incidence, or it may reflect my own observation from 35 years of teaching in Vanuatu that teenage boys at Years 9-10 level are more likely than girls to miss classes when their teacher is female. Note that 84% of Year 9 students are aged 14-17, and 85% of Year 10 students are aged 15-18 (MOET, 2022, calculated from Table 18).

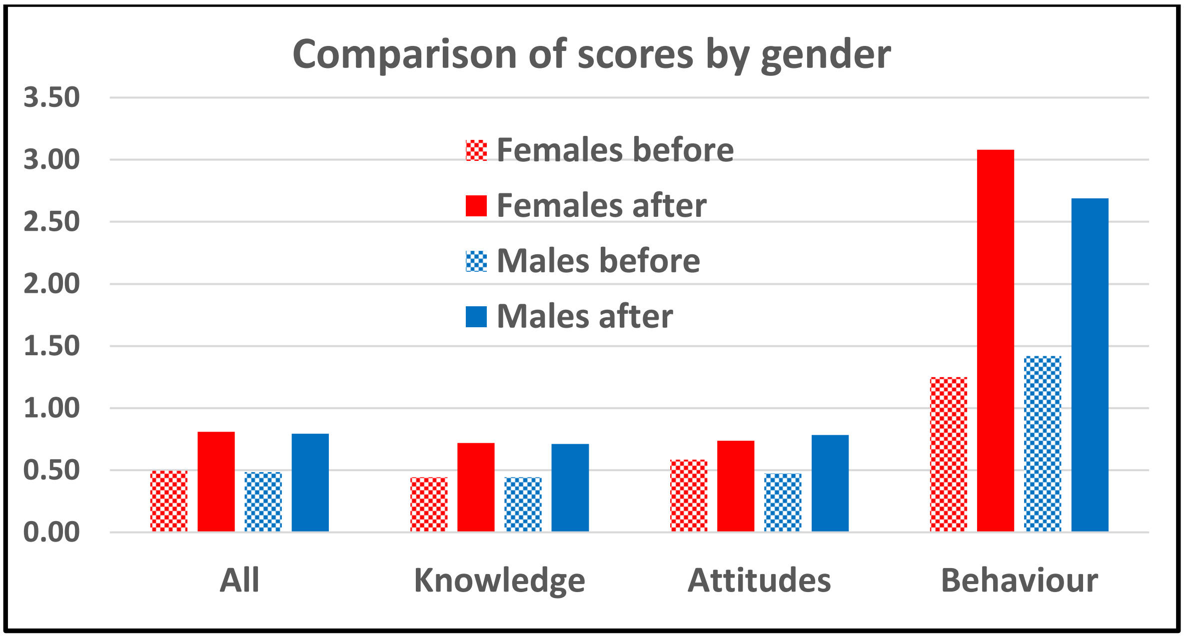
Table 4.16 and Figure 4.9 show that when looking at student responses to all items in the "before/after" questionnaire, the average scores for girls and boys were almost identical: 0.49 for both genders before the intervention, and 0.81 for girls and 0.80 for boys afterwards. Likewise, the change in average scores before/after was 0.32 for girls and 0.31 for boys. Scores could range from -1.0 to +1.0 for items 1 to 20, and from 0.0 to +5.0 for items 21 to 27. The higher the score, the higher the degree of resilience implied and so the better the performance.

For knowledge items, there was a similar pattern, with girls attaining average scores of 0.44 beforehand and 0.72 afterwards, with an increase of 0.28, while the comparable scores for boys were 0.45 and 0.71 with an increase of 0.27. For attitudes, girls had a higher average score than boys before the intervention (0.58 to 0.48), but a lower score afterwards (0.73 to 0.78), so that the improvement for girls was half that for boys (0.15 to 0.31). In terms of behaviour, boys had a higher score than girls beforehand (1.42 to 1.25), and a lower score afterwards (2.69 to 3.08), with a lower degree of improvement (1.27 to 1.83). Note that the scores for behaviour are based on one item only (Q27), which has a mark range of 0 to 5.

Table 4.16 Comparison of average scores for females and males before and after the intervention

Statement / Question no.	Females (n = 112)			Males (n = 97)		
	Before Av. score	After Av. score	Change	Before Av. score	After Av. score	Change
1. Weather refers to the way that atmospheric conditions such as temperature, rainfall, pressure and wind are always changing.	0.94	0.92	**-0.02**	0.80	0.82	**0.02**
2. Climate refers to average conditions of temperature, rainfall, etc. over a long period of time.	0.47	0.53	**0.05**	0.38	0.65	**0.27**
3. Our climate changes because of both natural and human factors	0.63	0.85	**0.22**	0.63	0.92	**0.29**
4. Evaporation occurs when water vapour in the air changes back to tiny droplets of water.	-0.30	-0.30	**0.00**	-0.04	-0.16	**-0.12**
5. Climate variability means that the climate of a place may change from year to year.	0.25	0.54	**0.29**	0.23	0.64	**0.41**
6. During an El Niño period, Vanuatu experiences droughts.	0.48	0.76	**0.28**	0.69	0.68	**-0.01**
7. The greenhouse effect means that certain gases in the atmosphere absorb the heat being radiated back from the Earth, so keeping the atmosphere warm.	0.30	0.76	**0.46**	0.33	0.64	**0.31**
8. Greenhouse gases include carbon dioxide, methane, nitrous oxide and water vapour.	0.27	0.78	**0.51**	0.25	0.48	**0.24**
9. For the past 200 years, human activities are putting extra greenhouse gases into the atmosphere.	0.16	0.43	**0.27**	0.18	0.46	**0.29**
10. Carbon dioxide is absorbed by forests and the oceans	0.29	0.45	**0.16**	0.38	0.77	**0.39**
11. Coral reefs are being damaged by warmer temperatures and ocean acidification.	0.39	0.68	**0.29**	0.46	0.66	**0.20**
12. Vanuatu's greatest climatic dangers are cyclones and droughts.	0.86	0.89	**0.04**	0.70	0.91	**0.21**
13. Adaptation refers to the actions we can take to reduce the levels of greenhouse gases in the atmosphere.	-0.27	-0.38	**-0.12**	0.00	-0.54	**-0.54**
14. Using compost is a sustainable form of gardening.	0.72	0.92	**0.20**	0.56	0.80	**0.25**
15. Catching fish with nets that have very small holes is a sustainable form of fishing.	-0.05	0.10	**0.15**	-0.01	0.39	**0.40**
16. Vanuatu is one of the most vulnerable countries in the world to natural disasters.	0.41	0.71	**0.30**	0.55	0.76	**0.22**
17. I am worried that climate change will bring great dangers to the world in the future.	0.63	0.88	**0.24**	0.42	0.81	**0.39**
18. I want to join a student strike to show my concern about climate change.	0.69	0.70	**0.01**	0.71	0.81	**0.10**
19. I know a lot about the causes and impacts of climate change.	0.20	0.44	**0.24**	0.11	0.61	**0.49**
20. I want to help my community prepare for climate change and disasters.	0.82	0.93	**0.11**	0.66	0.90	**0.24**
21. What does "climate change" mean?	0.57	0.91	**0.34**	0.27	0.67	**0.40**
22. What is the enhanced greenhouse effect?	0.59	0.88	**0.29**	0.47	0.86	**0.38**
23. What are 3 human activities putting extra GHGs into the atmosphere?	1.47	2.08	**0.61**	1.16	2.08	**0.92**
24. What causes ocean acidification?	0.35	0.73	**0.38**	0.41	0.72	**0.31**
25. Why is forestry important for mitigating climate change?	0.66	1.15	**0.49**	0.72	1.21	**0.48**
26. What are some of the main impacts of climate change in Vanuatu?	0.58	1.46	**0.88**	0.67	1.23	**0.56**
27. What kinds of actions can I take to help my family and community become better prepared for the impacts of climate change and more intense disasters? List 3.	1.25	3.08	**1.83**	1.42	2.69	**1.27**
Knowledge	**0.44**	**0.72**	**0.28**	**0.45**	**0.71**	**0.27**
Attitudes	**0.58**	**0.73**	**0.15**	**0.48**	**0.78**	**0.31**
Behaviour	**1.25**	**3.08**	**1.83**	**1.42**	**2.69**	**1.27**
All	**0.49**	**0.81**	**0.32**	**0.49**	**0.80**	**0.31**

Figure 4.9 Comparison of average scores for females and males before and after the intervention



Another aspect to investigate is whether the gender of the teacher affects student performance. Hadjar et al (2014, p.120) concluded that 'the gender of the teacher has been shown <u>not</u> to have an influence on boys' educational success'. On the other hand, Muralidharan & Sheth (2013) showed that male and female teachers are more effective at teaching students of their own gender, but that female teachers are more effective than male teachers overall. In contrast, Nnamani & Oyibe (2016), researching secondary students learning Social Studies in Nigeria, found that male and female students taught by male teachers obtained higher mean scores than male and female students taught by female teachers.

In view of these differing findings, I decided to analyse the situation in Vanuatu using the disaggregated average scores for male and female students for the CC Toolkit activity. Numbers involved were 112 female and 97 male students from 8 classes in 5 schools taught by 8 different teachers, of whom 4 were female and 4 were male.

The first analysis compares results for students in mixed classes taught by female teachers with those taught by male teachers (Table 4.17 and Figure 4.10).

Table 4.17 Comparison of average scores for 209 students taught by female and male teachers

Statement / Question no.	Students taught by female teachers (n = 127)			Students taught by male teachers (n = 82)		
	Before Av. score	After Av. score	Change	Before Av. score	After Av. score	Change
1. Weather refers to the way that atmospheric conditions such as temperature, rainfall, pressure and wind are always changing.	0.91	0.80	-0.11	0.83	1.00	0.17
2. Climate refers to average conditions of temperature, rainfall, etc. over a long period of time.	0.36	0.45	0.09	0.54	0.79	0.26
3. Our climate changes because of both natural and human factors	0.70	0.86	0.16	0.51	0.91	0.40
4. Evaporation occurs when water vapour in the air changes back to tiny droplets of water.	-0.17	-0.28	-0.10	-0.20	-0.18	0.01
5. Climate variability means that the climate of a place may change from year to year.	0.30	0.57	0.28	0.15	0.61	0.46
6. During an El Niño period, Vanuatu experiences droughts.	0.69	0.69	0.00	0.40	0.77	0.37
7. The greenhouse effect means that certain gases in the atmosphere absorb the heat being radiated back from the Earth, so keeping the atmosphere warm.	0.28	0.56	0.28	0.37	0.93	0.56
8. Greenhouse gases include carbon dioxide, methane, nitrous oxide and water vapour.	0.21	0.65	0.44	0.33	0.62	0.29
9. For the past 200 years, human activities are putting extra greenhouse gases into the atmosphere.	0.25	0.44	0.19	0.04	0.45	0.41
10. Carbon dioxide is absorbed by forests and the oceans	0.30	0.58	0.28	0.38	0.62	0.24
11. Coral reefs are being damaged by warmer temperatures and ocean acidification.	0.55	0.61	0.06	0.23	0.77	0.54
12. Vanuatu's greatest climatic dangers are cyclones and droughts.	0.89	0.89	0.00	0.62	0.91	0.29
13. Adaptation refers to the actions we can take to reduce the levels of greenhouse gases in the atmosphere.	-0.14	-0.34	-0.20	-0.15	-0.63	-0.49
14. Using compost is a sustainable form of gardening.	0.76	0.87	0.11	0.46	0.85	0.39
15. Catching fish with nets that have very small holes is a sustainable form of fishing.	0.06	0.26	0.20	-0.18	0.20	0.38
16. Vanuatu is one of the most vulnerable countries in the world to natural disasters.	0.51	0.76	0.25	0.41	0.70	0.28
17. I am worried that climate change will bring great dangers to the world in the future.	0.55	0.80	0.24	0.51	0.93	0.41
18. I want to join a student strike to show my concern about climate change.	0.74	0.67	-0.07	0.63	0.88	0.24
19. I know a lot about the causes and impacts of climate change.	0.21	0.60	0.39	0.07	0.39	0.32
20. I want to help my community prepare for climate change and disasters.	0.82	0.86	0.04	0.63	1.00	0.37
21. What does "climate change" mean?	0.46	0.76	0.29	0.38	0.87	0.49
22. What is the enhanced greenhouse effect?	0.60	0.91	0.31	0.44	0.80	0.37
23. What are 3 human activities putting extra GHGs into the atmosphere?	1.71	2.39	0.69	0.74	1.60	0.85
24. What causes ocean acidification?	0.35	0.69	0.35	0.43	0.78	0.35
25. Why is forestry important for mitigating climate change?	0.74	1.25	0.51	0.61	1.06	0.45
26. What are some of the main impacts of climate change in Vanuatu?	0.67	1.52	0.85	0.55	1.10	0.55
27. What kinds of actions can I take to help my family and community become better prepared for the impacts of climate change and more intense disasters? List 3.	1.30	3.02	1.72	1.38	2.71	1.33
Knowledge	**0.50**	**0.72**	**0.22**	**0.36**	**0.71**	**0.35**
Attitudes	**0.58**	**0.73**	**0.15**	**0.46**	**0.80**	**0.34**
Behaviour	**1.30**	**3.02**	**1.72**	**1.38**	**2.71**	**1.33**
All	**0.54**	**0.81**	**0.27**	**0.41**	**0.79**	**0.38**

Figure 4.10 Comparison of average scores for 209 students in mixed classes taught by female and male teachers

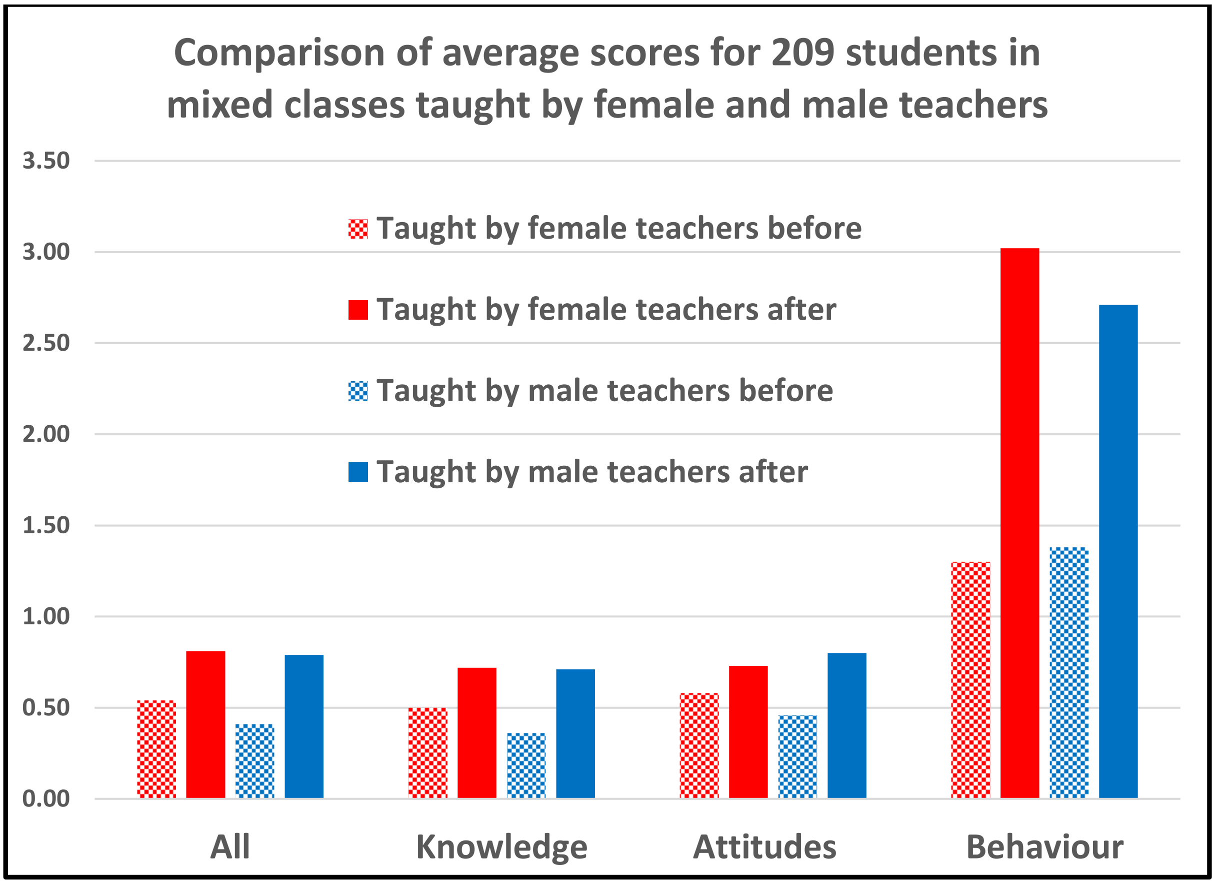


Table 4.17 and Figure 4.10 show that average scores for all items before students participated in the CC Toolkit activity were significantly higher in those classes taught by female teachers (0.54) than those taught by male teachers (0.41). However, participation in the activity enabled students taught by male teachers to attain almost the same score (0.79) as those taught by female teachers (0.81). One reason could be that male teachers were more effective in implementing the Toolkit activity. Another might be that the students taught by female teachers already knew more of the material under study. A third possibility is that the small sample size led to a distortion of results, and that with a much larger group of students and teachers there would have been no significant change in overall performance between students taught by male and female teachers.

The same pattern can be observed for knowledge and attitude items, but not for the one short-answer question on behaviour, in which female teachers were more effective than males in raising students' awareness of a greater range of adaptation methods. This might be because female teachers have a heightened risk perception of environmental dangers (Bord & O'Connor, 1997; Kiao & McCright, 2012) and because of their natural tendency to stress the importance of caring for family and community (Tzelezny et al, 2000).

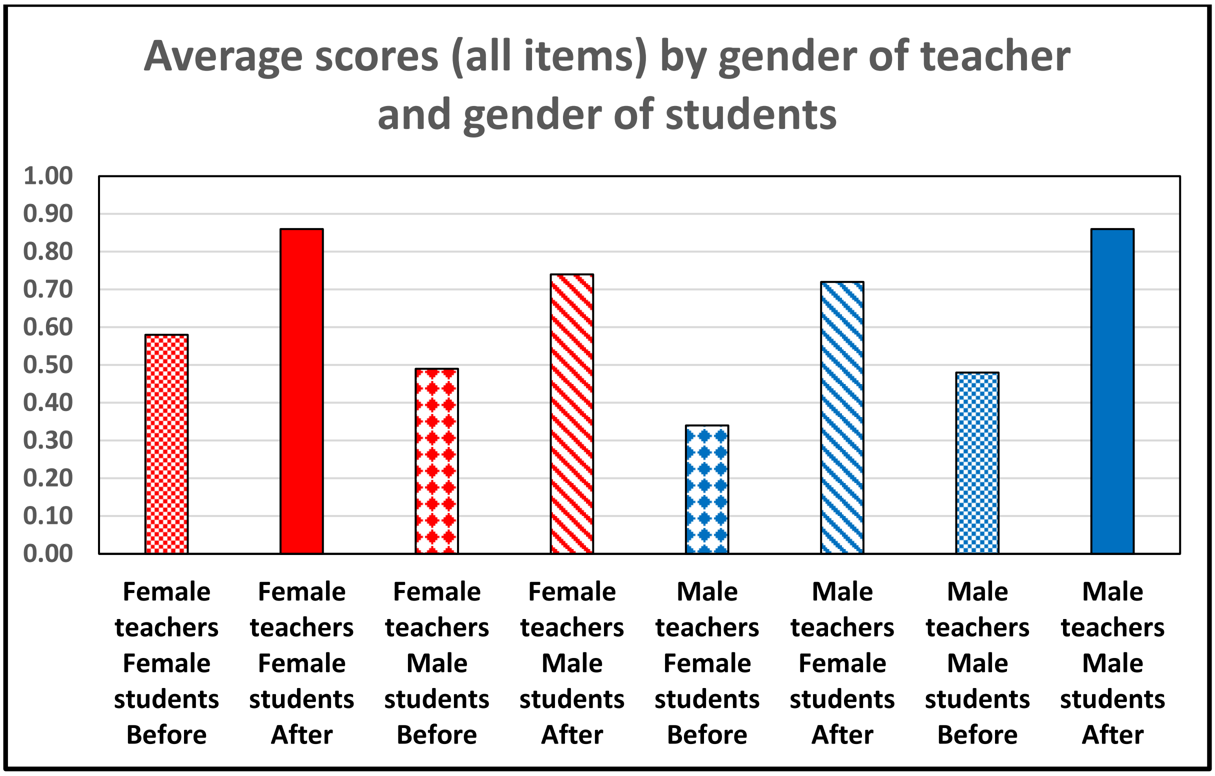
The second analysis looks at whether there are differences in performance of female and male students according to whether the teacher is female or male. The same sample of 209 secondary students in eight classes taught by four female and four male teachers was used.

Table 4.18 and Figure 4.11 show male and female performance in the Toolkit activity by gender of the teacher. The most salient finding relates to students' average scores for all items before and after the intervention. When a class had a female teacher, girls achieved significantly higher overall scores than boys, both before and after the activity: 0.58 and 0.86 for girls compared with 0.49 and 0.74 for boys. When the class had a male teacher, boys achieved significantly higher overall scores than girls, both before and after the activity: 0.72 and 0.86 for boys compared with 0.34 and 0.72 for girls. Thus there was a certain symmetry about the results, with the pattern for male teachers being the mirror image of the pattern for female teachers: the "after" average score for girls taught by women (0.86) was identical to the "after" score for boys taught by men.

Table 4.18 Comparison of average scores for female and male students taught by female teachers with those taught by male teachers

Gender	Female teachers				Male teachers			
	Female students (n = 74)		Male students (n = 53)		Female students (n = 38)		Male students (n = 44)	
Before/After	Before	After	Before	After	Before	After	Before	After
Knowledge 1-16	0.40	0.55	0.42	0.49	0.25	0.53	0.34	0.63
Attitudes 17-20	0.67	0.73	0.46	0.73	0.42	0.74	0.50	0.85
Knowledge 21-26	0.86	1.35	0.61	1.12	0.40	0.92	0.63	1.14
Behaviour 27	1.36	3.35	1.21	2.57	1.13	2.56	1.60	2.84
All 1-27	**0.58**	**0.86**	**0.49**	**0.74**	**0.34**	**0.72**	**0.48**	**0.86**

Figure 4.11 Comparison of average overall scores for female and male students taught by female teachers with those taught by male teachers



Tables 4.19 and 4.20 show the validity of differences between average "after" scores for male and female students by gender of teacher, measured using the Paired Samples t-test in the statistical package SPSS.

Table 4.19 Determination of validity of differences between average "after" scores for male and female students taught by female teachers

Average score after the CC Toolkit intervention	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
Female students	0.8563	27	0.72460					
Male students	0.7452	27	0.59745					
Diff female-male	0.1111	27	0.21922	0.02430	0.19783	2.634	26	0.014

N: number of items; Conf.Int: confidence interval; t: t-value; df: degrees of freedom

Table 4.20 Determination of validity of differences between average "after" scores for male and female students taught by male teachers

Average score after the CC Toolkit intervention	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
Female students	0.7204	27	0.55647					
Male students	0.8570	27	0.59278					
Diff female-male	-0.1367	27	0.20197	-0.21656	-0.05677	-3.516	26	0.002

N: number of items; Conf.Int: confidence interval; t: t-value; df: degrees of freedom

When mixed classes taught by female teachers carried out the CC Toolkit activity (Table 4.19), girls achieved significantly higher “after” scores than boys. This was demonstrated by a two-tailed significance (p-value) of less than 0.05, by a t-value exceeding the critical value (cv) of 2.056 for a 95% confidence level, and by the range between lower and upper limits of the 95% confidence interval not crossing 0. Similarly, in mixed classes taught by male teachers (Table 4.20), boys achieved significantly higher “after” scores than girls.

I infer that in the context of the climate change activity carried out in Vanuatu, a teacher’s gender does influence student achievement, with male and female teachers being more effective with students of their own gender. These findings on performance confirm those of Muralidharan & Sheth (2013), who based their conclusions on five years of data from primary schools in the Indian state of Andhra Pradesh. However, they were looking at performance across all school subjects, and at levels corresponding to Years 1 to 6 in Vanuatu’s educational system, while my study focused on just one classroom activity carried out by an older cohort of Year 9-11 students. Muridhalan & Sheth found that having a same-gender teacher had no effect on student attendance, while my study suggests the opposite for students in Vanuatu: both participation and performance are linked to gender, with girls and boys more comfortable with teachers of the same gender as they transition from childhood to adolescence. One reason could be linked to different ways that boys and girls are raised in society (Hadjar et al, 2014), with Melanesian culture traditionally emphasizing the separation of boys and men from girls and women.

In summarizing the effect of gender on students’ performance in carrying out the CC Toolkit activity, we can say that overall, there was no significant difference between the achievement level of girls and boys. For knowledge and attitudes, the activity improved male scores more than female ones, while it was the reverse for behaviour, with females showing a higher degree of improvement. Regarding the effect of teacher gender on students’ performance, results suggest that overall and in terms of knowledge and attitudes, male teachers were more effective than female teachers in implementing the Toolkit activity, yet female teachers were more effective than males in improving student scores for behaviour. A significant finding has been that in terms of participation and performance, male and female teachers are more effective in teaching students of their own gender.

4.3.9 Comparison of Scores Between English- and French-speaking Students

A second aspect of variation between responses within the overall cohort of 363 students is to consider differences by official language of education. Of the 25,720 students in secondary schools in 2021, 18,803 (73%) had English as their language of instruction and 6,917 (27%) had French (MOET, 2022). In comparison, the number of English-speaking students involved in the Toolkit activity was 284 in 15 classes (78%), and French-speaking students totaled 79 in six classes (22%).

Figure 4.12 and Table 4.21 show average scores before and after the intervention. While average scores for all items before the intervention were slightly higher for French-speaking students (0.59 compared to 0.55 for English-speaking students), they were significantly lower afterwards (0.81 compared to 0.91). English-speaking students improved significantly more than their francophone counterparts, with a gain of 0.36 as compared to 0.22 points. Table 4.22 confirms that when "after" average scores for English- and French-speaking students for all items are compared using the Paired Samples t-test, that of English speakers was significantly higher.

Figure 4.12 Average scores (all items) before and after the intervention for students in English- and French-speaking secondary schools

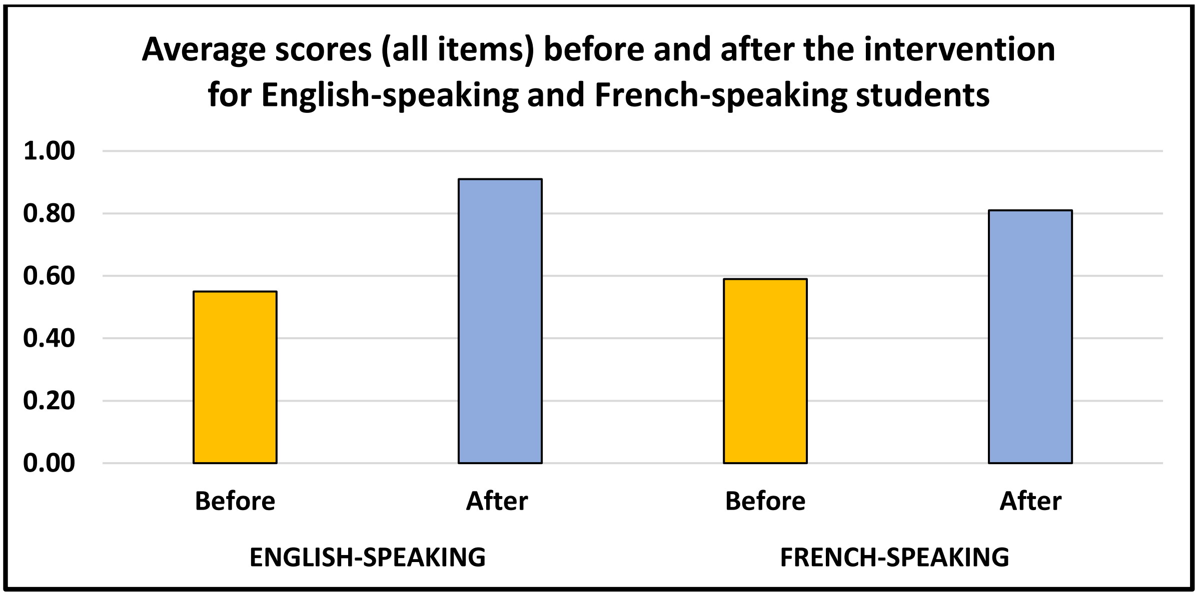


Table 4.21 Comparison of average scores for English-speaking and French-speaking students

Statement / Question no.	English-speaking (n = 284) Before Av. score	After Av. score	Change	French-speaking (n = 79) Before Av. score	After Av. score	Change
1. Weather refers to the way that atmospheric conditions such as temperature, rainfall, pressure and wind are always changing.	0.86	0.93	0.07	0.92	0.78	-0.14
2. Climate refers to average conditions of temperature, rainfall, etc. over a long period of time.	0.52	0.79	0.26	0.38	0.51	0.13
3. Our climate changes because of both natural and human factors	0.67	0.89	0.22	0.70	0.87	0.18
4. Evaporation occurs when water vapour in the air changes back to tiny droplets of water.	-0.24	0.05	0.29	-0.15	-0.47	-0.32
5. Climate variability means that the climate of a place may change from year to year.	0.25	0.70	0.45	0.29	0.53	0.24
6. During an El Niño period, Vanuatu experiences droughts.	0.57	0.82	0.25	0.65	0.75	0.10
7. The greenhouse effect means that certain gases in the atmosphere absorb the heat being radiated back from the Earth, so keeping the atmosphere warm.	0.42	0.76	0.35	0.33	0.72	0.39
8. Greenhouse gases include carbon dioxide, methane, nitrous oxide and water vapour.	0.38	0.71	0.33	0.23	0.75	0.52
9. For the past 200 years, human activities are putting extra greenhouse gases into the atmosphere.	0.22	0.53	0.31	0.18	0.41	0.23
10. Carbon dioxide is absorbed by forests and the oceans	0.35	0.69	0.34	0.43	0.66	0.23
11. Coral reefs are being damaged by warmer temperatures and ocean acidification.	0.42	0.73	0.31	0.51	0.68	0.18
12. Vanuatu's greatest climatic dangers are cyclones and droughts.	0.73	0.93	0.20	0.87	0.95	0.08
13. Adaptation refers to the actions we can take to reduce the levels of greenhouse gases in the atmosphere.	-0.13	-0.28	-0.15	-0.20	-0.57	-0.37
14. Using compost is a sustainable form of gardening.	0.77	0.87	0.10	0.72	0.90	0.18
15. Catching fish with nets that have very small holes is a sustainable form of fishing.	-0.07	0.18	0.26	0.06	0.20	0.14
16. Vanuatu is one of the most vulnerable countries in the world to natural disasters.	0.52	0.78	0.26	0.49	0.72	0.23
17. I am worried that climate change will bring great dangers to the world in the future.	0.68	0.88	0.20	0.71	0.78	0.08
18. I want to join a student strike to show my concern about climate change.	0.70	0.80	0.09	0.75	0.71	-0.04
19. I know a lot about the causes and impacts of climate change.	0.13	0.51	0.38	0.39	0.73	0.34
20. I want to help my community prepare for climate change and disasters.	0.79	0.94	0.15	0.86	0.94	0.08
21. What does "climate change" mean?	0.66	1.21	0.55	0.63	0.86	0.23
22. What is the enhanced greenhouse effect?	0.51	1.01	0.50	0.82	0.67	-0.15
23. What are 3 human activities putting extra GHGs into the atmosphere?	1.27	2.14	0.87	2.06	2.51	0.44
24. What causes ocean acidification?	0.56	1.18	0.62	0.32	0.62	0.30
25. Why is forestry important for mitigating climate change?	0.70	1.45	0.75	1.00	1.10	0.10
26. What are some of the main impacts of climate change in Vanuatu?	0.90	1.59	0.69	0.59	1.43	0.84
27. What kinds of actions can I take to help my family and community become better prepared for the impacts of climate change and more intense disasters? List 3.	1.70	2.80	1.10	1.27	3.01	1.75
Knowledge	**0.49**	**0.85**	**0.36**	**0.54**	**0.71**	**0.17**
Attitudes	**0.58**	**0.78**	**0.21**	**0.68**	**0.79**	**0.11**
Behaviour	**1.70**	**2.80**	**1.10**	**1.27**	**3.01**	**1.74**
All	**0.55**	**0.91**	**0.36**	**0.59**	**0.81**	**0.22**

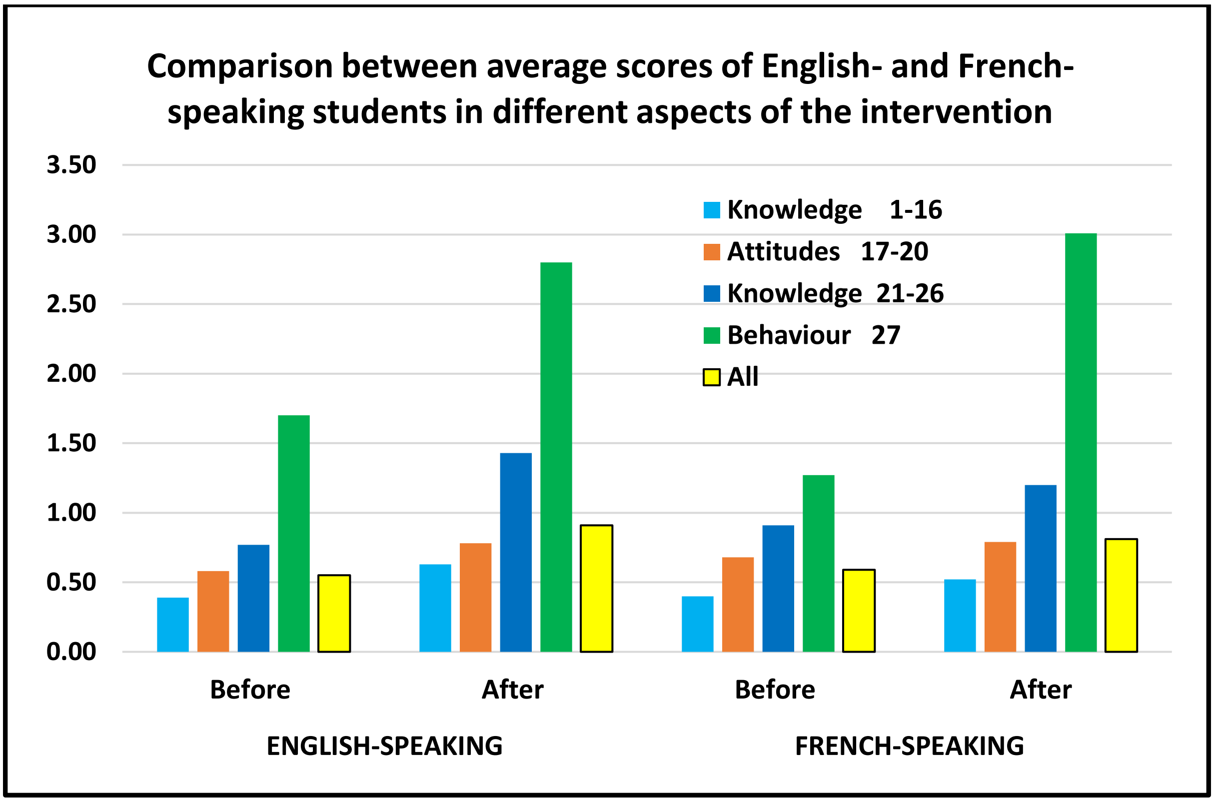
Table 4.22 Determination of validity of differences between average "after" scores (all items) for English-speaking and French-speaking students

Average score after the CC Toolkit intervention	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
English-speaking	0.9107	27	0.59641					
French-speaking	0.8056	27	0.69693					
Diff Eng-French	0.1052	27	0.21163	0.02147	0.18890	2.583	26	0.016

N: number of items; Conf.Int: confidence interval; t: t-value; df: degrees of freedom

We can also consider differences by aspect of learning (Figure 4.13). Before the intervention, French-speaking students had significantly higher scores than English-speaking students for attitudes and short-answer knowledge items (0.68 and 0.91 compared to 0.58 and 0.77), almost identical scores for A/D knowledge items (0.40 compared to 0.39) and a much lower score for the behaviour item (1.27 to 1.70). After the intervention, however, English speakers outperformed French speakers in all knowledge items (0.63 and 1.43 compared to 0.52 and 1.20), had similar scores for attitudes (0.78 compared to 0.79) and a lower score for behaviour (2.80 to 3.01).

Figure 4.13 Average scores in different aspects of the intervention for students in English- and French-speaking secondary schools



Language	English-speaking			French-speaking		
Time	Before	After	Change	Before	After	Change
Knowledge 1-16	0.39	0.63	0.24	0.40	0.52	0.12
Attitudes 17-20	0.58	0.78	0.21	0.68	0.79	0.11
Knowledge 21-26	0.77	1.43	0.66	0.91	1.20	0.29
Behaviour 27	1.70	2.80	1.10	1.27	3.01	1.74
All	**0.55**	**0.91**	**0.36**	**0.59**	**0.81**	**0.22**

When examining "after" scores for individual items (Table 4.21), English-speaking students had notably higher scores than their French counterparts in knowledge items 1, 2, 4, 5, 13, 21, 22, 24 and 25. All of these require an understanding of scientific aspects such as weather, climate, climate variability, climate change, evaporation, adaptation, the enhanced greenhouse effect and the absorption of carbon dioxide by oceans and forests. However, French-speaking students made a remarkable improvement in the score for behaviour, which rose from 1.27 beforehand to 3.01 afterwards.

To summarize, the CC Toolkit seems to have benefited English- and French-speaking students in different ways, significantly improving the knowledge of the former and the intended behaviour of the latter, but maintaining similar scores for attitudes. Overall, English-speaking students performed better and showed greater improvement.

I offer no clear explanation for these patterns. Theoretically, there should be no differences between English-speaking and French-speaking students, since the CC Toolkit pictures have text in both English and French, and Teacher Guides were available to all teachers in either English or French, as were the discussion questions used for the activity. Perhaps the difference in sample size is a factor, since the number of English-speaking students (284) far exceeds the number of French-speaking students (79). The small size of the latter means that individual classes may have an exaggerated effect on the overall average, whereas in a larger sample, such effects will be less pronounced. Newsom (2007) stated that if a sample is numerically small, there is a greater risk of this small sample being unusual just by chance; also, the mean score for the sample will have a greater standard deviation (SD), making it less reliable. Table 4.22 shows that the SD for French-speaking students was much higher than of English-speaking students, so that although the paired sample t-test showed that the mean scores were significantly different, the smaller number of students in the French-speaking sample may have been distorting the results. Another factor might be the personality and capacity of the teacher, with 78% of the French-speaking students taught by the same person, as well as pedagogy, with a more instructor-centred approach possibly contributing to the dramatic rise in behaviour item Q27 for French speakers.

4.3.10 Comparison of Scores Between Students from Urban and Rural schools

This sub-section looks at a third aspect of variation within the overall cohort of 363 students – a comparison between students learning in urban and rural settings. Figure 4.14 and Table 4.23 show average scores before and after the intervention.

Of the nine schools surveyed, four were within the urban boundaries of Port Vila and Luganville, two were boarding schools between 15 and 20 km away from the nearest urban centre and therefore classed as rural, and the remaining three were in rural island locations outside Efate and Santo. In all, there were 219 students from urban settings and 144 from rural areas.

Figure 4.14 Average scores (all items) of students in urban and rural schools

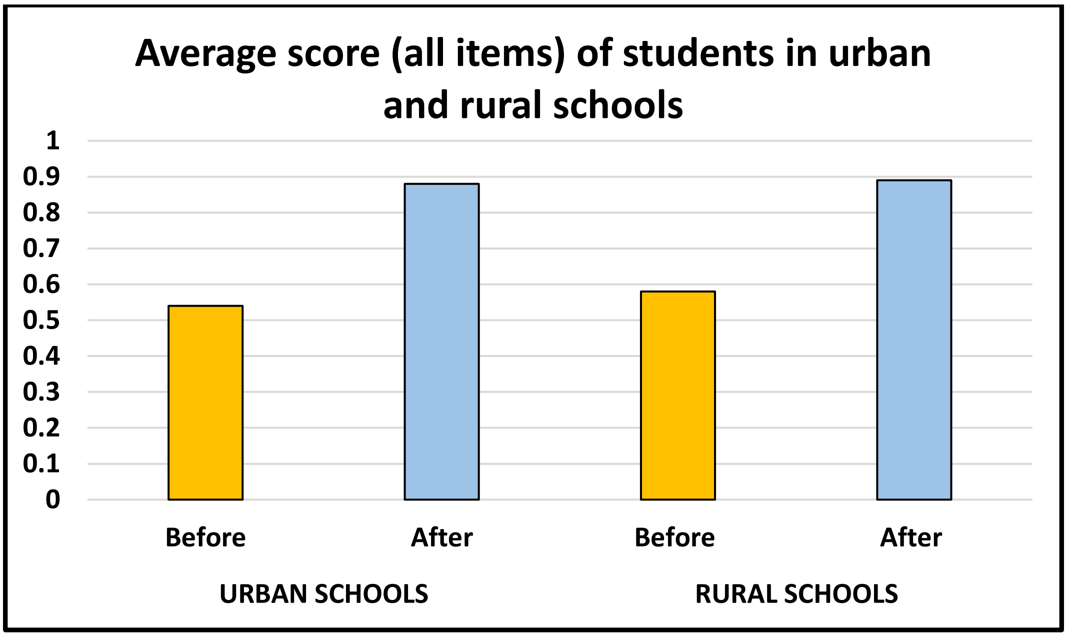


Table 4.23 Comparison of average scores for students from urban and rural schools

Statement / Question no.	Urban schools (n = 219)			Rural schools (n = 144)		
	Before Av. score	After Av. score	Change	Before Av. score	After Av. score	Change
1. Weather refers to the way that atmospheric conditions such as temperature, rainfall, pressure and wind are always changing.	0.90	0.89	-0.01	0.83	0.91	0.08
2. Climate refers to average conditions of temperature, rainfall, etc. over a long period of time.	0.51	0.65	0.14	0.46	0.84	0.38
3. Our climate changes because of both natural and human factors	0.68	0.87	0.19	0.67	0.91	0.24
4. Evaporation occurs when water vapour in the air changes back to tiny droplets of water.	-0.19	-0.04	0.15	-0.26	-0.10	0.16
5. Climate variability means that the climate of a place may change from year to year.	0.18	0.60	0.42	0.38	0.77	0.39
6. During an El Niño period, Vanuatu experiences droughts.	0.60	0.82	0.22	0.56	0.77	0.21
7. The greenhouse effect means that certain gases in the atmosphere absorb the heat being radiated back from the Earth, so keeping the atmosphere warm.	0.36	0.71	0.35	0.45	0.82	0.37
8. Greenhouse gases include carbon dioxide, methane, nitrous oxide and water vapour.	0.32	0.68	0.37	0.39	0.76	0.38
9. For the past 200 years, human activities are putting extra greenhouse gases into the atmosphere.	0.22	0.50	0.28	0.20	0.51	0.31
10. Carbon dioxide is absorbed by forests and the oceans	0.37	0.64	0.27	0.36	0.74	0.38
11. Coral reefs are being damaged by warmer temperatures and ocean acidification.	0.38	0.65	0.27	0.52	0.81	0.29
12. Vanuatu's greatest climatic dangers are cyclones and droughts.	0.86	0.93	0.07	0.60	0.93	0.33
13. Adaptation refers to the actions we can take to reduce the levels of greenhouse gases in the atmosphere.	-0.16	-0.23	-0.06	-0.12	-0.51	-0.40
14. Using compost is a sustainable form of gardening.	0.86	0.89	0.03	0.60	0.85	0.25
15. Catching fish with nets that have very small holes is a sustainable form of fishing.	-0.15	0.12	0.27	0.11	0.28	0.17
16. Vanuatu is one of the most vulnerable countries in the world to natural disasters.	0.56	0.74	0.19	0.45	0.80	0.35
17. I am worried that climate change will bring great dangers to the world in the future.	0.74	0.86	0.12	0.61	0.85	0.24
18. I want to join a student strike to show my concern about climate change.	0.68	0.68	0.00	0.76	0.92	0.17
19. I know a lot about the causes and impacts of climate change.	0.16	0.39	0.22	0.22	0.81	0.60
20. I want to help my community prepare for climate change and disasters.	0.84	0.92	0.08	0.75	0.97	0.22
21. What does "climate change" mean?	0.57	1.16	0.58	0.78	1.10	0.32
22. What is the enhanced greenhouse effect?	0.58	0.96	0.38	0.58	0.90	0.33
23. What are 3 human activities putting extra GHGs into the atmosphere?	1.44	2.24	0.80	1.44	2.19	0.74
24. What causes ocean acidification?	0.46	1.09	0.63	0.58	1.02	0.44
25. Why is forestry important for mitigating climate change?	0.67	1.47	0.81	0.91	1.22	0.31
26. What are some of the main impacts of climate change in Vanuatu?	0.74	1.72	0.98	0.97	1.30	0.33
27. What kinds of actions can I take to help my family and community become better prepared for the impacts of climate change and more intense disasters? List 3.	1.51	2.93	1.42	1.76	2.72	0.97
Knowledge	**0.49**	**0.82**	**0.33**	**0.52**	**0.81**	**0.29**
Attitudes	**0.61**	**0.71**	**0.11**	**0.58**	**0.89**	**0.31**
Behaviour	**1.51**	**2.93**	**1.42**	**1.76**	**2.72**	**0.96**
All	**0.54**	**0.88**	**0.34**	**0.58**	**0.89**	**0.32**

Figure 4.14 and Table 4.23 demonstrate that when average scores for all items were compared for urban and rural students, there was no significant difference, either before or after the intervention. Beforehand, urban students scored 0.54, while those in rural schools scored 0.58; afterwards, the scores were 0.88 and 0.89 respectively. The lack of significant differences between the scores was confirmed using the Paired Samples t-test (Tables 4.24 and 4.25): none of the three criteria for validity of difference were met.

Table 4.24 Determination of validity of differences between average "before" scores (all items) for urban and rural students

Average score before the CC Toolkit intervention	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
Urban students	0.5441	27	0.40835					
Rural students	0.5763	27	0.41294					
Diff Urban-Rural	-0.0322	27	0.14439	-0.08934	0.02490	-1.160	26	0.257

N: number of items; Conf.Int: confidence interval; t: t-value; df: degrees of freedom

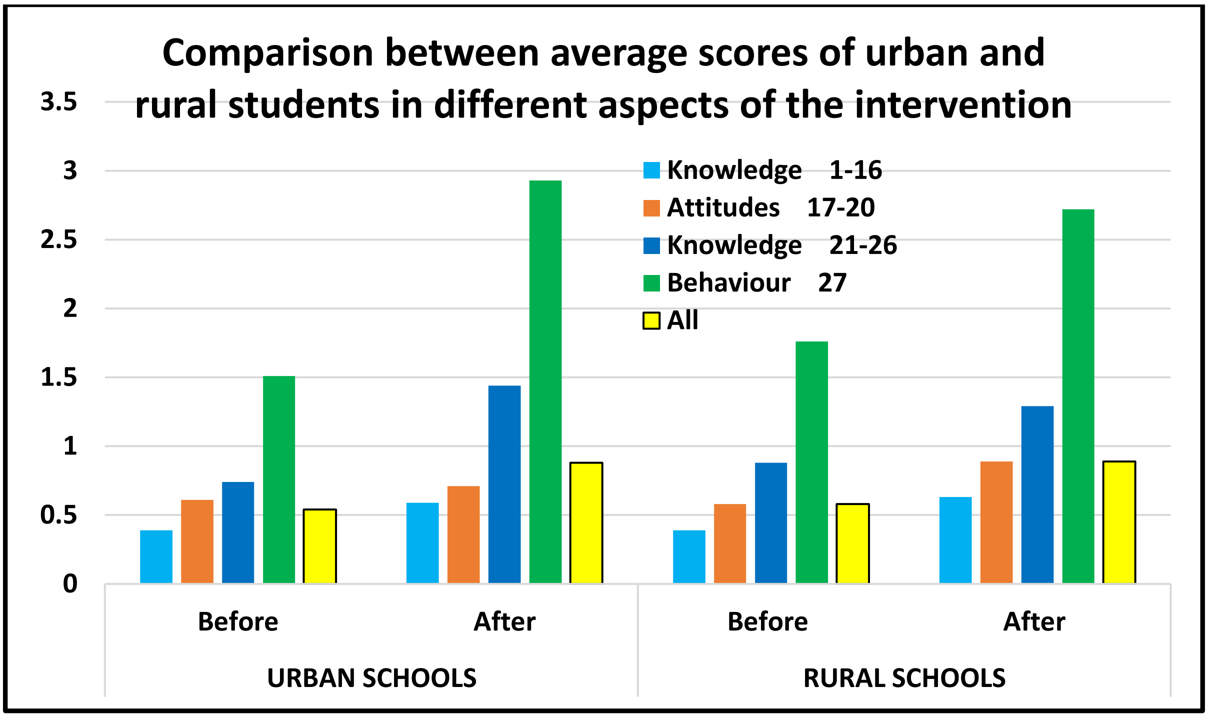
Table 4.25 Determination of validity of differences between average "after" scores (all items) for urban and rural students

Average score after the CC Toolkit intervention	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
Urban students	0.8830	27	0.64013					
Rural students	0.8922	27	0.58648					
Diff Urban-Rural	-0.0093	27	0.17191	-0.07726	0.05875	-0.280	26	0.782

N: number of items; Conf.Int: confidence interval; t: t-value; df: degrees of freedom

Figure 4.15 and Table 4.23 reveal that before the intervention, students in urban schools had similar average scores for the A/D knowledge and attitude items to those of rural schools, but for short answer knowledge and behaviour questions, scores for rural students were higher (0.88 compared to 0.74 for knowledge and 1.76 compared to 1.51 for behaviour). After the intervention, differences were more marked: rural students had higher average scores in A/D knowledge and attitude items (0.63 to 0.59 for knowledge and 0.89 to 0.71 for attitudes), while urban students had higher average scores for the knowledge and behaviour questions (1.44 to 1.29 for knowledge and 2.93 to 2.72 for behaviour). Urban students showed greater improvement in the short-answer questions than rural students, while the reverse happened in the A/D items. As we have seen in previous sub-sections, the influence of item 19 (confidence in knowledge of climate change) had an inflated effect on the overall score for attitudes.

Figure 4.15 Average scores in different aspects of the intervention for students in urban and rural schools



Location	Urban schools			Rural schools		
Time	Before	After	Change	Before	After	Change
Knowledge 1-16	0.39	0.59	0.20	0.39	0.63	0.24
Attitudes 17-20	0.61	0.71	0.11	0.58	0.89	0.31
Knowledge 21-26	0.74	1.44	0.70	0.88	1.29	0.41
Behaviour 27	1.51	2.93	1.42	1.76	2.72	0.96
All	**0.54**	**0.88**	**0.34**	**0.58**	**0.89**	**0.32**

A further investigation sought to determine whether there was a difference between performance by gender in urban and rural schools, using the smaller sample of 209 students identified in Section 4.3.8. Of the five schools in this sample, two were located in the city of Port Vila on the island of Efate, with a total of 75 females and 44 males. The remainder, located in rural areas, had a total of 37 females and 53 males. In all, the sample comprised 119 students in urban and 90 in rural schools.

Table 4.26 and Figures 4.16 and 4.17 compare before and after scores for all girls and boys in urban schools with before and after scores for all girls and boys in rural schools. There is a clear pattern in the overall performance (all items): in urban schools, girls outperformed boys in average scores both before the intervention (0.54 compared to 0.47) and afterwards (0.84 to 0.76); in rural schools, boys outperformed girls beforehand (0.50 to 0.40) and afterwards (0.83 to 0.76). Figure 4.16 shows that the configuration for rural was almost a mirror image of that for urban.

A similar pattern is observable in the results for knowledge (A/D items and short answer questions), for attitudes and behaviour. In almost all categories, and both before and after the intervention, girls outperformed boys in urban schools, but boys outperformed girls in rural schools.

Table 4.26 Average scores for female and male students in urban and rural schools before and after participating in the CC Toolkit activity

Location	Urban schools				Rural schools			
Gender	Female students (n = 75)		Male students (n = 44)		Female students (n = 37)		Male students (n = 53)	
Before/After	Before	After	Before	After	Before	After	Before	After
Knowledge 1-16	0.37	0.53	0.39	0.49	0.29	0.55	0.37	0.61
Attitudes 17-20	0.64	0.68	0.45	0.64	0.48	0.84	0.50	0.90
Knowledge 21-26	0.78	1.32	0.57	1.19	0.54	0.97	0.66	1.07
Behaviour 27	1.43	3.41	1.11	2.89	0.89	2.41	1.68	2.53
All 1-27	**0.54**	**0.84**	**0.47**	**0.76**	**0.40**	**0.76**	**0.50**	**0.83**

Figure 4.16 Comparison of average overall scores for male and female students in urban and rural schools

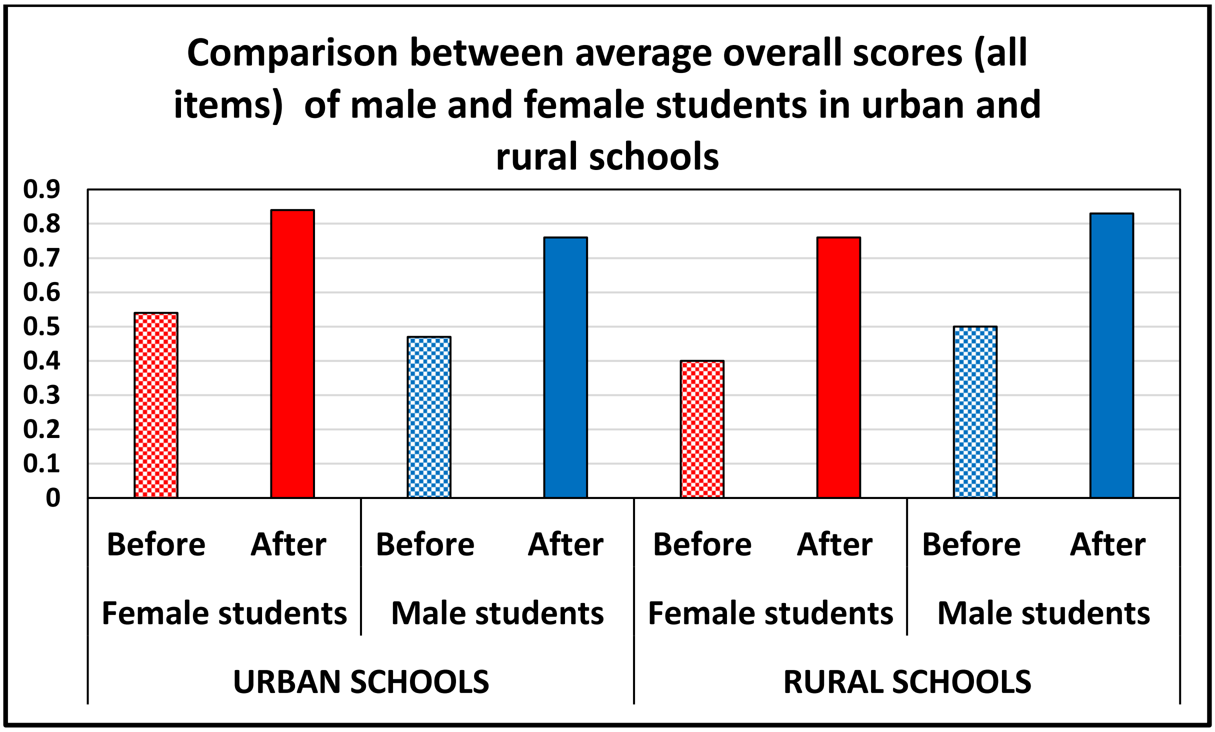
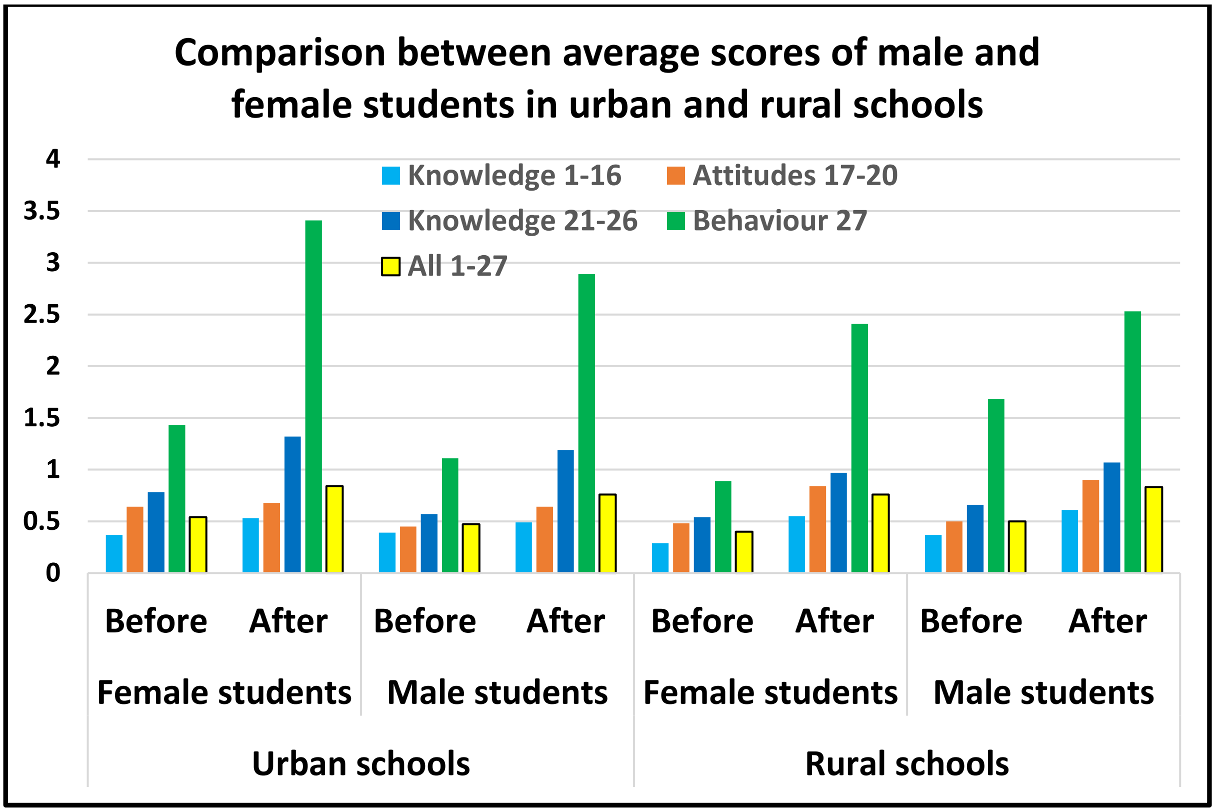


Figure 4.17 Comparison of average scores in knowledge, attitudes and behaviour for male and female students in urban and rural schools



A verification of the statistical validity of the difference between "after" average scores for all items 1-27 for females and males in urban and rural schools is provided in Tables 4.27 and 4.28. Using the Paired Samples t-test, there was a significant difference between average "after" scores of female and male students in urban schools, demonstrated by a two-tailed significance (p-value) less than 0.05, by a t-value greater than the critical value of 2.056 for a 95% confidence level, and by the range between lower and upper limits of the 95% confidence level not crossing 0. However, the difference between average "after" scores of female and male students in rural schools did not quite meet the three criteria for significance.

Table 4.27 Determination of validity of differences between average "after" scores (all items) for female and male students in urban schools

Average score after the CC Toolkit intervention	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
Female students	0.8348	27	0.55647					
Male students	0.7552	27	0.59278					
Diff female-male	0.0796	27	0.18544	0.00627	0.15299	2.231	26	0.035

N: number of items; Conf.Int: confidence interval; t: t-value; df: degrees of freedom

Table 4.28 Determination of validity of differences between average "after" scores (all items) for female and male students in rural schools

Average score after the CC Toolkit intervention	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
Female students	0.7589	27	0.52706					
Male students	0.8289	27	0.53116					
Diff female-male	-0.0700	27	0.20426	-0.15080	0.01080	-1.781	26	0.087

N: number of items; Conf.Int: confidence interval; t: t-value; df: degrees of freedom

To explain why females scored significantly higher scores than males when the CC Toolkit activity was conducted in urban schools, two reasons are proposed. Firstly, on purely statistical grounds, females constituted a higher proportion (63%) of the students in the sample from urban schools, and two of the three teachers involved were female. In contrast, males made up 59% of the students in the sample from rural schools, and three of the five teachers were male. As has already been suggested from the results on the influence of teacher gender (Table 4.18 and Figure 4.11), girls perform better when their teacher is female, and this might be a factor to explain the results for urban schools (Table 4.27). Secondly, my own long experience of teaching in Vanuatu is that students in urban schools are exposed to more distractions than those in rural schools, and that this affects boys more than girls.

To test the hypothesis that Year 9/10 boys in towns are more distracted from their studies than girls, email interviews were conducted with three secondary school principals, seven secondary school teachers and one undergraduate student at the University of the South Pacific in Fiji. Seven were male and four female, and all were ni-Vanuatu with experience of living in either Port Vila or Luganville.

The question asked was: "From your experience in living in towns, would you say that boys at Year 9/10 level are more distracted or more disengaged from their studies than girls? What are the things in town that distract boys more than girls?"

Of the eleven respondents, nine had no doubt that boys are more easily distracted than girls. Among their responses are the following:

I think boys are much more distracted than girls. From my experience, girls generally are very committed in studying. Boys on the other hand are easily distracted by peers, which influences them to be involved in activities such as drinking, smoking tobacco and cigarettes at a very young age, going to night clubs and some even creating gangs to steal in the shops and plenty more.
(Teacher of English, Whitewood High School, 1st October 2021)

Boys are more distracted than girls. The biggest distraction today is the online video game PUBG (Players Unknown Battle Ground). Boys want to do little chores to earn themselves money for purchasing phone data. They play this game at home till late hours and even in school during breaks, lunch time or free periods. In addition to this we have TikTok, Facebook Madlpz and FruityLoops, Remix/Music Software, which are more suited to boys than girls.
(Teacher of Social Science, Acacia Secondary School, 5th October 2021)

Two respondents, however, had differing views:

No, girls are more easily distracted. Their distractions are drugs, boy-girl relationships, social media (especially Facebook), and physical appearance.
(Deputy Principal, Namariu Junior Secondary School, 30th September 2021)

Girls are more easily distracted because nowadays they usually have boy friends at an earlier age than in the past due to social platforms.
(Teacher of Social Science, Banyan School, 29th September 2021)

Table 4.29 summarizes respondents' perceptions of the main factors causing boys to be more easily diverted from their studies at school than girls:

Table 4.29 Teachers' perceptions of factors causing boys to have greater disengagement from school than girls in urban areas of Vanuatu

Factor	Number of respondents reporting this factor
Taking alcoholic drinks	**8**
Smoking cigarettes/tobacco	**6**
Drinking kava	**4**
Taking marijuana/illegal drugs	**4**
Peer pressure, especially from those who have left school	**4**
Involvement in gangs	**3**
Going to night clubs	**3**
Entertainment provided on social media, internet, movies, etc.	**3**
Stealing	**2**
Boys have more freedom than girls	**2**
Mobile phones	**2**
Lack of parental care	**2**
Higher participation in sport than girls	**1**
Boy-girl relationships	**1**
Influence of swearing	**1**
Inadequate school curriculum	**1**
Online video game PUBG	**1**

These interviews support the statistical finding that in urban schools, girls performed significantly better than boys in the CC Toolkit activity because of the many factors causing Year 9/10 boys to become disengaged from formal education. This confirms research by Hadjar et al (2014) that boys are more alienated from school than girls, leading to 'non-conformity and anti-social behaviour in the school environment' (ibid, p.121) and lower educational achievement. Their study drew on literature in a European context, but is relevant to Vanuatu in that its two urban centres will offer a similar intensity of distractions to that found in a Western environment – which in turn will affect boys more than girls and perhaps explain girls' superior performance in the Toolkit activity when undertaken in towns.

The findings also resonate with research conducted by Nakaseko et al (2022), who during almost the same time period surveyed 368 Year 6 to 8 students in public schools on the island of Efate. They found that underage drinking and smoking was more prevalent among urban than rural students (13.5% to 10.3% of students for tobacco and 16.9% to 8.3% for alcohol), and higher for males than for females (14.7% to 9.4% for tobacco and 14.6% to 12.0 % for alcohol). In the present study, students are older (14-18 years old) than those in Nakaseko's research, who had a mean age of approximately 13 years, and we can infer that the percentages of urban males involved in tobacco and alcohol consumption will be much higher, leading to greater alienation from school.

The relevance of these results to formal education about climate and disaster resilience is that although the CC Toolkit activity is designed to stimulate discovery learning and engage students at mid-secondary level, other factors are also at play: the effectiveness of the teacher; the presence or absence of a whole-school approach to students' health and well-being (SDERA, 2022); and distractions in Port Vila and Luganville that particularly affect teenage males. In other words, the effectiveness of this educational resource (in terms of Research Question 1) does not only depend on the materials and pedagogy used, but must be considered in the context of these other factors.

4.3.11 Erosion of Knowledge, Attitudes and Behaviour Over Time

A final aspect of variation to be examined is the extent to which student performance in the before/after questionnaire changes over time – specifically, how students performed when they completed the same questionnaire several months after participating in the CC Toolkit activity.

Although requests were made to several teachers for their same students to complete the same questionnaire at a later time period, only two teachers responded. One reason was that most schools carried out the Toolkit activity with their Year 10 students between March and September 2020, and then when the new school year started in 2021, many of these students had left those schools, either moving to Year 11 in another school or dropping out completely.

There are two classes for which data are available. The first was the Year 9 Social Science class in Pandanus JSS that completed the “before/after” questionnaire in March 2020 and again when in Year 10 in February 2021, by which time only 11 of the original 21 students were still in school. The second was the Year 12 Earth Science class in Mangrove College that undertook the activity in June 2020 and completed the “before/after” questionnaire for the third time 8 months later in February 2021 when they were in Year 13, by which time only 6 were left. The small size of these two samples does not enable valid generalisations to be made, but the findings do provide insights into the effectiveness of the CC Toolkit over time. Tables 4.30 and Figures 4.18 to 4.20 show my findings.

Table 4.30 Average scores for students before, after and 8-11 months after the intervention

Statement / Question no.	Pandanus JSS (n = 11)			Mangrove College (n = 6)		
	Before Av. score	After Av. score	11m after Av. score	Before Av. score	After Av. score	8m after Av. score
1. Weather refers to the way that atmospheric conditions such as temperature, rainfall, pressure and wind are always changing.	1.00	0.64	0.82	0.67	1.00	1.00
2. Climate refers to average conditions of temperature, rainfall, etc. over a long period of time.	0.27	0.45	-0.09	1.00	1.00	1.00
3. Our climate changes because of both natural and human factors	0.54	0.82	0.27	1.00	1.00	1.00
4. Evaporation occurs when water vapour in the air changes back to tiny droplets of water.	-0.82	0.09	-0.36	0.67	1.00	0.50
5. Climate variability means that the climate of a place may change from year to year.	0.45	0.54	0.54	0.67	1.00	0.83
6. During an El Niño period, Vanuatu experiences droughts.	0.91	0.73	1.00	0.67	1.00	1.00
7. The greenhouse effect means that certain gases in the atmosphere absorb the heat being radiated back from the Earth, so keeping the atmosphere warm.	0.27	0.18	-0.09	0.50	1.00	1.00
8. Greenhouse gases include carbon dioxide, methane, nitrous oxide and water vapour.	-0.36	0.18	0.18	1.00	1.00	1.00
9. For the past 200 years, human activities are putting extra greenhouse gases into the atmosphere.	-0.09	0.54	0.73	1.00	1.00	0.83
10. Carbon dioxide is absorbed by forests and the oceans	0.09	0.73	0.73	0.17	1.00	0.67
11. Coral reefs are being damaged by warmer temperatures and ocean acidification.	1.00	1.00	0.45	1.00	0.83	0.83
12. Vanuatu's greatest climatic dangers are cyclones and droughts.	1.00	0.54	0.82	0.50	1.00	1.00
13. Adaptation refers to the actions we can take to reduce the levels of greenhouse gases in the atmosphere.	-0.18	-0.18	-0.64	-0.33	0.83	0.00
14. Using compost is a sustainable form of gardening.	1.00	1.00	1.00	0.83	1.00	1.00
15. Catching fish with nets that have very small holes is a sustainable form of fishing.	0.82	1.00	1.00	-0.33	0.83	0.17
16. Vanuatu is one of the most vulnerable countries in the world to natural disasters.	0.82	0.73	0.45	0.83	0.83	1.00
17. I am worried that climate change will bring great dangers to the world in the future.	-0.18	0.36	0.09	0.83	1.00	0.83
18. I want to join a student strike to show my concern about climate change.	0.91	0.91	0.64	0.67	0.83	0.67
19. I know a lot about the causes and impacts of CC	-0.45	0.82	-0.18	0.33	0.83	0.83
20. I want to help my community prepare for climate change and disasters.	1.00	0.82	0.91	0.83	1.00	1.00
21. What does "climate change" mean?	0.45	0.36	0.27	3.00	4.00	4.00
22. What is the enhanced greenhouse effect?	0.18	0.27	0.18	1.50	1.67	2.00
23. What are 3 human activities putting extra GHGs into the atmosphere?	1.27	1.45	0.91	2.33	2.17	2.67
24. What causes ocean acidification?	0.54	0.36	0.45	1.33	0.67	0.67
25. Why is forestry important for mitigating climate change?	0.18	0.18	0.18	1.67	2.17	1.33
26. What are some of the main impacts of climate change in Vanuatu?	1.00	0.91	0.73	2.33	3.00	2.50
27. What kinds of actions can I take to help my family and community become better prepared for the impacts of climate change and more intense disasters? List 3.	0.82	2.09	0.36	2.33	4.00	2.67
Knowledge 1-16	**0.42**	**0.56**	**0.43**	**0.62**	**0.96**	**0.80**
Attitudes 17-20	**0.32**	**0.73**	**0.37**	**0.67**	**0.92**	**0.83**
Knowledge 21-26	**0.60**	**0.59**	**0.45**	**2.03**	**2.28**	**2.20**
Behaviour 27	**0.82**	**2.09**	**0.36**	**2.33**	**4.00**	**2.67**
All	**0.46**	**0.65**	**0.42**	**1.00**	**1.36**	**1.19**

Figure 4.18 Comparison of average scores (all items) between Pandanus and Mangrove schools before, after and 8-11 months after the intervention
Figure 4.19 Comparison of average scores in different aspects of the intervention for Pandanus school before, after and 11 months after the intervention
Figure 4.20 Comparison of average scores in different aspects of the intervention for Mangrove College before, after and 8 months after the intervention

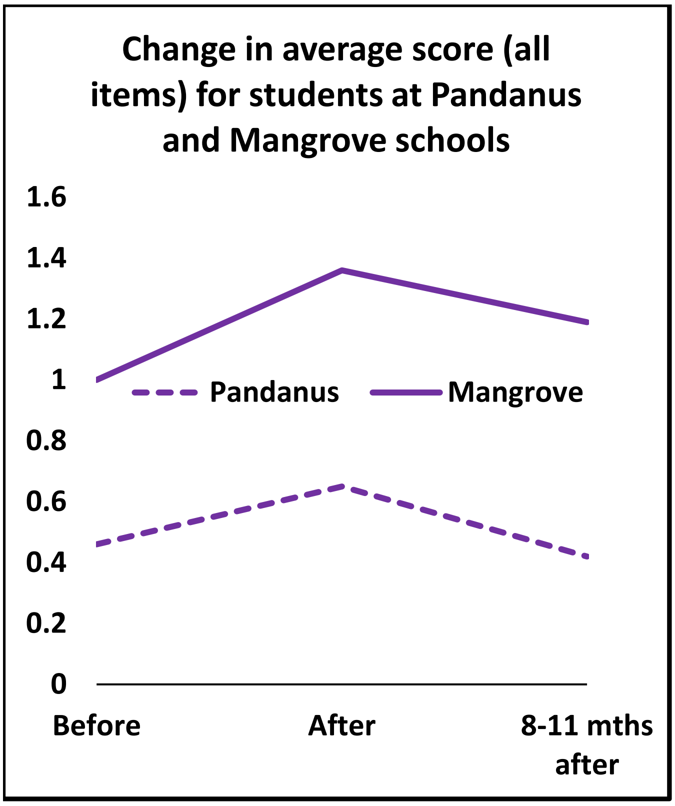


Figure 4.18

Figure 4.19

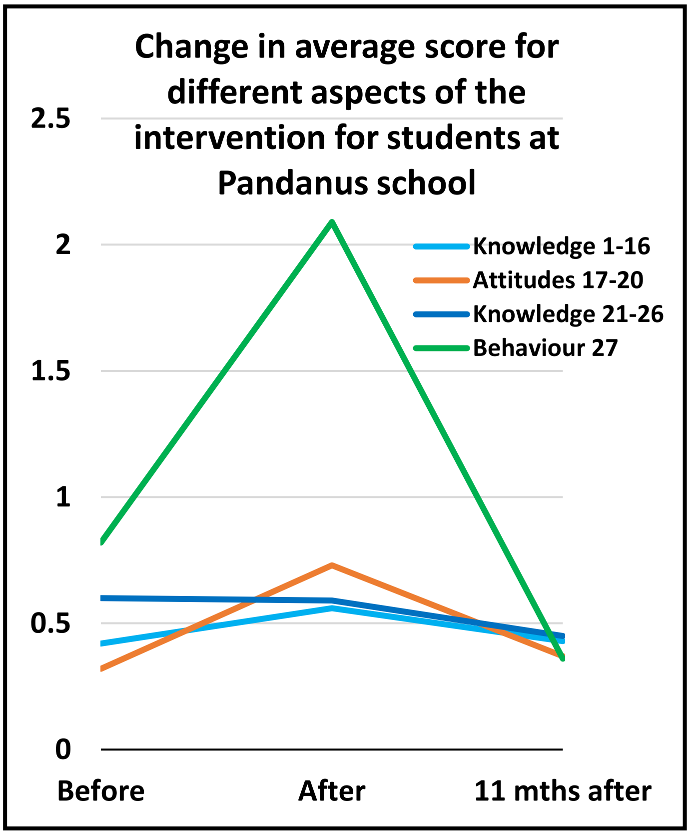
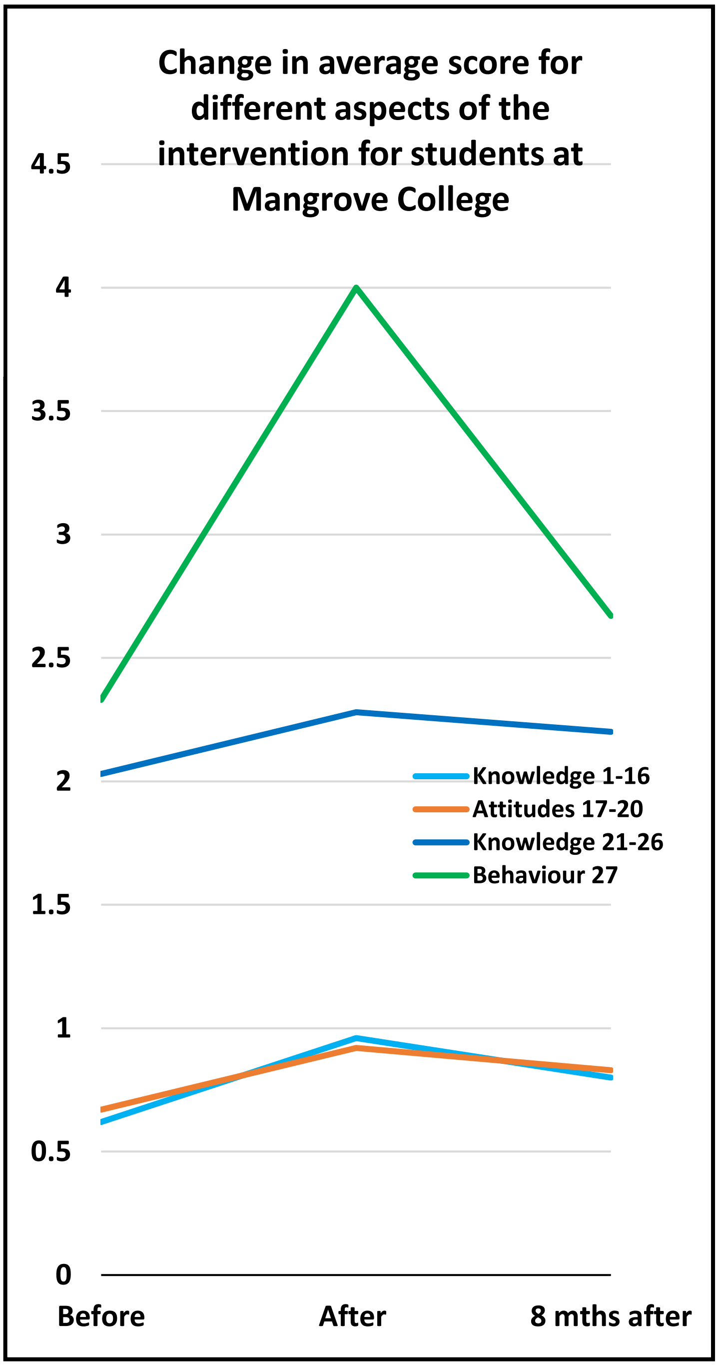


Figure 4.20



From Table 4.30 and Figure 4.18, we learn that in both classes, students' average overall scores for all items in the before/after questionnaire scores declined over time, being significantly lower than they had been immediately after completing the CC Toolkit activity. Thus scores for students from Mangrove College declined from 1.36 to 1.19, half way between the before and after scores at the time of the intervention. Those for students from Pandanus JSS fell from 0.65 to 0.42, which is even lower than their scores before actually participating in the intervention (0.46).

For students at Pandanus JSS (Figure 4.19), the regression in average scores to below those recorded before the intervention was due to sharp decreases in marks for attitudes and behaviour. Scores for knowledge items did not decline by the same degree. For students at Mangrove College (Figure 4.20), the most notable fall was in the score for behaviour, from 4.0 to 2.67, but this was still well above pre-intervention levels (2.33), as were the 8-months-after scores for short-answer questions on knowledge (2.20), and the A/D items on knowledge (0.80) and attitudes (0.83).

Several explanations can be offered for these inter-class differences. Firstly, the small size of the samples could mean that the differences occurred by chance. Secondly, the level of schooling could be a factor. The 11 students at Pandanus first encountered the CC Toolkit when they were at the start of Year 9 in a school that was offering this level for the first time, and eleven months later were at the start of Year 10, the last year of junior secondary education. On the other hand, the 6 students at Mangrove had already passed the Year 10 Leaving Examination, had undergone one year in the senior cycle and reached Year 12 level when they undertook the CC Toolkit activity in June 2020; further, they were studying Earth Science at the time, so we should expect their performance to be better. By February 2021, however, they were no longer studying Earth Science, since Year 13 courses in that subject had not yet been implemented. A third influence could be the effectiveness of the CC Toolkit per se. It had an immediate impact on students in both schools, with scores in knowledge, attitudes and behaviour rising dramatically, but its impact eroded more rapidly for Pandanus than for Mangrove students, with the latter continuing to gain further insights on climate change and disasters through Earth Science. The implication is that the Toolkit is effective in the short term, but needs further reinforcement through follow-up activities organised by the teacher.

In summary, data on the effectiveness of the CC Toolkit activity over time in enhancing resilience to climate change is limited, comprising responses from a small sample of 17 students from two dissimilar classes. The performance of Pandanus students is likely to be more typical of the student population for which the Toolkit was designed, since they were at Year 9/10 level and had minimal prior exposure to classroom studies of hazards and climate change. The fact that their overall score almost one year after participating in the intervention dropped markedly from 0.65 to 0.42, with a striking fall for intended behaviour, suggests that the stimulation to learning engendered by the activity was only temporary. Mangrove students, on the other hand, were at Year 12/13 level, had already surmounted more academic hurdles, and were using the Toolkit to supplement learning about climate change in Earth Science at Years 11/12; yet once concepts were no longer being strengthened at Year 13 level, their scores for knowledge, attitudes and behaviour all declined.

4.3.12 Summary and Discussion of Results

Before participating in the CC Toolkit activity, average scores for 363 students showed that they already had a reasonable understanding of weather, causes of climate change as both natural and human, cyclones and droughts as Vanuatu's principal climatic hazards, and human activities responsible for GHG emissions. However, scientific processes were poorly grasped. After the intervention, students improved their scores in 26 out of 27 items in the questionnaire, but were still confused between adaptation and mitigation, and had not advanced in their understanding of evaporation, ocean acidification and the enhanced greenhouse effect. There was a marked improvement in their score for behaviour - willingness to improve the adaptive and coping capacities of their families and communities. Overall achievement increased from 25% to 44% of the level indicating a high resilience to disasters and climate change, suggesting that the intervention was moderately effective.

In summary, quantitative evidence suggests that the Toolkit reinforces learning in the short-term about the "what" and the "how" of climate change and hydro-meteorological hazards, but not the "why".

CHAPTER 5: RESULTS AND DISCUSSION - RQ1: SENIOR SECONDARY EDUCATION

5.1 Scope of the Chapter

This chapter will deal with Research Question 1 in relation to education about resilience at senior secondary level in Vanuatu.

How effective is formal education on climate and disaster resilience in Vanuatu in terms of knowledge and skills gained, changes in attitude and behaviour and impacts on individuals and their communities?

Regarding senior secondary education (years 11 to 13), climate change and disasters feature in new curricula currently being introduced in Geography, Development Studies and Earth Science. The process began in 2019, and only in 2021 were the first students at Year 13 level in French-speaking schools completing the whole curriculum. Quantitative data has been obtained from 180 students from 20 classes and 12 teachers on the effectiveness of courses in these three disciplines, with additional qualitative data from interviews with teachers and school principals.

5.2 Senior Secondary Education (Years 11-13)

5.2.1 Delays in the Implementation of the New Common Curriculum

According to official statistics from the Ministry of Education and Training (MOET, 2022), there were 110 secondary schools operating in Vanuatu in 2021, of which 77 (70%) used English as language of instruction, and 33 (30%) used French. These schools catered for a total of 25,720 students. Numbers of students in the senior secondary cycle were 2,281 in Year 11, 2034 in Year 12 and 1,640 in Years 13 and 14 - a total of 5,955, of whom 3,989 were learning in English and 1,606 in French (author’s estimation, based on MOET, 2022, Table 16).

Prior to 2019, senior-cycle students in all schools followed curricula leading to the Vanuatu Senior Schools Certificate (VSSC) at the end of Year 12. In Year 13, English-medium students took the South Pacific Form Seven Certificate (SPFSC), an accredited course for university entry offered by the Pacific Community through its Educational Quality and Assessment Programme (EQAP), based in Suva, Fiji. Meanwhile, French-medium students continued in Years 13 and 14 to take programmes leading to entrance qualifications for universities in New Caledonia and France. In Year 13, they took the Certificat de Treizième Année, while in Year 14 they completed the Diplộme d'Accès aux Études Universitaires (DAEU). The new common curriculum for Years 11-13 of the secondary cycle of education in English- and French-speaking schools was designed to ensure that this divergence at Year 13 level disappeared.

This common curriculum, initially formulated in 2011-2013, was first implemented at Year 11 in 2019. The plan had been to continue the implementation of courses in succeeding years, so that by 2021, they would be followed by all students in Year 13, regardless of language. For the purposes of my research, this was important, since the most meaningful learning about climate change and disaster risk reduction takes place in the three optional subjects of Geography, Development Studies and Earth Science at Year 13 level, and I had planned to gather data from teachers and students on their experiences towards the end of that year.

Unfortunately, the planned unfoldment of courses has only partially transpired. The national State of Emergency for most of 2020 due to Cyclone Harold and the COVID-19 pandemic severely affected school attendance and retarded the implementation of Year 12 syllabi during that year. By 2021, when Year 13 syllabi should have been introduced, the situation is best summarized by the Chief Executive Officer of the Curriculum Development Unit:

> The Year 13 syllabi have been rolled out, but only for the Francophone schools. A decision was made to maintain the SPFSC for a couple more years and strengthen the capacity of the Examinations and Assessment Unit (EAU) to implement outcome-based examinations before switching to the new syllabi in Anglophone schools. This means that the English-speaking schools are now using the common syllabus in Years 11 and 12, but still follow SPFSC courses in Year 13. The plan is to implement the Year 13 common syllabus in 2022 or 2023, with the date still to be confirmed by the EAU.
>
> (Felicity Rogers Nilwo, email interview on 13th October 2021)

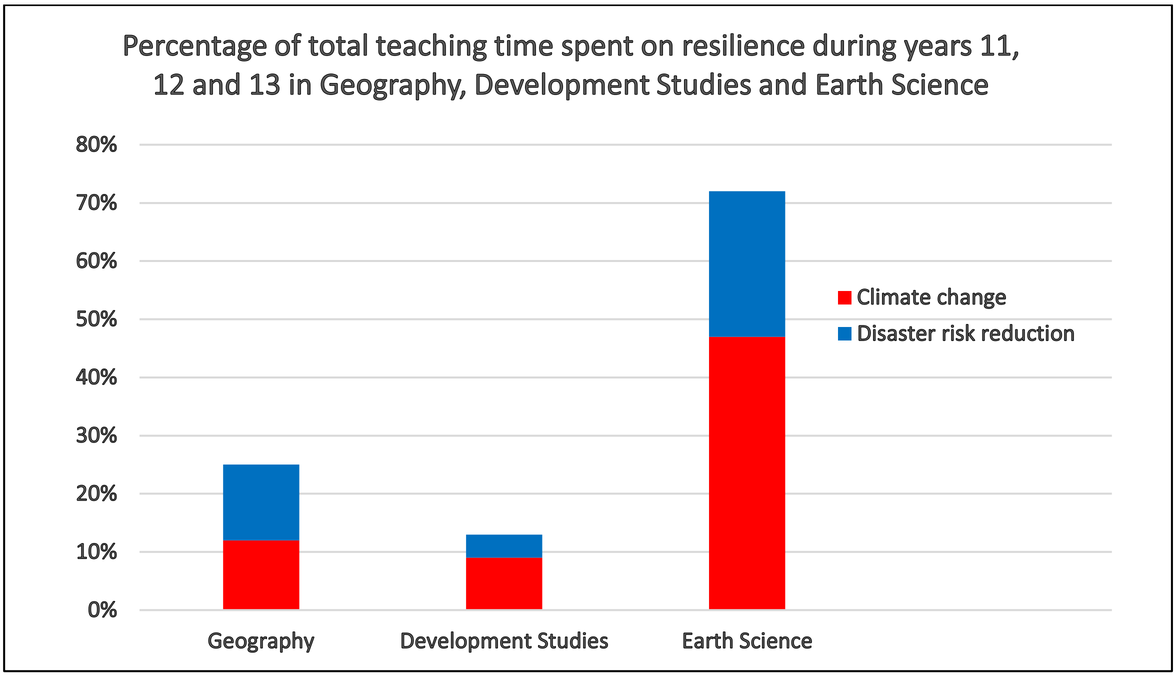
Because climate change and disaster risk reduction do not appear in syllabi for any subject at SPFSC level, the implication of this decision is that while data on teaching and learning about resilience issues is obtainable at the end of 2021 from French-speaking classes at Year 11-13 level, it is only available for English-speaking classes at Year 11-12 level, and will not be accessible at Year 13 level until after the life cycle of this thesis.

5.2.2 Resilience Issues in the new Senior Cycle Curriculum

Before considering that data, I will analyse the importance of climate change and disaster topics in the new common syllabi for Geography, Development Studies and Earth Science that are in process of implementation. These resilience issues feature in strands delivered in increasing complexity through the three years of the senior secondary course (CDU, 2018).

Following information contained in the syllabus document for each subject, especially in terms of time allocation, I have compared the three subjects in total teaching hours spent on resilience (Figure 5.1), and then calculated the number of hours on each sub-strand within each subject (Tables 5.1, 5.2 and 5.3), distinguishing between time spent on climate change (shown in red) and on disasters (blue).

Figure 5.1 Percentage of total teaching time spent on resilience in the new Yr 11-13 curriculum



Source: Calculated from syllabus documents for the three subjects (CDU, 2018)

Students who choose Geography spend 25% of their time on resilience issues, almost equally divided between CC and DRR. Those who opt for Development Studies only spend 13% of their time on resilience, largely on CC. But those who study Earth Science spend 72% of their time on resilience, of which two thirds is on CC. Thus the most comprehensive treatment of resilience issues is in Earth Science, which has a heavy emphasis on climate science and geology, but also examines mitigation, adaptation and vulnerability in some detail and gives students a valuable technical background in renewable energy and the management of water resources. Development Studies has the least amount of teaching hours on resilience, and most of them occur in Years 12 and 13; CC and DRR are placed within the framework of sustainable development, and there is some acknowledgement of the ethical and traditional values involved in resilience education. Geography gives adequate time to resilience, but focuses on geological and hydro-meteorological processes, their features, distribution and impacts rather than on mitigation and adaptation. In none of the three syllabi is there explicit mention of fieldwork or practical training on strategies for CCA or DRR.

If we look in more detail at Geography, by far the most popular of the three optional subjects, we find three principal knowledge strands and a fourth strand devoted to generic geographic skills and ideas. A student who completes years 11, 12 and 13 is exposed to 462 teaching hours of Geography, of which 89 hours (19%) cover the nature, causes and impacts of disasters and climate change, and 28 hours (6%) are on mitigation and adaptation – with half of that time on conservation and sustainable development. Ethical principles involved in CC – prevention of harm, equity and justice for the most vulnerable, sharing of knowledge and technologies (UNESCO, 2019, pp.13-15) – are not addressed. Also lacking are specific skills such as risk mapping and fostering of community awareness, attitudes such as avoidance of consumerism (Kagawa & Selby, 2009, p.241) and environmental responsibility (Wahlstrom, 1998, p.65), and the promotion of behaviours such as CC advocacy and environmental care. Pedagogical approaches are not promoting the kind of participatory, field and affective learning needed to engage with communities and build proactive citizenship (UNICEF & UNESCO, 2012).

Table 5.1 Importance of resilience in the Year 11-13 syllabus: Geography

Strand	Yr	Topic or sub-strand relating to climate change or disasters	Aspect of resilience education (CC = climate change)	Estimated teaching hours on disasters and CC per year	Total teaching hours for the strand per year	% of teaching time (all strands Yrs 11-13) on resilience
Natural Processes	11	Geological processes: plate tectonics, earthquakes, volcanoes	Nature and causes of disasters and climate change	6	30	1
		Geological processes: weathering, fluvial and/or coastal		6	30	1
		Atmospheric processes and their effects		6	30	1
	12	Living with natural hazards – plate tectonics, volcanoes, earthquakes and tropical cyclones	Nature and causes and impacts of disasters and CC. Strategies for DRR. Adaptation.	6 + 6 = 12	47	2
		Living with natural hazards – tsunamis, floods and droughts		6 + 6 = 12	47	2
	13	Tectonic, volcanic, fluvial, coastal processes OR cyclonic processes	Nature, causes and impacts of disasters	18	35	4
Cultural Processes	11 12 13	- - -	- - -	0 0 0	44 36 25	0 0 0
Local, Regional and Global Studies	11	Islands and geology of Vanuatu	Nature and causes of disasters/CC	5	28	1
		Climate of Vanuatu		5	28	1
		Biodiversity, ecosystems and conservation	Conservation of biodiversity (adaptation)	5	28	1
	12	Geomorphology and geology of the Pacific islands	Nature, causes and impacts of disasters/CC/ ENSO. Mitigation and adaptation	4	22	1
		Climate and climate change in the Pacific region		4	22	1
		SPREP and conservation issues in the Pacific	Conservation & sustainable development	4	22	1
	13	Issues relating to climate change	Nature and impacts of CC	6	25	1
		Treaties relating to biodiversity and conservation	Biodiversity and conservation	6	25	1
Geographical skills and ideas	11	Practical skills	Communication skills.	3 + 3 = 6	30	1
	12	Practical skills and key geographic ideas		3 + 3 = 6	30	1
	13	Practical and planning skills. Research.	Planning and research skills	3 + 3 = 6	45	1
Internal assessment	12	Internal assessment			30	?
	13	Internal assessment			35	?
All strands	11 12 13			20 + 19 = 39 19 + 23 = 42 21 + 15 = 36 117	132 165 165 462	30% 25% 22% 25%

Table 5.2 Importance of resilience in the Year 11-13 syllabus: Development Studies

Strand	Yr	Topic or sub-strand relating to climate change or disasters	Aspect of resilience education (CCA = climate change adaptation)	Estimated teaching hours on disasters and CC per year	Total teaching hours for the strand per year	% of teaching time (all strands Yrs 11-13) on resilience
What is Development?	11	-	-	0	16	0
	12	-	-	0	30	0
	13	-	-	0	20	0
Economic Development	11	-	-	0	16	0
	12	-	-	0	45	0
	13	-	-	0	35	0
Promoting Development	11	International aid	Aid for DRR and CCA	1 + 1 = 2	24	0.5
		Non-government organisations	Role of NGOs in DRR/CCA	2 + 2 = 4	24	1
	12	Rural development	Community awareness on DRR/CCA. Role of NGOs/Gov. in CCA/DRR	1 + 1 = 2	25	0.5
		Local and national organisations		1 + 1 = 2	25	0.5
	13	Regional and international organisations	Role of int. and regional organisations in CCA/DRR	1 + 1 = 2	15	0.5
Development and Environment	11	The Earth's natural environment	Causes of climate change	7	38	2
	12	Environmental degradation and sustainable development	Environmental conservation & sustainable development.	10	20	2
		Land and energy issues	Renewable energy	2	20	0.5
	13	Climate change, ozone depletion and environmental treaties	Nature, causes and impacts of CC. Mitigation and adaptation of CC and DRR. Treaties on CC and DRR	2 + 12 = 14	20	3
		Natural disasters and development		6	20	1
Social, Cultural, Spiritual and Political Development	11	-	-	0	38	0
	12	Women and youth in development	Role of women & youth in CCA/DRR	1 + 1 = 2	20	0.5
		Cultural and spiritual influences on development	Moral, spiritual and traditional values that build resilience	1 + 1 = 2	20	0.5
	13	Spirituality and development		3 + 3 = 6	40	0.5
Research Project	12	Research project			25	?
	13	Research project			35	?
All strands	11 12 13		3 + 10 = 13 4 + 16 = 20 12 + 16 = 28 61		132 165 165 462	10% 12% 17% 13%

Table 5.3 Importance of resilience in the Year 11-13 syllabus: Earth Science

Strand	Yr	Topic or sub-strand relating to climate change or disasters	Aspect of resilience education (CC = climate change)	Estimated teaching hours on disasters and CC per year	Total teaching hours for the strand per year	% of teaching time (all strands Yrs 11-13) on resilience
Planet Earth, its Geology and its External and Internal Movements	11	Solar radiation & climate	Nature of climate, atmosphere and oceans	16	80	4
		Atmospheric and oceanic movement		16	80	4
		Earth realms	Holistic approach	2 + 2 = 4	80	1
		Internal structure of the earth	Nature of earthquakes	8	80	2
	12	The lithosphere and plate tectonics	Nature/causes of disasters & atmospheric processes	8	80	2
		Earth as a heat engine		3 + 1 = 4	80	1
		Measuring geological time	Nature/causes of climate change	4 + 4 = 8	80	2
	13	Mineralogy	Impacts of disasters	10	80	2
		External geological processes	Nature/causes of disasters	10	80	2
Climate Change and Disaster Risk Reduction	11	Earth realm in peril	Ozone layer	6	28	1
		Climate change issues	Climate, weather, variability, causes	8	28	2
		Mitigation of climate change	Mitigation of GHG emissions	7	28	2
		Disaster risk	Disaster risks and vulnerability	7	28	2
	12	Earth realm in peril	Greenhouse effect	9	43	2
		Climate change issues	CC causes/impacts	12	43	3
		Mitigation and adaptation of CC	International efforts. Mitig. & adaptation	12	43	3
		Disaster risk reduction	Vulnerability	10	43	2
	13	Earth realm in peril	Sources of GHGs	8	43	2
		Climate change issues	Impacts of CC	10	43	2
		Adaptation to CC	Adaptation to CC	12	43	3
		Disaster risk reduction	Hazards. Resilience.	13	43	3
Renewable Energy	11	Solar energy	CC mitigation (renewables)	4	12	1
		Wind energy		4	12	1
		Marine energy		4	12	1
	12	Geothermal energy		6	21	1
		Hydraulic energy		9	21	2
		Solid biomass: wood		6	21	1
	13	Biomass: biogas	CC mitigation (renewables)	10	21	2
		Biomass: biofuel		11	21	2
Water Supplies and Management of Water Reserves	11	Exploitation of water resources	Impacts of CC and disasters	3 + 3 = 6	12	1
		Pollution of fresh water		6 + 6 = 12	12	3
	12	Managing reserves	Climate change adaptation and disaster risk reduction	5 + 5 = 10	21	2
		Water purification		10 + 11 = 21	21	4
	13	Desalination		5 + 5 = 10	21	2
		Rain water catchment		11 + 10 = 21	21	4
Internal assessment	11	Internal assessment		(Included in hours for content strands)		
	12	Internal assessment				
	13	Internal assessment				
All strands	11		26 + 76 = 102	332	132	77%
	12		40 + 75 = 115		165 (462)	70% (72%)
	13		49 + 66 = 115		165	70%

Thus many aspects emphasised in Vanuatu's two key environmental policies – the Climate Change and Disaster Reduction Policy 2016-2030 and the National Sustainable Development Plan 2016-2030 – are missing. Contrast the specific outcomes for the Geography sub-strand that contains the fullest treatment of CC (Table 5.4) with the goals of the two key policies (Table 5.5). A comparison of the key policies (Table 5.5) with the Development Studies syllabus for Year 13 (Table 5.6) shows a greater degree of correspondence, and with Earth Science Year 13 (Table 5.7) much more so, but even in these two subjects, practical work on CCA and disaster mitigation is minimal.

Table 5.4 Specific learning outcomes in Geography for the sub-strand 13GEO3.2 on Issues Relating to Climate Change

Identify the major elements in climate change
Describe the major elements in climate change
Describe ways these elements interact to result in climate change
Explain why the interactions of these elements result in climate change
List some local, regional and global characteristics of climate change
Describe the characteristics of climate change
Describe the major global patterns of climate change
Compare the major global patterns of climate change
Discuss the effects of climate change on the environment, using specific examples
Discuss the effects of climate change on people, using specific examples

Source: CDU, 2018, p.53

Table 5.5 Goals of Vanuatu's two current policies on resilience

VANUATU CLIMATE CHANGE AND DISASTER RISK REDUCTION POLICY 2016-2030	NATIONAL SUSTAINABLE DEVELOPMENT PLAN 2016-2030
Priorities for achieving the strategic goal of "resilient development", classified by themes	**Environmental pillar 3: Climate and disaster resilience: Policy objectives**
Climate change adaptation and disaster risk reduction • Vulnerability and impact assessment • Community-based adaptation • Loss and damage • Ecosystem-based approach **Low carbon development** • Energy Road Map • Renewable energy • Energy efficiency • Mitigation and REDD+ • Blue Carbon **Response and recovery** • Planning and preparedness • Community awareness • Early warning systems • Post-disaster assessment • Recovery	**A strong and resilient nation in the face of climate change and disaster risks posed by natural and man-made hazards** • **ENV 3.1** Institutionalise climate change and disaster risk governance, and build institutional capacity and awareness • **ENV 3.2** Improve monitoring and early warning systems • **ENV 3.3** Strengthen post-disaster systems in planning, preparedness, response and recovery • **ENV 3.4** Promote and ensure strengthened resilience and adaptive capacity to climate related, natural and man-made hazards • **ENV 3.5** Access available financing for climate change adaptation and disaster risk management

Sources: Adapted from Government of Vanuatu, 2015, pp.17-25 and DSPPAC, 2016, p.14

Table 5.6 Specific learning outcomes in Development Studies for the sub-strands 13DST4.3 and 13 DST4.4 on Climate Change and Natural Disasters

Identify some of the changes in climate that have occurred in geological history.
List the major causes of the chanting climatic patterns in the Pacific region.
Describe the impacts of climate change on people and the environment.
Describe important treaties and conventions addressing environmental problems.
Discuss opinions on the difficulties in reaching agreement over international conventions on climate change.
Summarize important treaties and conventions that have been made regarding climate change, biodiversity and the mitigation of natural disasters.
Propose specific actions to offset climate change, e.g. re-afforestation, multiple water sources for humans and animals, cultivation of heat- and drought-resistant crops, walking to school/work.
Evaluate the effectiveness of various forms of adaptation, and measures that will help slow down the rate of ozone depletion, using examples.
Describe a natural disaster (e.g. earthquake, volcanic eruption, flood, landslide, drought or tsunami) ant its impacts on development.
Give examples of methods of disaster reduction management, e.g. warnings, building designs.
Summarize measures that can be taken to mitigate some of the harmful effects of natural disasters.

Source: CDU, 2018, pp.36-37

Table 5.7 Specific learning outcomes in Earth Science for the sub-strands 13ESC2.1, 13ESC2.2, 13ESC2.3 and 13ESC2.4 on Earth Realms in Peril, Climate Change Issues, Climate Change Adaptation and Disaster Risk Reduction

Identify sources of carbon dioxide emissions
Carry out and write a report on research into the carbon dioxide content of the atmosphere since before the Industrial Revolution (IR) until today.
Analyse data on CO2 emissions per household in a country of your choice.
Carry out and report on research into the methane content of the atmosphere since before the IR until today.
List the sources of methane.
Explain how different sources of methane (CH_4) world-wide affect the concentration in the atmosphere.
List the impacts of climate change on the atmosphere, the oceans, ecosystems and human society.
Explain the impacts of climate change on the atmosphere.
Explain the impacts of climate change on the oceans.
Explain the impacts of climate change on ecosystems.
Explain the impacts of climate change on human society.
Compare rainfall totals during wet and dry seasons in Vanuatu.
Analyse predictions for changes in Vanuatu's temperature, rainfall and the number of extreme events
Predict a scenario for the likely consequences and impacts of these future climatic changes in Vanuatu
Define sustainable livelihoods.
Name the different measures being taken to adapt to climate change at community levels in Vanuatu.
Explain the scientific basis of these measures taken at community level in Vanuatu.
Evaluate and report on the practicality of measures being taken to adapt to climate change in Vanuatu communities.
Discuss why adaptation measures are needed to provide sustainable livelihoods for Vanuatu communities in future.
Define "hazard".
Define "disaster".
Define "hydro-meteorological hazards".
Explain the difference between a hazard and a disaster.
Analyse the nature of hydro-meteorological hazards such as drought.
Analyse the causes of hydro-meteorological hazards such as drought.
Analyse the consequences of hydro-meteorological hazards such as drought.
Analyse the nature of hydro-meteorological hazards such as cyclones.
Analyse the causes of hydro-meteorological hazards such as cyclones.
Analyse the consequences of hydro-meteorological hazards such as cyclones.
Analyse the nature of hydro-meteorological hazards such as floods.
Analyse the causes of hydro-meteorological hazards such as floods.
Analyse the consequences of hydro-meteorological hazards such as floods.
Research and report on ways of becoming more resilient to these hydro-meteorological hazards
Analyse the nature, causes & consequences of geological hazards (earthquakes, volcanic eruptions, ashfalls, tsunami)
Research and report on ways of becoming more resilient to these geological hazards.
Analyse the nature, causes and consequences of biological hazards such as pests and diseases.
Research ways of becoming more resilient to these biological hazards.
Explain the major causes of people's vulnerability to disasters.
Relate development frameworks (e.g. Sendai Framework for Disaster Risk Reduction) to the strengthening of people's resilience.

Source: CDU, 2018, pp.34-36

Therefore, although resilience issues are covered in these three school subjects, we must question whether any of the three will have done enough to promote behaviours that create ‘a more sustainable future in terms of environmental integrity, economic viability and a just society for present and future generations’ – the goal of the United Nations Decade for Sustainable Development (UNESCO, 2020, p.1)

Regarding numbers of students learning about resilience through the three optional subjects, statistics for 2021 provided by the National Examinations Office (Table 5.8 and Figure 5.2) underscore the very small numbers taking Earth Science – the optional subject that has the most effective treatment of resilience issues.

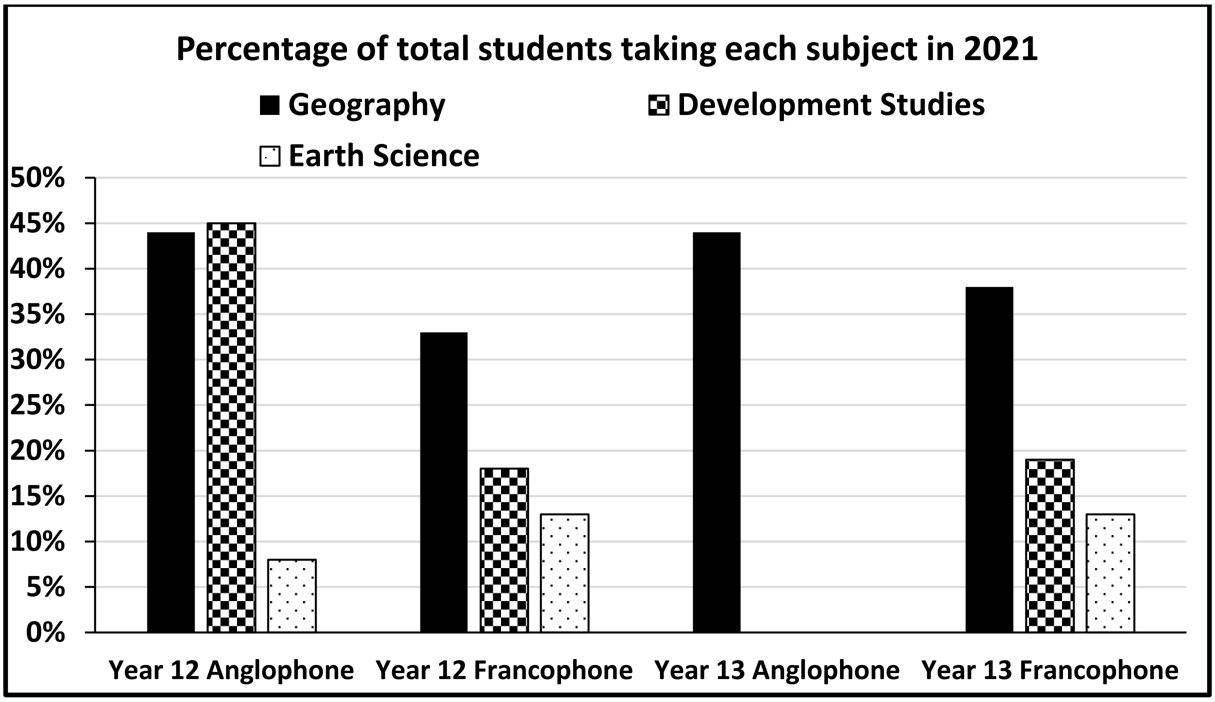
In 2021, a year when the number of COVID-19 cases in Vanuatu was negligible, the new curriculum was being taught in all schools in Year 12, but only in francophone schools in Year 13. Of those who completed Year 12 and sat for the Vanuatu Senior Secondary Certificate (VSSC), 44% of students in English-medium schools took Geography, 45% took Development Studies and only 8% took Earth Science. For French-medium schools, corresponding figures were 33%, 18% and 13%. At Year 13 level, English-speaking students took the SPFSC, which has no courses in Development Studies or Earth Science, and minimal reference to resilience in Geography. Of French-speaking students – just one third of the total number at this level – 38% took Geography, 19% Development Studies and 13% Earth Science.

Table 5.8 Numbers of Year 12 & 13 students enrolled for national examinations in 2021

Examination	Language of delivery	Subject	M	F	T
YEAR 12 / ANNÉE 12					
Vanuatu Senior Secondary Certificate (VSSC)	Anglophone (Courses delivered in English)	First language English	532	671	1,203
		Geography	228	302	530
		Development Studies	190	352	542
		Earth Science	57	34	91
	Francophone (Courses delivered in French)	First language French	282	293	575
		Géographie	86	105	191
		Études de Développement	48	54	102
		Science de la Terre	30	44	74
YEAR 13 / ANNÉE 13					
South Pacific Form Seven Certificate	Anglophone (Courses delivered in English)	First language English	362	468	830
		Geography	170	198	368
		Development Studies	-	-	-
		Earth Science	-	-	-
Vanuatu Year 13 Certificate	Francophone (Courses delivered in French)	First language French	186	239	425
		Géographie	51	110	161
		Études de Développement	23	59	82
		Science de la Terre	33	24	57

Source: National Examinations Office, 2022

Figure 5.2 Percentage of all examination candidates taking Geography, Development Studies and Earth Science in Years 12 and 13 during 2021



Subject	Year 12		Year 13	
	Anglophone	Francophone	Anglophone	Francophone
Geography	44%	33%	44%	38%
Development Studies	45%	18%	-	19%
Earth Science	8%	13%	-	13%

Source: National Examinations Office, 2022

The new curriculum may not be implemented at Year 13 level in English-medium schools until 2023. When that happens, and assuming similar proportions to those in Year 12 in 2021, 44% of students will take Geography, 45% Development Studies and 8% Earth Science. If the total overall Year 13 cohort (Anglophone and Francophone) is 1,255 (2022 figure), then only an estimated 124 students nationally (approximately 1 in 10) will have graduated from an Earth Science Course and have the best appreciation of actions to build resilience to climate change and disasters.

Another issue relevant to the effectiveness of formal education in resilience in Vanuatu's senior cycle of education is the rate of student attrition. As documented in Section 1.3.2 of the Introduction, the national attrition rate between Year 1 and Year 13 in 2021 was 82%. Since most learning about CC and DRR takes place in the senior cycle, especially in Years 12 and 13, and is restricted to three optional subjects, the high rate of attrition means that the vast majority of young people in Vanuatu are not benefiting from formal exposure to resilience education.

In 2021, the most effective in-depth study of CC and disasters occurs in all three years of Earth Science and in Year 13 of Development Studies by those who opted for those subjects, but this only applies to a minority of those in French-medium schools, which themselves cater for just one third of all Year 11-13 students. In the larger cohort of students in English-medium schools, students are learning about resilience in Years 11 and 12 in three optional subjects, but are missing out on the more meaningful aspects covered if the Year 13 common curriculum was in place.

5.2.3 Educating Year 11-13 Students about Resilience: Data from Students

It was not until September/October of 2021 that I was able to reach out to 33 teachers in eight senior secondary schools to seek data on resilience education in Years 11-13. Teachers of Geography, Development Studies and Earth Science were requested to complete specific questionnaires relating to their own subject, together with questionnaires QC1 (course characteristics) and QC2 (teaching and learning techniques). Their students answered questionnaires QS1 and QS4 in either English or French. QS1 was designed to elicit student views on materials and course delivery, while QS4 was to measure changes in knowledge, skills, attitudes and behaviour during a course on resilience, to be completed at the start and end of a course. Unfortunately, QS4 could only be answered at the end of that school year.

Information was obtained from seven senior secondary schools, of which three were English-medium, three French-medium and one bilingual. A total of 12 teachers and 180 students in 20 classes replied; the remainder were unable to complete questionnaires in the face of end-of-year activities and examination pressures. Data included responses from Year 12 students at Mangrove College who participated in the CC Toolkit activity in June 2020 and answered QS1 and QS4 at the same time.

QS1: Student views on course delivery and course characteristics

QS1 (Appendix A3) uses a five-point Likert scale that attempts to measure two aspects of course effectiveness – qualities of course delivery (statements 1 to 20) and characteristics of the course itself (statements 21 to 30). Additionally, the three open-ended questions at the bottom of the questionnaire ask students to state three reasons why they enjoy the course/lessons, three important things they are learning from the course/lessons and their suggestions for how the course/lessons might be improved. In summary, QS1 elicits a student's point of view on the relative importance of the teacher and the course when participating in resilience education.

Table 5.9 provides an example of how responses from one class of students were assessed. For the 30 statements (called "questions" on the form), scores were allotted on a five-point scale according to the level of agreement, ranging from +2 for "strongly agree" to -2 for "strongly disagree", with 0 for "neutral/don't know". The total score for each statement for all students in the class was calculated, and then an Excel spreadsheet used to calculate the average for each item by dividing total score by total number of students. Finally, average scores for statements 1 to 20 (the teacher) and statements 21 to 30 (the course) were calculated, together with the overall average score for all statements for the class.

Data was aggregated according to each of the three optional subjects (Geography, Development Studies and Earth Science), and also by year of study (11, 12 and 13).

Table 5.9 Example of a summary data form for one class for student questionnaire QS1

Course/cohort: Hibiscus College : Géographie 11^{e} Total participants (n) : 10
Date of questionnaire completion: October 2021

Question		Strong disag -2	Dis-ag -1	Neut / Don't know 0	Agree +1	Strong agree +2	Total (T)	Av. Score (T/n)
1.	The teacher/facilitator is knowledgeable			1	1111	11111	14	1.40
2.	The teacher/facilitator is well prepared				11111	11111	15	1.50
3.	The teacher/facilitator comes on time			1111	11	1111	10	1.00
4.	The teacher/facilitator is enthusiastic			11111	1111	1	6	0.60
5.	The teacher/facilitator is creative			1	11111	1111	13	1.30
6.	The teacher/facilitator is well organised				111111	1111	14	1.40
7.	The teacher/facilitator uses visual materials		1	111	111111		5	0.50
8.	The teacher/facilitator is approachable			1111	11111	1	7	0.70
9.	The teacher/facilitator treats us as individuals		1		1111	11111	13	1.30
10.	The teacher/facilitator values my contributions		1	1	111111	11	9	0.90
11.	The teacher/facilitator shows compassion			1	1111111	11	11	1.10
12.	The teacher/facilitator is helpful				1	1111111 11	19	1.90
13.	The teacher/facilitator communicates clearly				111	1111111	17	1.70
14.	The teacher/facilitator explains new concepts				1111	111111	16	1.60
15.	The teacher/facilitator makes me think			1	1111111	11	11	1.10
16.	The teacher/facilitator asks us questions			11	111	11111	13	1.30
17.	The teacher/facilitator makes us participate				1111111	111	13	1.30
18.	The teacher/facilitator participates in the activities				1111	111111	16	1.60
19.	The teacher/facilitator promotes cooperative learning				1111	111111	16	1.60
20.	The teacher/facilitator checks up on our progress			1111	11	1111	10	1.00
21.	The course/lesson stimulates my interest in CC/ DRR			11111	11111		5	0.50
22.	The learning materials are exciting and appropriate			111	1111111		7	0.70
23.	I am encouraged to be responsible for my own learning		1	1	11	111111	13	1.30
24.	I know how to prepare for all kinds of disaster			1	111	111111	15	1.50
25.	I know ways to mitigate and adapt to climate change			1	11111	1111	13	1.30
26.	I learn new skills through the course/lessons		1		111	111111	14	1.40
27.	I want to put my learning into action			1	111111	111	12	1.20
28.	I am ready to take action on climate change			1	11111	1111	13	1.30
29.	I am ready to help others understand about disaster risk			1	11111	1111	13	1.30
30.	The way that the teacher/facilitator delivers the lesson is more important than the learning materials used.			11	1111	1111	12	1.20

Table 5.9 (cont.)

Give three reasons why you enjoy/enjoyed this course/session/these lessons

CODES	
A. Gaining knowledge about specific topics in the course B. In general, gaining new knowledge/ideas C. Gaining specific skills, e.g. public speaking, working with local communities, carrying out awareness, drawing risk maps D. Appreciation of the facilitator(s) and his/her/their qualities E. Appreciation of teaching and learning strategies used, e.g. empowerment through group work, encouragement of participation, field work F. Personal reasons, e.g. making new friends, having fun G. Other reasons H. No answers given/ Irrelevant	• I am learning new things about CC in order to apply them later (1,1) A • It enables me to discover other countries B • It talks about responsibilities towards other people in the school B • Helps me to share my opinions with my teachers E • It talks about natural disasters and how to adapt to face these risks A • Encourages me to help others to understand the hazards and disasters in climate change A • I am learning things that are new to me B • It helps me to take care of my family F • Climate change A • Risks of CC A • How to prepare for natural disasters A • It gives us a good example G • It is informative B • Helps us to understand CC A • This is the easiest course (1,1) G • We study things and the climates in Vanuatu A • Because this course is important in the world B • Because I understand the seasonal changes of climate A • Because I understand the causes of natural disasters A • I learn new information that will help me in the future B • Course content is passionate and interesting, with many different subjects of which each one is instructive B • It helps to live more easily within a community, because the knowledge enables me to gain experience of the things around me B • It relates to the behaviour of teachers H • It relates to students' learning E • Answer unclear H • How to prepare for CC A • Encourages us to learn E • We participate in activities E **Total students: 10 Total responses: 30**

A	B	C	D	E	F	G	H
12	8			4	1	3	2

Note: Students' answers have been translated from the original French

Table 5.9 continues on page 202

State the three most important things you learned from this course/these lessons

CODES	
A. Gaining knowledge about specific topics in the course B. Gaining generic knowledge C. Gaining specific skills D. Gaining generic skills, e.g. how to be an effective facilitator at community level E. Irrelevant /No answer	• No answer (1) E • We must prepare in advance for CC A • We must help our community to prepare for CC A • We should talk about the causes and consequences of CC to our neighbours every day A • Methods of prevention B • Competency (1,1) E • Responsibility (1,1) B • Methods that enable us to combat CC A • Be responsible for everyone and help others B • Knowing about my own climate and that of other countries A • Helping others to prepare for natural disasters A • Avoiding pollution in the world A • Climate change A • Natural disasters A • Temperature A • How to survive the hazards of volcanoes, earthquakes, cyclones, etc. A • Things that ni-Vanuatu must do to protect the country/ their environment B • Things that happen in real life B • Knowledge B • Things I must do in case of natural disasters, including security measures A • The importance of family planning in order to avoid over population B • The importance of a country's economy B • Sometimes teachers do not come on time E • Students have difficulties E • Lessons are not well explained E • We must always prepare in advance and be well organised B • We must always listen to the radio A • We must help others to understand disaster risks A **Total students: 10 Total responses: 30** **A B C D E** **14 10 6**

Note: Students' answers have been translated from the original French

How could this course/session/these lessons be improved?

CODES	
A. Changes in the behaviour or manner of the facilitator B. Changes in the course itself, e.g. content, materials, length, field work, financial assistance C. Changes in the way the participants/students approach the course D. No need for improvement – fine as it is E. Answer applies to improvement of the individual, not the course F. Answer unclear/irrelevant G. No answer	• No answer (1) G • By sharing this in other places, in schools, television, mobile phones, etc. so that people stop polluting the air water and land, stop deforestation, undertake reforestation and recycling and use renewable energy B • By putting into practice the practical adaptations to face disasters. B • By sharing these ideas with others in order to find other ways of prevention against CC B • By demonstrating to the public how to survive when there is a natural disaster and to ask the public to practice certain strategies in order to reduce pollution in countries B • Share this on the radio and in social media B • Undertake recycling, planting more trees, stopping deforestation, cultivating our own food, stopping pollution, stopping the killing of marine life, stopping imports (1,1) E • By having more visual aids B • Explaining certain subjects in greater detail, including the practice of security measures during natural disasters, especially earthquakes B • Teachers should come on time, help students who are in difficulties and better explain the lessons A **Total students: 10 Total responses: 11** **A B C D E F G** **1 7 2 1**

Note: Students' answers have been translated from the original French

Figure 5.3 is a photograph of the Year 11 and Year 12 Earth Science students from one school who willingly participated in the completion of Questionnaires QS1 and QS4.

Figure 5.3
Year 11 & Year 12 students from Blackpalm High School who completed questionnaires QS1 and QS4 in October 2021

Earth Science teacher, Blackpalm High School, October 2021

The overall findings from QS1 are summarised in Tables 5.10, 5.11 and 5.12 and in Figures 5.4, 5.5, 5.6, 5.7, 5.8 and 5.9.

Table 5.10 and Figures 5.4, 5.5 and 5.6 indicate students' views on how their teacher's delivery and the course itself impact on learning about resilience. Average scores for each statement have been tabulated for Year 11-13 students in each of Geography (40 students), Development Studies (66 students) and Earth Science (74 students), and then calculated for all three subjects together (180 students). The average scores for all statements aggregated for effectiveness of delivery (1 to 20) and for effectiveness of course materials (21 to 30) are also shown for the three subjects, summarised in Figure 5.4.

On a scale of -2 to +2, the overall average score for all aspects of resilience education was 1.21, reflecting students' overall satisfaction with their lessons. It was significantly higher for those taking Earth Science (1.30) than for those studying Development Studies (1.17) and Geography (1.13), as demonstrated by the 2-tailed significance of less than 0.05 shown in Tables 5.11 and 5.12. In all three subjects, scores for course delivery were higher than those for course materials, especially in

Development Studies, suggesting that the teacher has a greater influence on student performance than the learning materials used – a view supported by students' answers to statements no. 22 and 30. Later, I shall refer to the inadequacy of learning resources as expressed by students in their answers to the three questions in QS1 and by teachers in their responses to questionnaires provided in Section 5.2.4.

An analysis of overall student views on course delivery and materials by individual statement (Figure 5.5) shows that the highest score was for Q12, a teacher's quality of helpfulness (1.67), closely followed by Q13, ability to communicate (1.58), Q16, propensity to use questioning (1.52) and Q19, promotion of cooperative learning (1.51). These four top scores all related to course delivery. Among statements for effectiveness of course materials, the highest score was for Q26, the learning of new skills (1.44), followed by Q23, for a student encouraged to be responsible for his/her own learning (1.34). At the other end of the scale, the lowest score of all (0.73) was recorded for Q22, the statement on the relevance and excitement-value of learning materials, which emphasizes the lack of inspiring educational resources for climate change and disasters: with the implementation of content on resilience still in its infancy, there are as yet no standard guides or texts, and much therefore depends on individual teacher initiative. Almost as low was the score of 0.74 for statement Q9, which asked whether students thought they were being treated as individuals. Other scores around or below 1.0 were recorded for Q3, a teacher's punctuality; Q4, a teacher's level of enthusiasm; Q7, the use of visual materials; Q21, the level of stimulation to know about resilience issues (CC/DRR); and Q24, knowing how to prepare for all kinds of disaster. I would submit that these lower scores are a cause of concern, since they suggest that resilience courses at senior secondary level are not providing the required level of motivation for students to learn and become agents of change.

On the other hand, Figure 5.6 shows that in relation to course characteristics, students' overall opinions were more positive than negative. Figure 5.6 compares the percentage of students in their level of agreement with Q26, which had the highest score, with the percentages for Qs 21 and 22, which had the lowest scores.

Table 5.10 Average scores for senior secondary students' views on effectiveness of course delivery and course materials in subjects offering resilience education

Question/Statement		Average scores within a range of -2.0 to +2.0			
		Geography 40 students	Development Studies 66 students	Earth Science 74 students	All three subjects 180 students
1.	The teacher/facilitator is knowledgeable	1.33	1.38	1.34	**1.35**
2.	The teacher/facilitator is well prepared	1.30	1.41	1.30	**1.34**
3.	The teacher/facilitator comes on time	0.78	1.02	1.14	**1.01**
4.	The teacher/facilitator is enthusiastic	0.58	0.82	1.38	**0.99**
5.	The teacher/facilitator is creative	1.25	1.50	1.14	**1.29**
6.	The teacher/facilitator is well organised	1.23	1.29	1.22	**1.24**
7.	The teacher/facilitator uses visual materials	0.80	0.85	0.97	**0.89**
8.	The teacher/facilitator is approachable	0.90	1.18	1.34	**1.18**
9.	The teacher/facilitator treats us as individuals	0.75	0.58	0.89	**0.74**
10.	The teacher/facilitator values my contributions	1.08	1.02	1.26	**1.13**
11.	The teacher/facilitator shows compassion	0.95	1.09	1.27	**1.13**
12.	The teacher/facilitator is helpful	1.65	1.62	1.73	**1.67**
13.	The teacher/facilitator communicates clearly	1.45	1.64	1.61	**1.58**
14.	The teacher/facilitator explains new concepts	1.35	1.55	1.42	**1.45**
15.	The teacher/facilitator makes me think	1.10	1.23	1.43	**1.28**
16.	The teacher/facilitator asks us questions	1.55	1.55	1.49	**1.52**
17.	The teacher/facilitator makes us participate	1.45	1.45	1.41	**1.43**
18.	The teacher/facilitator participates in the activities	1.23	1.08	1.34	**1.22**
19.	The teacher/facilitator promotes cooperative learning	1.53	1.50	1.51	**1.51**
20.	The teacher/facilitator checks up on our progress	0.98	1.36	1.28	**1.24**
21.	The course/lesson stimulates my interest in CC/ DRR	0.48	0.70	1.27	**0.88**
22.	The learning materials are exciting and appropriate	0.63	0.64	0.88	**0.73**
23.	I am encouraged to be responsible for my own learning	1.30	1.36	1.35	**1.34**
24.	I know how to prepare for all kinds of disaster	1.15	0.82	1.09	**1.01**
25.	I know ways to mitigate and adapt to climate change	1.18	0.85	1.31	**1.11**
26.	I learn new skills through the course/lessons	1.38	1.35	1.55	**1.44**
27.	I want to put my learning into action	1.20	1.21	1.38	**1.28**
28.	I am ready to take action on climate change	1.05	0.83	1.20	**1.03**
29.	I am ready to help others understand about disaster risk	1.25	0.98	1.34	**1.19**
30.	The way that the teacher/facilitator delivers the lesson is more important than the learning materials used.	1.00	1.21	1.23	**1.17**

Effectiveness of course delivery (Teacher)	**1.16**	**1.25**	**1.32**	1.26
Effectiveness of course materials (Course)	**1.06**	**1.00**	**1.26**	1.12
Effectiveness of all aspects (Teacher + Course)	**1.13**	**1.17**	**1.30**	1.21

Figure 5.4 Average scores for senior secondary students' views on effectiveness of course delivery and course materials in all three subjects offering resilience education

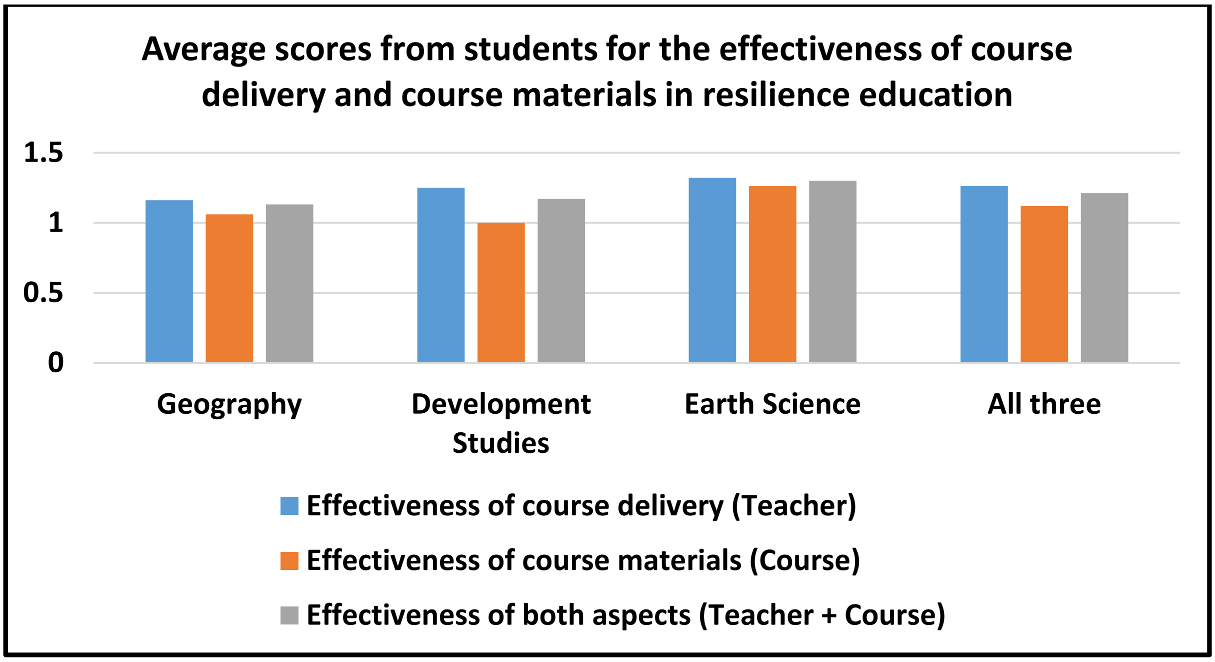


Figure 5.5 Average scores by statement for senior secondary students' views on course delivery and course materials in all subjects offering resilience education

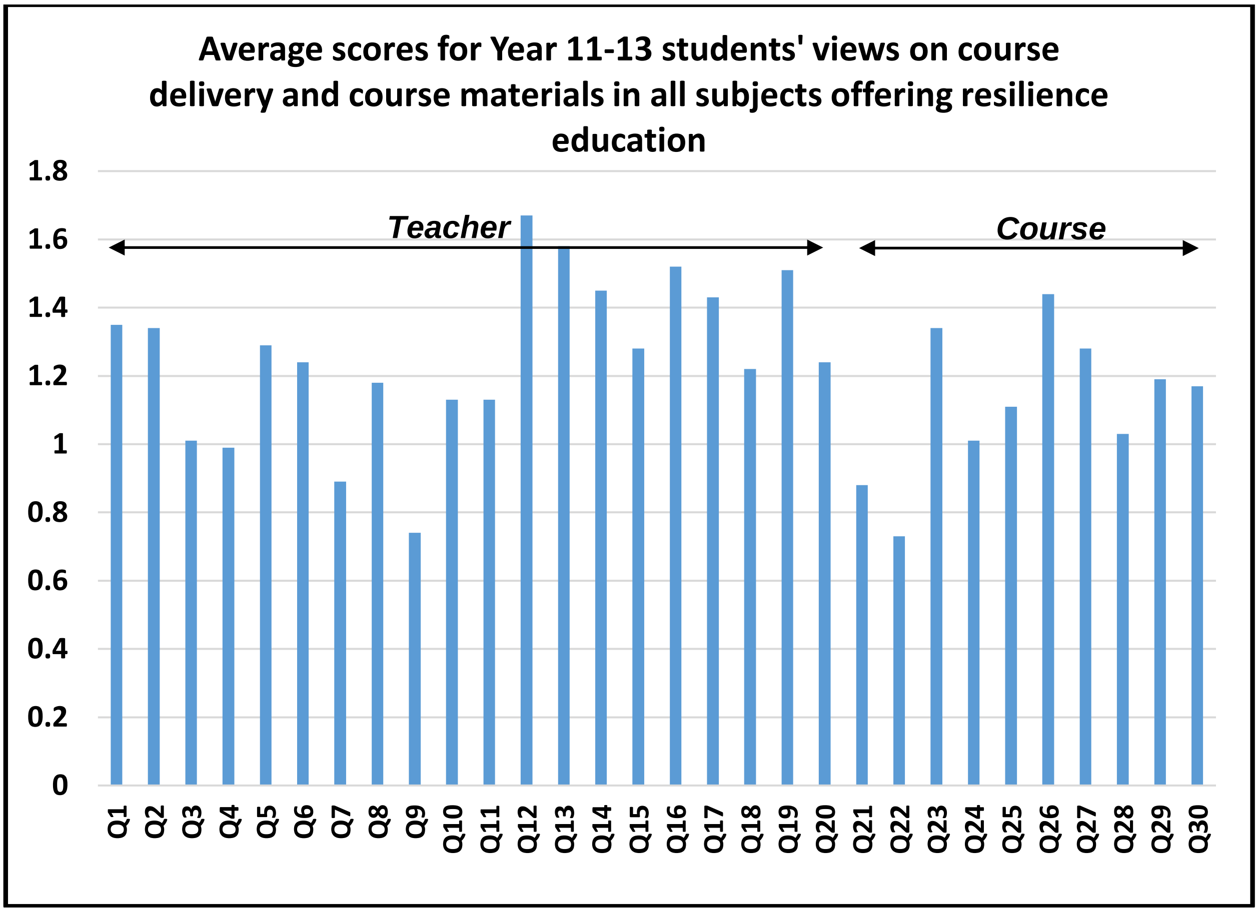


Figure 5.6 Percentage of students in the sample (n=180) stating their level of agreement with three statements on course characteristics: Qs 21, 22 and 26

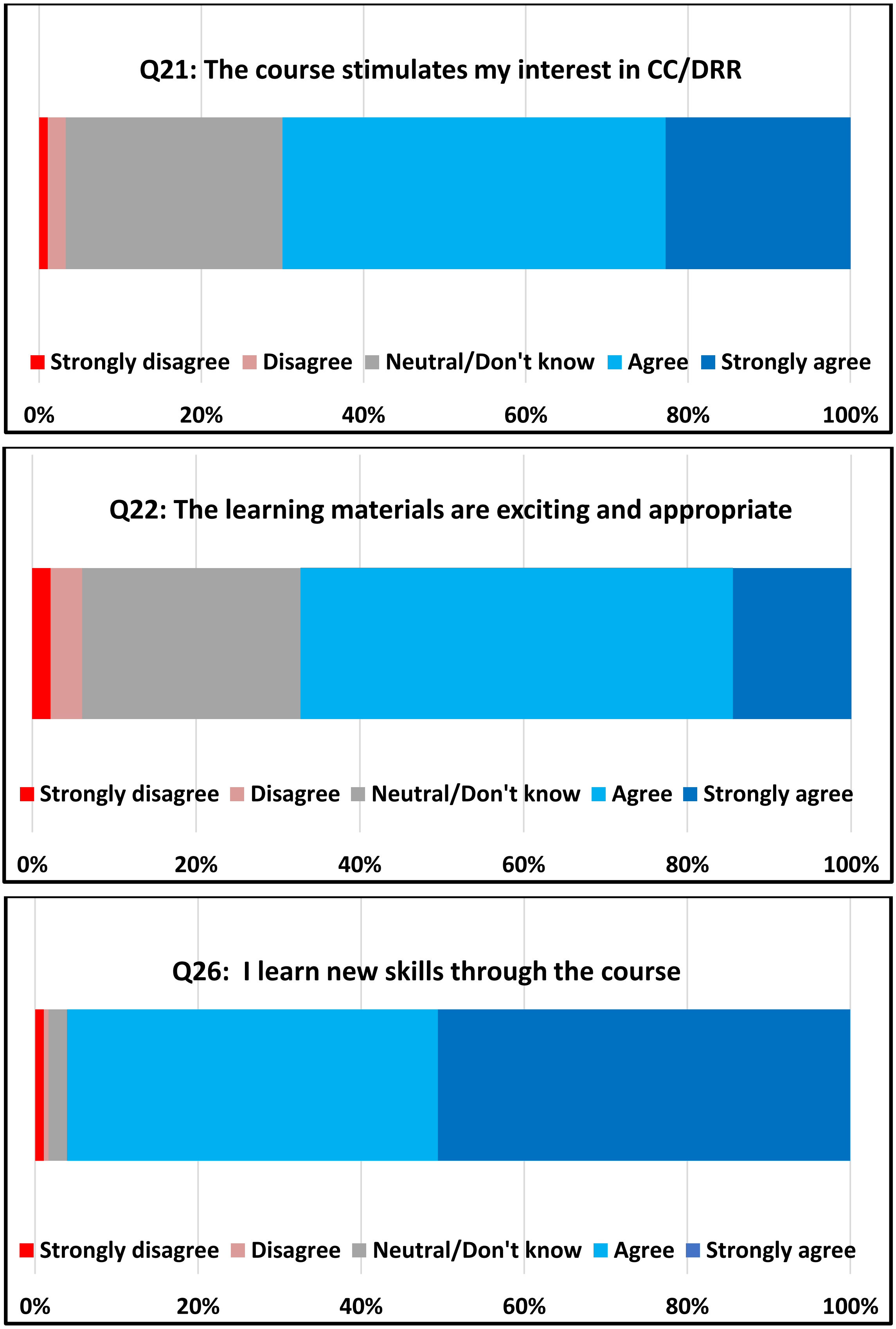


Table 5.11 Determination of validity of difference between average scores (all 30 items) for students taking Earth Science and those taking Geography

Average score for all items	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
Earth Science	1.3023	30	0.19141					
Geography	1.1287	30	0.29724					
Diff EarthSc-Geo	0.1737	30	0.21671	0.09275	0.25459	4.389	29	0.000

N: number of items; Conf. Int: confidence interval; t: t-value; df: degrees of freedom

Table 5.12 Determination of validity of difference between average scores (all 30 items) for students taking Earth Science and those taking Development Studies

Average score for all items	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
Earth Science	1.3023	30	0.19141					
Dev. Studies	1.1690	30	0.30777					
Diff EarthSc-DS	0.1737	30	0.21343	0.05364	0.21303	3.422	29	0.002

N: number of items; Conf. Int: confidence interval; t: t-value; df: degrees of freedom

A few words of caution, however, must be given. Firstly, the small size of the sample – 180 students from 20 classes in 7 schools – may mean that results were not fully representative of the Vanuatu reality. Secondly, students may have answered the questionnaire in relation to the entire course they were taking, rather than focusing on sections dealing with climate and disasters. This may have affected the scores in Geography and Development Studies, where resilience issues have lesser importance in Years 11 and 12 than they do in Earth Science, as mentioned in Section 5.2.2 above. Thirdly, some distortion may have resulted from the complexity of language used in the questionnaire. In Q21, for example, many French-speaking students put “Neutral/Do not know”. This could be because they were unfamiliar with the French equivalent of CC/DRR (“*CC/RCC*” or *Changement climatique/Réduction des risques de catastrophe)*, or else because the course they are following does not stimulate their interest in CC/DRR. Similarly, many students, particularly those in French-speaking schools, ticked “Neutral/Do not know” for Q11. Was this because their teacher is not compassionate, or because the meaning of compassion is not known? Note that 98 French-speaking students were involved, representing 54% of the sample. A fourth factor possibly influencing results was that a teacher was asking the class to complete a questionnaire containing statements relating to him/herself, so that students may have felt inhibited to express their real opinions. However, responses to Q3 and Q9 suggest that students were not shy to point out a teacher’s lack of punctuality or inability to treat pupils as individuals.

If average scores for individual statements are compared across the three optional subjects, some show a broad similarity. Examples are Q1, Q6 and Q12, reflecting a teacher's knowledge, level of organisation and helpfulness; Q16, Q17 and Q19, indicating a teacher's promotion of questioning, student participation and cooperative learning; and Q23, indicating that students are encouraged to feel responsible for their own learning. Yet scores for the remaining 23 statements showed wide discrepancies between subjects, reinforcing the notion that at this stage of resilience education at senior secondary level, the onus is on the teacher to develop strategies and materials. Examples of such differences across subjects were for Q3 and Q4, where teachers' punctuality and enthusiasm were significantly lower in Geography than in Earth Science; Q5, where Development Studies teachers had a much higher score for creativity than in the other two subjects; Q8, Q9, Q10 and Q11, where Earth Science teachers had the highest scores for treating students as individuals, valuing their ideas, being more approachable and showing compassion – perhaps because their class size is generally smaller; Q24, Q25, Q28 and Q29, in which Development Studies students had the lowest scores for their knowledge of how to prepare for disasters, mitigate and adapt to climate change, their readiness to take action on climate change and their willingness to help others understand about disaster risk – in other words, for practical actions to build resilience. Perhaps the greatest discrepancy occurred with Q21, where students of Earth Science scored the effectiveness of their course in stimulating their interest in CC/DRR as 1.27, as compared with 0.48 in Geography and 0.70 in Development Studies. In summary, these findings across subjects exemplified the overall status of Earth Science as the discipline with the greatest effectiveness in promoting resilience education.

Students' responses to the three questions at the end of QS1 are summarized in Figures 5.7, 5.8 and 5.9. The coding system for each was developed out of the responses, with broad categories devised to cover the huge range of ideas submitted. For 180 students, 540 answers were anticipated for Q1, 540 for Q2 and at least 180 for Q3. It quickly became evident that most answers for the first two questions related to the acquisition of knowledge, so a distinction was drawn between knowledge linked to climate change and disaster issues, termed "specific knowledge", and other broad statements of knowledge and ideas, including topics in a field not linked to CC/DRR, termed "generic knowledge". It was also apparent that many students did not provide any answers at all; one reason could be that a student had written on the back of the questionnaire, as required, but this answer was not scanned by the teacher for forwarding to me; other reasons might be that a student was rushed for time and could not complete the longer answers required, or that he/she did not see the questions, or the teacher had not pointed out the importance of answering them. Another trend observed was that French-speaking students showed greater language fluency than their English-speaking counterparts, but often wrote irrelevant answers: they tended to articulate ideas in complete sentences, but did not focus on specific knowledge or skills relating to CC/DRR.

The first question was "Give three reasons why you enjoy/enjoyed this course/session/these lessons." Figure 5.7 shows that just over one third of all students did not answer this at all, that 29% enjoyed the course because of specific items of knowledge that they gained, 19% appreciated the generic knowledge learned, 4% of students liked the course because of the teacher's qualities, 4% for the teaching/learning strategies used, 4% because it helped them to advance personally in some way, and 3% for other reasons. Only 2% enjoyed the lessons because of skills they had gained - which is in contrast to the overall student response to Q26 in the questionnaire, which was a relatively high score of 1.44 (Table 5.11). Examples of student responses were as follows:

For specific knowledge:

> Because it helps me know how to adapt and mitigate to CC and disasters
> (Year 12 student of Earth Science, Mangrove College)

For generic knowledge:

> Because it teaches us about real life situations
> (Year 13 student of Development Studies, Hibiscus College)

For a teacher's qualities:

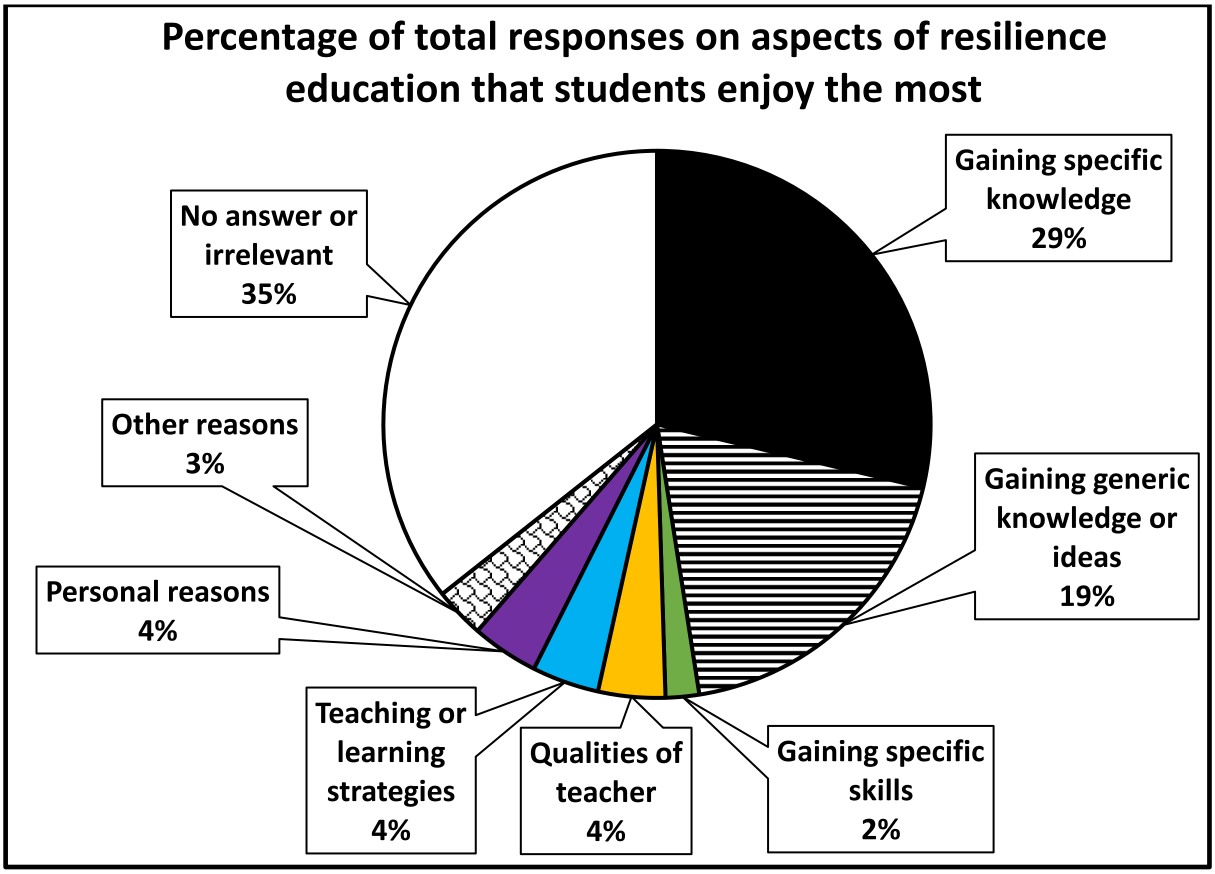
> Because the teacher attends class every time
> (Year 12 student of Development Studies at Kauri College)

For personal reasons:

> Because it helps me with my future career
> (Year 12 student of Earth Science, Mangrove College)

A few students answered this question based on the actual lesson when they completed the questionnaire, so wrote about why they liked completing the form – mentioning for example, that they enjoying knowing more about their teacher's qualities. Occasionally, a student of Development Studies or Earth Science said that he/she enjoyed the course because it was easier than other subjects.

Figure 5.7 Responses of senior secondary students taking Geography, Development Studies and Earth Science on aspects of resilience education that they enjoy the most



The second question was "State the three most important things you have learnt from this course/session/these lessons". Responses are shown in Figure 5.8. Again, the most common category of response was for "No answer or irrelevant" (43%), with 32% of answers identifying items of specific knowledge on CC/DRR as the most important aspects learned through the course, and 20% choosing items of generic knowledge. Perhaps the focus on knowledge relates to students' priorities on examination grades. Only 2% of all responses referred to specific skills and 3% to generic skills, suggesting that the skills component of resilience courses is largely lacking.   For specific knowledge, many answers referred to the causes, impacts and mitigation of climate change, and to adaptation to climate change and disasters, with vulnerability also mentioned. Under generic knowledge, answers commonly referred to aspects of the subject with limited connection to resilience: population studies, natural and cultural processes in Geography; world trade, foreign aid and different forms of development in Development Studies; and pollution, water resources, and plate tectonics in Earth Science. Examples of student responses were as follows:

For specific knowledge:

> How to survive the hazards of volcanoes, earthquakes, cyclones, etc.
>
> (Year 11 student of Geography, Hibiscus College)

For generic knowledge:

> How processes operate
>
> (Year 13 student of Geography, Hibiscus College)

For specific skills:

> How to make evacuation maps for a community
>
> (Year 12 student of Earth Science, Mangrove College)

Figure 5.8 Responses of senior secondary students taking Geography, Development Studies and Earth Science on the most important things learnt during resilience education

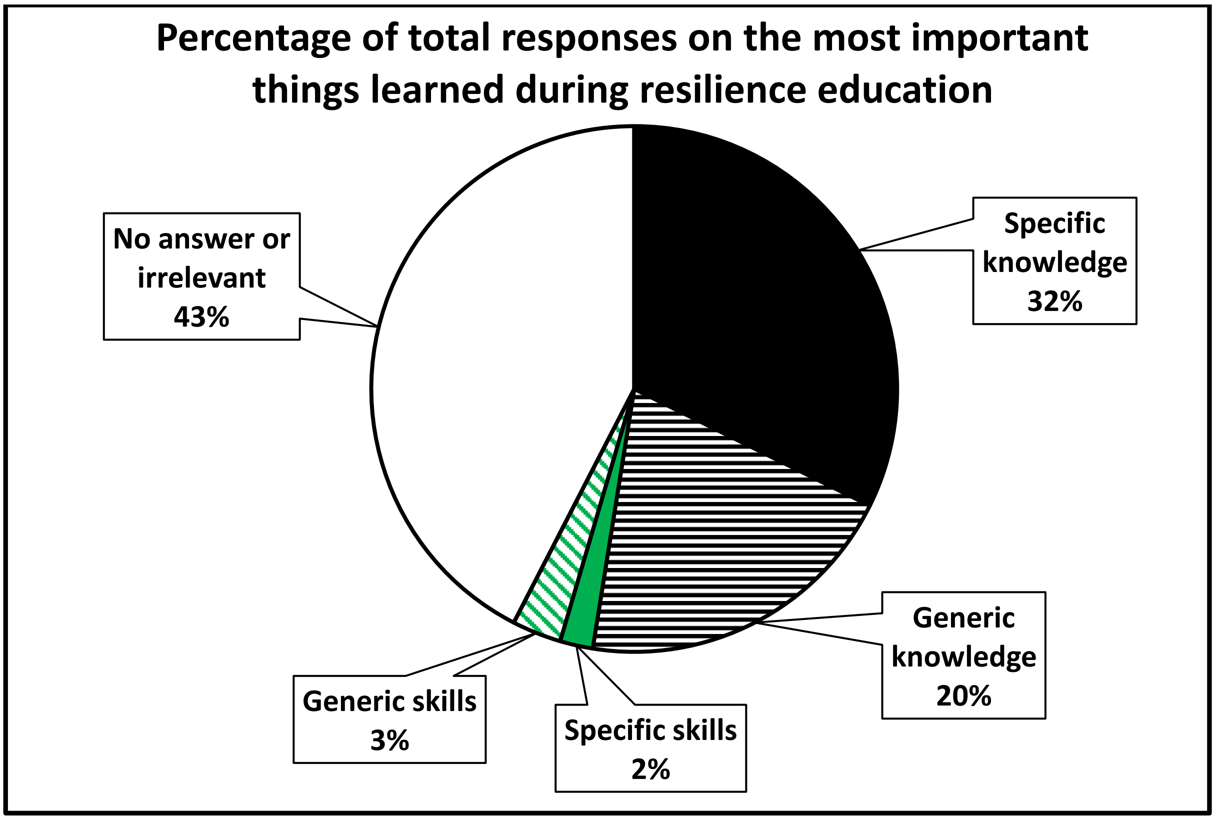


Figure 5.9 shows responses to the third question – "How could this course/session/ these lessons be improved?" As with the other two questions, more than one third of students provided no answer. But another third (32%) provided valid suggestions for improving course content or delivery, 8% offered ideas for improving teacher behaviour and performance, and 7% suggested ways in which students themselves might improve their approach to learning. Other answers referred to ways in which a student might improve him/herself (3%), or were unclear or irrelevant (7%).

For proposed improvements to the course itself, three recurring themes emerged from responses. Firstly, that learning about resilience issues should be opened up to people at community level and to students in all schools, through awareness programmes. Secondly, that teachers should make greater use of visual aids, especially video-clips, and of books and printed materials. Thirdly, that teachers should take students out into the field to observe impacts of climate change and disasters and involve them in practical activities that enhance learning. Examples:

For changes in teacher behaviour:

> Teachers should come on time, help students who are in difficulties and better explain the lessons.
>
> (Year 11 student of Geography, Hibiscus College)

> By the teacher providing students with clear explanations
>
> (Year 11 student of Development Studies, Melektri College)

For changes in the course:

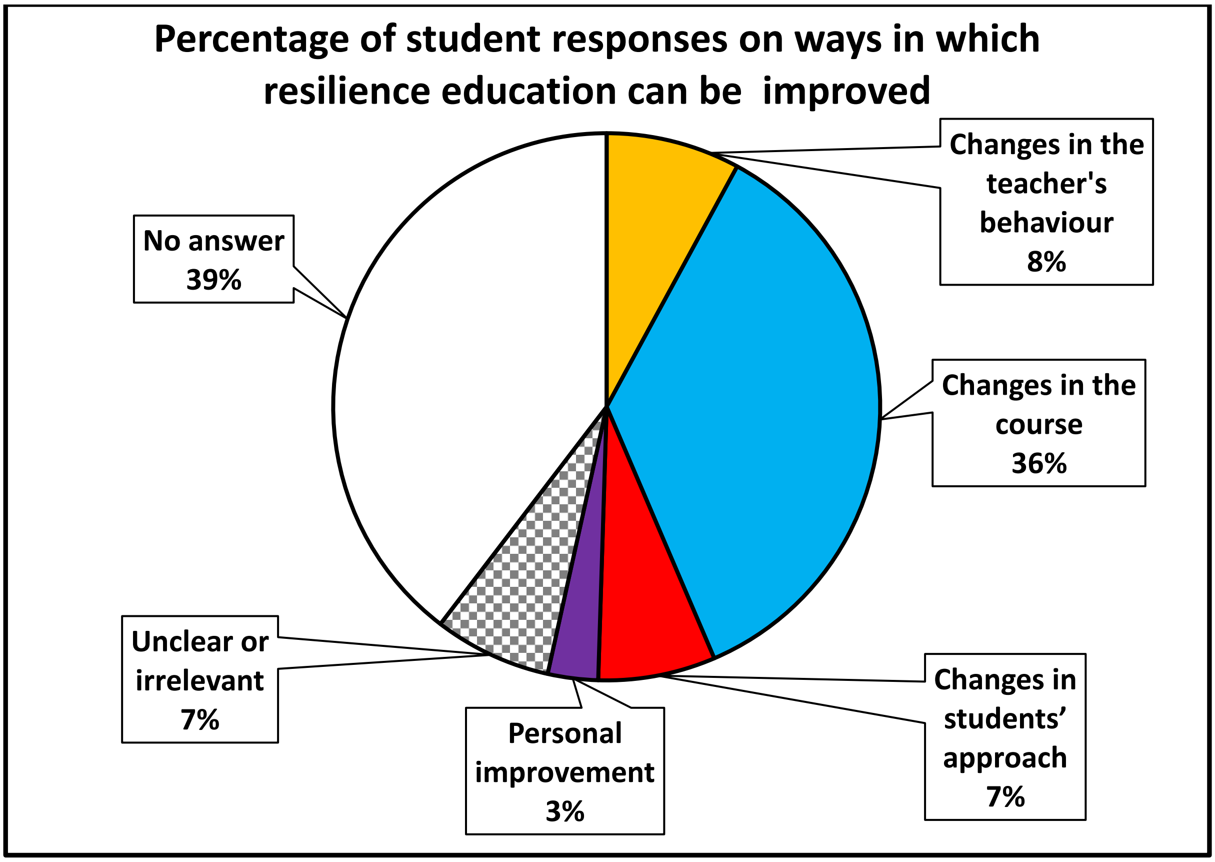
> We should have fieldwork and field visits after our class studies, and undertake practical activities on things we learn in class
>
> (Year 13 students of Earth Science, Glutri College)

> By putting into practice the practical adaptations to face disasters
>
> (Year 11 student of Geography, Hibiscus College)

For changes in students' approach:

> By always being present in class, being attentive, asking questions, reading and participating in activities
>
> (Year 11 student of Development Studies, Melektri College)

Figure 5.9 Responses of senior secondary students taking Geography, Development Studies and Earth Science on how resilience education can be improved



QS4: Student views on changes in their knowledge, skills, attitudes and behaviour

As already mentioned, QS4 (Appendix A6) was designed to measure changes in students' knowledge, skills, attitudes and behaviour at the start and end of a course. In the case of senior secondary students, this questionnaire could not be distributed at the start of the 2021 academic year to provide a baseline for data collected at the end of that year, but it was duly completed by 180 students from 20 classes in October/November of 2021, and enables us to view their progress through a student rather than a teacher lens.

Table 5.13 shows the form used for tabulating numerical responses to QS4 for each class of participating students. The 27 statements (called "questions" on the form) were divided into four groups, with 12 for knowledge, 5 for skills, 5 for attitudes and 5 for behaviour. For statements 1 to 22 referring to knowledge, skills and attitudes, scores were allotted on a five-point scale according to the level of agreement, ranging from +2 for "strongly agree" to -2 for "strongly disagree", with 0 for “neutral/don’t know”. For statements 3, 7, 9 and 19, however, a reversed scoring system was used, with +2 for “strongly disagree” and -2 for “strongly agree”. Statements 23 to 27, reflecting pro-environmental behaviours, were marked according to the level of frequency on a five-point scale ranging from +2 for “always” and -2 for “never”, with 0 for “sometimes”. To be consistent with the marking scheme used for student response to the CC Toolkit activity (Section 4.3), scores for statement 25 were modified to ensure that those who did not wish to participate in demonstrations supporting action on climate change were given neutral rather than negative scores. Total scores for each item for all students in the class were calculated, and then an average obtained for each item by dividing total score by total number of students.

Table 5.14 provides an example of how scores for a Year 12 Earth Science class in one school were summarized for subsequent entry into an Excel worksheet in which average scores were then calculated.

Table 5.13 Form for tabulating numerical responses to student questionnaire QS4

Course/cohort: Total participants (n)
Date of questionnaire completion:

	Question	Strongly disagree -2	Dis-agree -1	Neutral/ Don't know 0	Agree +1	Strongly agree +2	Total (T)	Av. (T/n)
	KNOWLEDGE							
1.	Climate change is happening now, caused mainly by human activities							
2.	Ocean temperatures will get warmer in the future							
3.	Atmospheric concentrations of CO_2 are now < 400 ppm	+2	+1	0	-1	-2		
4.	Temperatures are rising most rapidly in the Arctic							
5.	Future changes in seasonal rainfall patterns are likely							
6.	Tree planting is an effective mitigation measure for CC							
7.	The best protection against sea level rise is a sea wall	+2	+1	0	-1	-2		
8.	Ash falls affect food and water security							
9.	An earthquake is caused by a tsunami	+2	+1	0	-1	-2		
10.	Traditional knowledge helps us to adapt to CC							
11.	Climate change is really just a slow acting disaster							
12.	Children, women, elderly and handicapped people are the most vulnerable to disasters and climate change.							
	SKILLS							
13.	I can give an awareness talk on disaster risk reduction							
14.	I can give an awareness talk on climate change							
15.	I can go to a community and draw a hazard risk map							
16.	I can demonstrate one way of adapting to CC							
17.	I can carry out a vulnerability survey in a village							
	ATTITUDES							
18.	It is my responsibility to be prepared for disasters							
19.	It is the government's responsibility to reduce Vanuatu's carbon footprint	+2	+1	0	-1	-2		
20.	I must help my community to prepare for CC							
21.	I must help to conserve biodiversity							
22.	I must consume more vegetables and fruit and reduce my intake of meat and processed food							
	BEHAVIOUR							
	Question	Never -2	Rarely -1	Sometimes 0	Often +1	Always +2	Total (T)	Av. (T/n)
23.	I plant tree seedlings							
24.	I talk about climate change with my family							
25.	I take part in demonstrations to support action on CC	0	0	0	+1	+2		
26.	I look after vulnerable people during cyclones							
27.	I assist the CDCCC in my community							

Table 5.14 Example of a summary data form for one class for student questionnaire QS4

Course/cohort: Blackpalm High School Earth Science yr 12 Total participants (n) : 7
Date of questionnaire completion: October 2021

	Question	Strongly disagree -2	Disagree -1	Neutral/ Don't know 0	Agree +1	Strongly agree +2	**Total (T)**	**Av. (T/n)**
	KNOWLEDGE							
1.	Climate change is happening now, caused mainly by human activities				11111	11	**9**	
2.	Ocean temperatures will get warmer in the future				111111	1	**8**	
3.	Atmospheric concentrations of CO_2 are now < 400 ppm	**+2**	**+1**	**0** **111**	**-1** **1111**	**-2**	**-4**	
4.	Temperatures are rising most rapidly in the Arctic			1	111111		**6**	
5.	Future changes in seasonal rainfall patterns are likely			1	111111		**6**	
6.	Tree planting is an effective mitigation measure for CC				1111111		**7**	
7.	The best protection against sea level rise is a sea wall	**+2**	**+1** **1**	**0** **1**	**-1** **1111**	**-2** **1**	**-5**	
8.	Ash falls affect food and water security				111111	1	**8**	
9.	An earthquake is caused by a tsunami	**+2** **1**	**+1**	**0**	**-1** **111111**	**-2**	**-4**	
10.	Traditional knowledge helps us to adapt to CC				1111111		**7**	
11.	Climate change is really just a slow acting disaster	1	11		1111		**0**	
12.	Children, women, elderly and handicapped people are the most vulnerable to disasters and climate change.				1111	111	**10**	
	SKILLS							
13.	I can give an awareness talk on disaster risk reduction				1111111		**7**	
14.	I can give an awareness talk on climate change				1111111		**7**	
15.	I can go to a community and draw a hazard risk map		1	1	11111		**4**	
16.	I can demonstrate one way of adapting to CC				1111111		**7**	
17.	I can carry out a vulnerability survey in a village		1		111111		**5**	
	ATTITUDES							
18.	It is my responsibility to be prepared for disasters				111111	1	**8**	
19.	It is the government's responsibility to reduce Vanuatu's carbon footprint	**+2**	**+1**	**0**	**-1** **1111111**	**-2**	**-7**	
20.	I must help my community to prepare for CC				1111111		**7**	
21.	I must help to conserve biodiversity				111111	1	**8**	
22.	I must consume more vegetables and fruit and reduce my intake of meat and processed food			1	111111		**6**	
	BEHAVIOUR							
	Question	Never -2	Rarely -1	Sometimes 0	Often +1	Always +2	Total (T)	Av (T/n)
23.	I plant tree seedlings			1111	11	1	**4**	
24.	I talk about climate change with my family	1		11	11	11	**4**	
25.	I take part in demos to support action on CC	**0** **11**	**0**	**0** **111**	**+1** **1**	**+2** **1**	**3**	
26.	I look after vulnerable people during cyclones	11			111	11	**3**	
27.	I assist the CDCCC in my community	11	1	11	1	1	**-2**	

Findings from QS4 were classified in two ways – firstly by subject, with scores for all students from Years 11 to 13 aggregated for that subject, and secondly by year level, with scores for students in all three subjects aggregated for that level. In each case, scores from both English-medium and French-medium classes were combined together, noting that at Year 13 level, only French-speaking students were involved.

Table 5.15 and Figure 5.10 summarize the results for all 180 students involved in the survey.

Table 5.15 Summary of scores for senior secondary students taking Geography, Development Studies or Earth Science in October/November 2021 (n = 180)

ALL YEAR LEVELS

Subject	# stds	Average scores on scale -2 to +2				
		Knowledge	Skills	Attitudes	Behaviour	All
Geography	38	0.68	0.83	0.85	0.04	0.62
Dev. Studies	66	0.66	0.79	0.88	-0.04	0.60
Earth Science	76	0.58	0.93	0.81	0.20	0.61

YEAR 11

Subject	# stds	Average scores on scale -2 to +2				
		Knowledge	Skills	Attitudes	Behaviour	All
Geography	10	0.64	0.70	0.86	0.20	0.61
Dev. Studies	29	0.67	0.70	0.99	-0.06	0.60
Earth Science	35	0.49	0.86	0.79	0.18	0.55

YEAR 12

Subject	# stds	Average scores on scale -2 to +2				
		Knowledge	Skills	Attitudes	Behaviour	All
Geography	17	0.60	0.62	0.74	-0.02	0.51
Dev. Studies	25	0.66	0.78	0.87	-0.15	0.57
Earth Science	24	0.70	1.09	0.85	0.23	0.71

YEAR 13 (French-speaking students only)

Subject	# stds	Average scores on scale -2 to +2				
		Knowledge	Skills	Attitudes	Behaviour	All
Geography	11	0.83	1.27	1.00	0.00	0.79
Dev. Studies	12	0.61	1.02	0.67	0.27	0.63
Earth Science	17	0.58	0.82	0.78	0.20	0.59

Table 5.15 and Figure 5.10 show that if we compare the average scores for the sample of 180 Year 11-13 students aggregated for all four aspects of resilience education (knowledge, skills, attitudes and behaviour), there was no significant difference between students taking Geography (0.62), Development Studies (0.60)

and Earth Science (0.61). Within the possible range of scores, + 2 represent a very strong or positive level of performance, - 2 a very weak or negative level, and 0 a neutral level. Thus an overall score of 0.60 to 0.62 indicates that a low/moderate degree of effectiveness in terms of resilience education has been achieved.

In all three subjects, students performed best in skills and attitudes, and were significantly weaker in behaviour. When comparisons are made between subjects, students taking Geography and Development studies achieved higher scores in knowledge and attitudes than those taking Earth Science, while the Earth Science students performed significantly better than those of the other two subjects in skills (0.93) and behaviour (0.20)

Figure 5.10 Average scores for Year 11-13 students in aspects of resilience education taught in Geography, Development Studies or Earth Science in 2021 (n = 180)

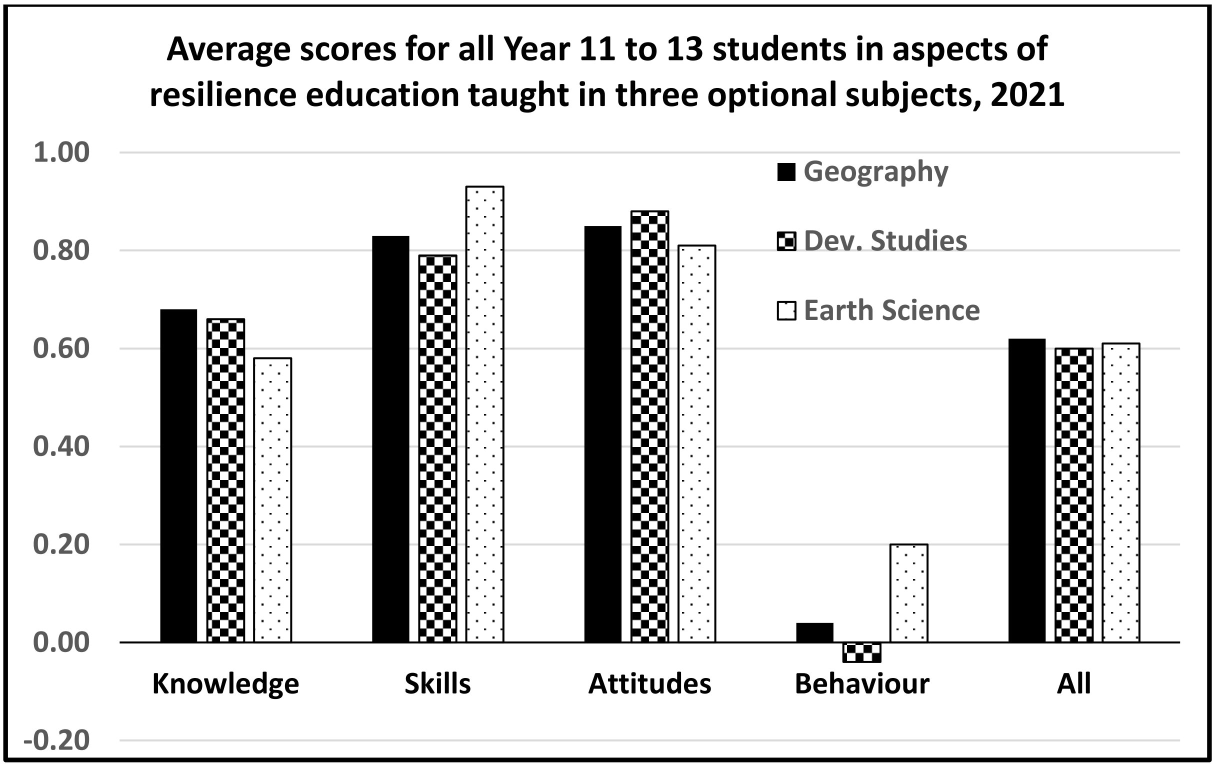


Table 5.15 also shows the variations in performance by Year cohort. At this scale, the small sample size may have had a significant influence on results, and overall patterns are harder to distinguish. For example, scores of > 1 that indicate higher levels of effective resilience education were achieved for skills at Year 13 level in Geography and Development Studies, in skills at Year 12 level for Earth Science,

and in attitudes for Geography at Year 13 level. The highest level of performance overall was for Geography students at Year 13 level, but this was from a sample of just 11 students, all in one school. The average score for all students in all three subjects increased from year to year, with 0.58 in Year 11, 0.61 in Year 12 and 0.66 in Year 13 (Table 5.16). This shows a degree of coherence with hours allotted to the teaching of resilience issues in syllabi for the three subjects, as provided in Tables 5.1, 5.2 and 5.3 and summarized below in Table 5.17.

Table 5.16 Average scores for students in all three subjects by year level

Subject	**Geography**		**Dev. Studies**		**Earth Science**		**All three**		
	stds*	**totsc****	**stds***	**totsc****	**stds***	**totsc****	**stds***	**totsc****	**avsc**
Year 11	270	165	783	470	945	524	1998	1159	**0.58**
Year 12	459	236	675	386	648	463	1782	1085	**0.61**
Year 13	297	235	324	205	459	272	1080	712	**0.66**

* Number of students x 27 ** Total score for 27 questions

Table 5.17 Teaching hours on resilience (climate change and disasters) per year

Year level	**Geography**	**Dev. Studies**	**Earth Science**	**Total hours**
Year 11	39	13	102	154
Year 12	42	20	115	177
Year 13	36	28	115	179

Table 5.18 is an aggregation of student scores in all three subjects at all three year levels. Its purpose is to identify overall patterns in students' knowledge, skills, attitudes and behaviour as a result of participation in courses with content related to resilience (climate change and disasters).

Among the twelve knowledge statements, students' average scores were strongest for item 1 (1.61), referring to awareness of anthropogenic climate change as a contemporary issue, and item 8 (1.31), on the effects of ash falls on food and water security. Scores were much weaker for item 10 (0.73), on the importance of traditional knowledge; item 4 (0.64), on rapid temperature rises in the Arctic; and item 11 (0.46), on climate change as a slow-acting disaster. For items 3, 7 and 9, average scores were negative, meaning that students' answers were incorrect: in fact these were the only the three knowledge statements that required students to disagree rather than agree. In the case of Q3, students may have misread the < sign, while in Q9, students may have been rushing through the questionnaire, not stopping to distinguish between cause and effect. For Q7, which had the lowest score of all, students may not have learned that as an adaptation measure, sea walls are much less effective against sea level rise than the replanting of mangroves and other coastal tree species. Another reason for the three negative scores could be the acquiescence factor, already mentioned in Section 4.3.5, whereby respondents naturally tend to agree rather than disagree with statements in a questionnaire.

For skills, average scores for all five statements are close to 1, indicating a level of confidence among students that they can that they can give awareness talks on climate change, draw hazard risk maps and carry out vulnerability surveys in a community, and demonstrate an adaptation strategy to others. The implication is that they have been out in the field to do these tasks. I found this surprising, especially when teachers' perceptions of the teaching/learning strategies they use (Table 5.22) reveal that fieldwork is the least practiced strategy, with a negative score. I therefore contacted four teachers whose students had completed the questionnaires and obtained these comments on their students' stated skills:

> For skills in Qs 13, 14 and 16, my students actually did a practical task on this as an individual presentation. For Qs 15 and 17, they have not done anything practical, but we did go through the concepts in class.
>
> (Year 11/12 teacher of Development Studies, Kauri College, email interview on 10th November 2021)

> Year 11 students don't really understand the meaning of these statements, but they were just copying from each other. For Year 12 students, we did carry out a field trip and I am sure that they know how to carry out an awareness talk on disaster risk. When we looked at the impacts of climate change, they managed to give some awareness to the people in the village we visited and told them about adaptation measures that the villagers could use to reduce the negative impacts of sea level rise.
>
> (Year 11/12 teacher of Earth Science, Blackpalm High School, email interview on 10th November 2021)

> For skills in Qs 13, 14, 15 and 16, I feel that the students <u>think</u> that they have the capacity to give these awareness talks, draw a hazard risk map and demonstrate an adaptation strategy – based upon their knowledge and their personal experiences, especially during recent cyclones. But for skill no. 17, students did carry out a field survey in an urban neighbourhood of their choice (not a village), when they prepared their own questionnaires and visited the National Disaster Management Office before going into the field.
>
> (Year 13 teacher of Geography, Hibiscus College, email interview on 12th November 2021, translated from the original French text)

Table 5.18 Scores for Year 11-13 students for competencies relating to resilience in Geography, Development Studies and Earth Science, November 2021 (n = 180)

Aspect		Question/Statement	Total score Geo	DS	ES	Total	Average score
KNOWLEDGE	1.	Climate change is happening now, caused mainly by human activities	62	106	122	**290**	**1.61**
	2.	Ocean temperatures will get warmer in the future	46	82	66	**194**	**1.08**
	3.	Atmospheric concentrations of CO_2 are now < 400 ppm	-8	-21	-22	**-51**	**-0.28**
	4.	Temperatures are rising most rapidly in the Arctic	19	50	46	**115**	**0.64**
	5.	Future changes in seasonal rainfall patterns are likely	52	81	67	**200**	**1.11**
	6.	Tree planting is an effective mitigation measure for CC	50	75	59	**184**	**1.02**
	7.	The best protection against sea level rise is a sea wall	-28	-59	-59	**-146**	**-0.81**
	8.	Ash falls affect food and water security	44	92	99	**235**	**1.31**
	9.	An earthquake is caused by a tsunami	-26	-47	-9	**-82**	**-0.46**
	10.	Traditional knowledge helps us to adapt to CC	30	52	50	**132**	**0.73**
	11.	Climate change is really just a slow acting disaster	25	38	20	**83**	**0.46**
	12.	Children, women, elderly and handicapped people are the most vulnerable to disasters and climate change.	43	72	87	**202**	**1.12**
SKILLS	13.	I can give an awareness talk on disaster risk reduction	35	68	72	**175**	**0.97**
	14.	I can give an awareness talk on climate change	38	67	77	**182**	**1.01**
	15.	I can go to a community and draw a hazard risk map	36	47	52	**135**	**0.75**
	16.	I can demonstrate one way of adapting to CC	23	29	80	**132**	**0.73**
	17.	I can carry out a vulnerability survey in a village	26	49	71	**146**	**0.81**
ATTITUDES	18.	It is my responsibility to be prepared for disasters	61	101	113	**275**	**1.53**
	19.	It is the government's responsibility to reduce Vanuatu's carbon footprint	-44	-66	-52	**-162**	**-0.90**
	20.	I must help my community to prepare for CC	53	88	94	**235**	**1.31**
	21.	I must help to conserve biodiversity	43	84	86	**213**	**1.18**
	22.	I must consume more vegetables and fruit and reduce my intake of meat and processed food	48	85	65	**198**	**1.10**
BEHAVIOUR	23.	I plant tree seedlings	6	11	23	**40**	**0.22**
	24.	I talk about climate change with my family	18	9	30	**57**	**0.32**
	25.	I take part in demos to support action on CC	4	9	26	**39**	**0.22**
	26.	I look after vulnerable people during cyclones	8	-5	38	**41**	**0.23**
	27.	I assist the CDCCC in my community	-28	-36	-42	**-106**	**-0.59**

> My students gained the theoretical knowledge about vulnerability, risk and risk maps from discussions in class, so they thought that they themselves would be able to do those things. But in fact they have never done the practical work in the field themselves, so probably they are unable to demonstrate an adaptation technique, carry out a vulnerability survey or draw a hazard risk map. Regarding giving awareness talks, I doubt that they can do this because it requires a deeper understanding and courage.
>
> (Year 11/12 teacher of Earth Science, Mangrove College, email interview on 4th November 2021)

In summary, the strength of students' capacities to actually carry out the tasks in statements 13 to 17 has probably been overstated. Most students believe that they have the necessary skills, but have not actually put them into practice. In hindsight, skills competencies would have been more realistically assessed by asking questions in this format: "I have given an awareness talk on disaster risk reduction", "I have been to a community and produced a hazard risk map", etc.

Students' average scores for four of the nominated attitudes (statements 18 and 20-22) were all over 1, reflecting their commitment to prepare for disasters, help their communities to be ready for climate change, conserve biodiversity and move towards a plant-based diet. Whether this commitment was actually translated into action is another matter and was not supported by results for pro-environmental behaviours (items 23-27). The remaining attitude item, no. 19, showed a negative value of -0.90 – the lowest score of all 27 items in the questionnaire. Despite students showing a high degree of personal responsibility for disaster preparation (item 18), the majority felt that it is the government that should be responsible for reducing Vanuatu's carbon footprint, not realizing that such a goal is more realistically attained through actions taken at individual and community level. Q19 is also a statement that requires the respondent to disagree rather than agree, so that the acquiescence factor may have been operating here. Another possibility is that unless a teacher had stimulated class discussion about the relative role of government and individuals in fostering GHG mitigation, a student might well have absorbed an attitude from home that the government should be responsible for everything.

Finally, the five questions on behaviour showed the lowest average scores of all four competency groups. Scores for items 23 to 26 were just above 0, meaning that the behaviour is slightly positive, only happening sometimes. Item 27 had a negative score of -0.59, indicating that most students do not support of the work of the Community Disaster and Climate Change Committee (CDCCC) in their communities. This is not surprising, firstly because the majority of students in the survey were living in urban areas or away from their island homes, so had little or no contact with the CDCCCs, and secondly because although these CDCCCs exist in theory, many of them only start to operate when a disaster is imminent or is already taking place. One reason for the low scores for behaviour could be that practical actions in disaster reduction and climate change mitigation and adaptation do not appear as required competencies in the syllabi for Geography, Development Studies or Earth Science at upper secondary level, so that teachers do not devote time to fostering such behaviours.

5.2.4 Educating Year 11-13 Students about Resilience: Data from Teachers

To supplement student-generated data, questionnaires QC1 and QC2 were given to their teachers, together with another subject-specific questionnaire that collected more open-ended, qualitative data on a teacher's experiences in teaching the subject and accessing the necessary educational resources. Thus while student data focused on learning, teacher data focused on teaching.

There are several justifications for collecting data from teachers. I wanted to know how they were coping with the new curriculum – whether they or their students were encountering difficulties, and how this might affect the effectiveness of learning about climate and disasters, as per Research Question 1. In relation to my proposed model for resilience education (Figure 2.14), were the desired features of "educational practice" taking place? Did teachers' perceptions of the content, skills, attitudes and behaviours promoted by the course triangulate with the reality expressed by students through questionnaires QS1 and QS4?

QC1

Teachers of Geography, Development Studies and Earth Science at Years 11-13 level were asked in QC1 (Appendix A1) to indicate their perceptions of the characteristics of the course taken by their students. In this questionnaire, 41 aspects of resilience education are organized into six groups – overall attitudes (7 items), pedagogy (5), knowledge (11), skills (7), attitudes (5) and behaviour (6). For each item, a teacher indicates his/her perception of its importance in the course as either high, low, none or don't know. Of the 33 teachers contacted, 12 completed QC1, and results are indicated in Tables 5.19, 5.20 and 5.21.

Table 5.19 Perceptions of course characteristics by teachers of Year 11, 12 and 13 students in Geography, Development Studies and Earth Science (n = 4 + 5 + 3 = 12)

Does the course promote or teach these aspects of resilience education?			Perceived importance												Total score
			High 2			Low 1			None -1			Don't know 0			
			Number of teachers expressing views												
			Yr 11	Yr 12	Yr 13	Yr 11	Yr 12	Yr 13	Yr 11	Yr 12	Yr 13	Yr 11	Yr 12	Yr 13	
Overall attitudes	1.	Moral qualities	2	3	1	1	2	2				1			17
	2.	Building on individual capacities	4	4	2		1	1							22
	3.	Service to others	2	4	1	1	1	2				1			18
	4.	Outward orientation	2	4		1		3				1	1		16
	5.	Equal treatment for all	3	4	1	1		2					1		19
	6.	Gender equality/ empowerment of women		4	1	3		2				1	1		15
	7.	Motivation to learn	3	4	3	1							1		21
Pedagogy	8.	Cooperative learning	4	5	2			1							23
	9.	Participatory learning	4	4	2		1	1							22
	10.	Constructivism	3	5	2	1		1							22
	11.	Field work	1		1	2	3	2	1	2					8
	12.	Experiential learning	3	1	2	1	3	1		1					16
Knowledge	13.	Meaning of resilience	3	3	3	1	1			1					19
	14.	Nature & causes of climate change (CC)	3	4	3	1	1								22
	15.	Nature and causes of disasters	3	4	3	1	1								22
	16.	Vulnerability	2	4	3	2	1								21
	17.	Impacts	3	4	3	1	1								22
	18.	Mitigation	3	4	3	1	1								22
	19.	Adaptation	3	4	3		1		1						20
	20.	Strategies for disaster risk reduction (DRR)	3	4	3		1		1						20
	21.	Climate injustice	1	1	3	1	2		2	2					9
	22.	Food and water security	1	2	1	2	3	2	1						14
	23.	Traditional knowledge	1	2	1	1	2	2	2	1					10
Skills	24.	Communication skills	1	3	2	2	2	1				1			17
	25.	Risk mapping	2	2		2	2	3		1					14
	26.	Literacy/numeracy	2	4	1	2	1	2							19
	27.	IT skills	1	1		2	3	3	1	1					10
	28.	Writing project proposals				1	4	2	3	1	1				2
	29.	Vulnerability /SWOT surveys				1	3	2	3	2	1				0
	30.	Community awareness		1		2	3	3	2	1					7
Attitudes	31.	Sustainable living	2	2	1	2	3	2							17
	32.	Pro-environmental attitudes	2	2	2	2	2	1		1					16
	33.	Holistic approach			2	4	5	1							14
	34.	Outward-looking orientation and openness		1	3	3	4		1						14
	35.	Avoiding consumerism		1	1	3	3	2		1		1			11
Behaviour	36.	Conservation of biodiversity	2	3	2	2	1	1					1		18
	37.	CC advocacy	2		1	2	3	2		2					11
	38.	Sharing knowledge of CC and/or DRR	1	2	2	3	2	1		1					15
	39.	Eating habits		1	2	4	2	1		2					11
	40.	Disaster preparedness	3	4	2	1	1	1							21
	41.	Other pro-environmental behaviours	1	1	1	2	3	2				1	1		13

Table 5.20 Summary of all Year 11-13 teachers' perceptions of course characteristics of Geography, Development Studies and Earth Science (n = 12)

Does the course promote or teach these aspects of resilience education?			Perceived importance	
			Total score	Average score
Overall attitudes	1.	Moral qualities	17	**1.42**
	2.	Building on individual/community capacities	22	**1.83**
	3.	Service to others	18	**1.50**
	4.	Outward orientation	16	**1.33**
	5.	Equal treatment for all	19	**1.58**
	6.	Gender equality/ empowerment of women	15	**1.25**
	7.	Motivation to learn	21	**1.75**
Pedagogy	8.	Cooperative learning	23	**1.92**
	9.	Participatory learning	22	**1.83**
	10.	Constructivism	22	**1.83**
	11.	Field work	8	**0.67**
	12.	Experiential learning	16	**1.33**
Knowledge	13.	Meaning of resilience	19	**1.58**
	14.	Nature & causes of climate change (CC)	22	**1.83**
	15.	Nature and causes of disasters	22	**1.83**
	16.	Vulnerability	21	**1.75**
	17.	Impacts	22	**1.83**
	18.	Mitigation	22	**1.83**
	19.	Adaptation	20	**1.67**
	20.	Strategies for disaster risk reduction (DRR)	20	**1.67**
	21.	Climate injustice	9	**0.75**
	22.	Food and water security	14	**1.17**
	23.	Traditional knowledge	10	**0.83**
Skills	24.	Communication skills	17	**1.42**
	25.	Risk mapping	14	**1.17**
	26.	Literacy/numeracy	19	**1.58**
	27.	IT skills	10	**0.83**
	28.	Writing project proposals	2	**0.17**
	29.	Vulnerability / SWOT surveys	0	**0.00**
	30.	Community awareness	7	**0.58**
Attitudes	31.	Sustainable living	17	**1.42**
	32.	Pro-environmental attitudes	16	**1.33**
	33.	Holistic approach	14	**1.17**
	34.	Outward-looking orientation and openness	14	**1.17**
	35.	Avoiding consumerism	11	**0.92**
Behaviour	36.	Conservation of biodiversity	18	**1.50**
	37.	CC advocacy	11	**0.92**
	38.	Sharing knowledge of CC and/or DRR	15	**1.25**
	39.	Eating habits	11	**0.92**
	40.	Disaster preparedness	21	**1.75**
	41.	Other pro-environmental behaviours	13	**1.08**

Summary	**Overall attitudes**	**1.52**
	Pedagogy	**1.52**
	Knowledge	**1.52**
	Skills	**0.82**
	Attitudes	**1.20**
	Behaviour	**1.24**
	All	**1.32**

In Table 5.19, teachers' choices have been aggregated under perceived level of importance (high, low, etc.), but further differentiated according to the Year level being taught – Year 11, 12 or 13. For example, in the case of moral qualities (item 1) six teachers selected "high", of whom two were teaching a Year 11 class, three a Year 12 class and one a Year 13 class; 5 teachers chose "low", of whom one was teaching a Year 11 class, two a Year 12 class and two a Year 13 class; one teacher chose "don't know", and this teacher had a Year 11 class. In cases where a teacher was teaching at more than one level, his/her choices are shown under the highest level taught. To calculate the total score for each item, numbers in each column were multiplied by 2 for "high", 1 for "low", -1 for "none' and 0 for "don't know", then added across the row. Thus for "moral qualities", total score = 2(2+3+1) + 1(1+2+2) + 0(1) = 17. In Table 5.20, the total score for each item was divided by the number of teachers participating. For moral qualities, the average score was 17÷12 = 1.42

In Tables 5.20, 5.21 and Figure 5.11, an average score can lie between +2 and -1. A score of between 1.5 and 2.0 indicates that an aspect is perceived to be of much higher importance in the course. A score close to 0 shows that the aspect is not regarded as important or not seen as a course component. When looking at the results, we must bear in mind that although the sample size was small, it ensured representation of urban and rural settings, all three optional subjects, all three year levels, and both English- and French-medium schools.

Within the category of overall attitudes (Table 5.20), teachers felt that the two aspects most promoted by resilience education were "building on individual or community capacities" (1.83) and "motivation to learn" (1.75), while "outward orientation" (1.33) and "gender equality" (1.25) were of lesser importance. Most aspects of pedagogy had high scores, especially "cooperative learning" (1.92), but "fieldwork" (0.67) and "experiential learning" (1.33) were markedly lower: this could be because field or practical experience is not mandated in the syllabus guides provided, or because a teacher did not perceive its importance. Under knowledge, the first eight aspects were all awarded scores of over 1.5, but "food and water security" (1.17), "traditional knowledge" (0.83) and "climate injustice" (0.75) were significantly lower. Scores for skills were the lowest overall of all six categories: the only item to score more than 1.5 was "literacy/numeracy", and four of the seven skills scored less than 1, with “vulnerability/SWOT surveys” (0.00) having the lowest score among all 41 items. For attitudes, average scores ranged between 1.42 for “sustainable living” to 0.92 for “avoiding consumerism”. Among behaviour items, the two seen as the most important, with scores of 1.5 or over, were “disaster preparedness” (1.75) and “conservation of biodiversity (1.50), while the two least important were “CC advocacy” and “eating habits” (each with O.92).

In summary (Table 5.20 and Figure 5.11), the average score for all items for all teachers was 1.32. Three categories – overall attitudes, pedagogy and knowledge – achieved an above-average score of 1.52, while below-average scores were recorded for behaviour (1.24), attitudes (1.20) and skills (0.82). The significantly lower score for skills contrasted with the relatively higher scores for skills that were self-awarded by students (Table 5.18 and Figure 5.10), but the two sets of scores were measured against different benchmarks. Also, the span of possible scores differed between the two, with teachers’ scores ranging from +2 to -1, and students’ scores from +2 to -2. Teachers’ scores for skills were based on what were perceived as occurring in resilience courses, covered a wide range of skills and include competencies such as ”community awareness”, “carry out SWOT surveys” and “writing project proposals” that are not specifically mentioned in syllabi. Students’ scores were based upon practice rather than theory – what they thought they could do when interacting with communities in the field; as we have seen, the scores were probably inflated because in most cases these practical skills had not actually been demonstrated. Teachers’ scores for the behaviour group of items were relatively higher than those awarded by students when self-assessing aspects of their own behaviour (Figure 5.10), which overall were close to 0 on a scale of +2 to -2. Again, the difference may have arisen because the aspects in the teacher survey were theoretical, while those in the student survey were practical. For example a teacher is asked to comment on the importance of the conservation of biodiversity, while a student responds to “I plant tree seedlings”; and in comparison with a teacher’s evaluation of the importance of CC advocacy, a student responds to “I take part in demonstrations to support action on CC”.

Figure 5.11 Summary of Year 11-13 teachers' scores for aspects of resilience taught in senior secondary schools in 2021 (n = 12)

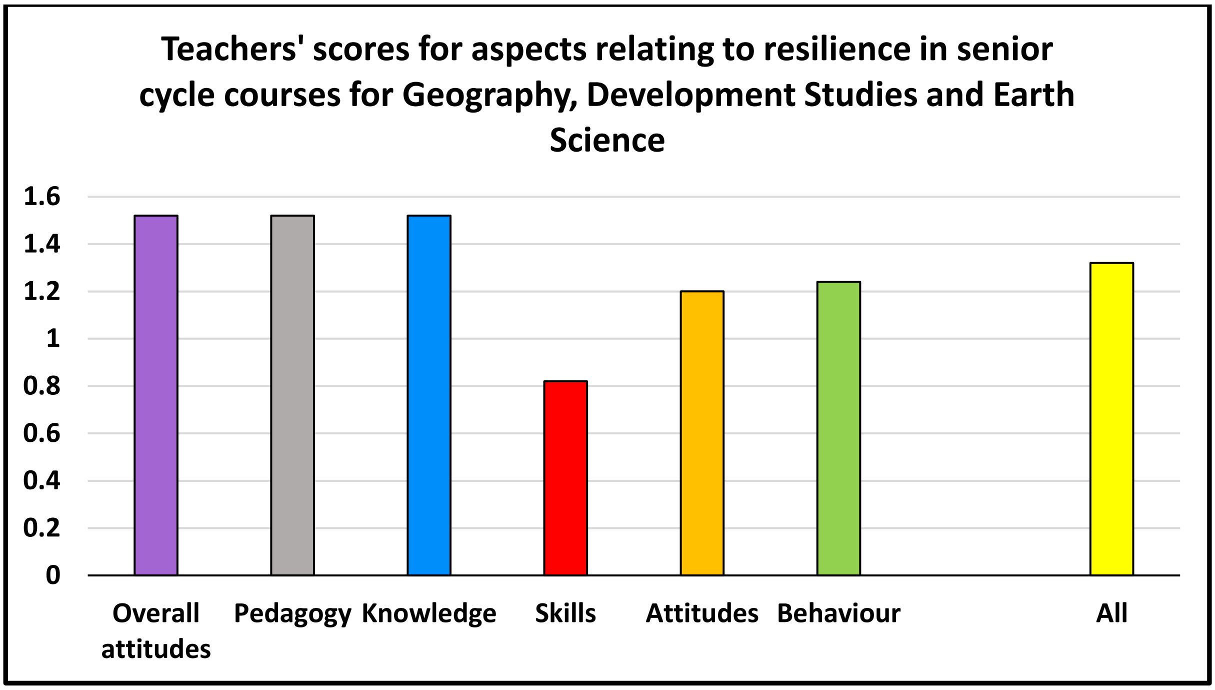


Figure 5.11 shows that a sample of 12 teachers rated the global effectiveness of their course on resilience as moderately high (+1.32 on a scale of +2 to -1), with higher scores (+1.52) for overall attitudes, pedagogy and knowledge and a notably lower score (+0.82) for skills.

Further clarification of teachers' perceptions of the relative importance of each desired aspect of resilience education is provided in Table 5.21, which presents average scores in descending rank order and uses a colour scheme corresponding to that of Table 5.20 and Figure 5.11. The highest score was for the promotion of cooperative learning (1.92). The top eleven aspects identified, all scoring 1.75 or over, comprised five items relating to knowledge, three to pedagogy, two to overall attitudes and one to behaviour. The bottom ten aspects, all below 1.00, comprised four items linked to skills, three to behaviour, two to knowledge and one each to attitudes and pedagogy. The skills of "community awareness", "writing project proposals" and "conducting vulnerability or SWOT surveys" occupied the bottom three places in the table, most likely because these skills are not mentioned in any of the Year 11-13 syllabi for Geography, Development Studies or Earth Science.

Table 5.21 Teachers' average scores for the importance of aspects of resilience education taught at upper secondary level, ranked in descending order

Rank	Aspect of resilience education promoted or taught		Total score	Average score
1.	8	P Cooperative learning	23	**1.92**
2.	9	P Participatory learning	22	**1.83**
3.	10	P Constructivism	22	**1.83**
4.	2	OA Building on individual capacities	22	**1.83**
5.	15	K Nature and causes of disasters	22	**1.83**
6.	14	K Nature & causes of climate change (CC)	22	**1.83**
7.	18	K Mitigation	22	**1.83**
8.	17	K Impacts	22	**1.83**
9.	7	OA Motivation to learn	21	**1.75**
10.	16	K Vulnerability	21	**1.75**
11.	40	B Disaster preparedness	21	**1.75**
12.	20	K Strategies for disaster risk reduction (DRR)	20	**1.67**
13.	19	K Adaptation	20	**1.67**
14.	26	S Literacy/numeracy	19	**1.58**
15.	5	OA Equal treatment for all	19	**1.58**
16.	13	K Meaning of resilience	19	**1.58**
17.	3	OA Service to others	18	**1.50**
18.	36	B Conservation of biodiversity	18	**1.50**
19.	24	S Communication skills	17	**1.42**
20.	1	OA Moral qualities	17	**1.42**
21.	31	A Sustainable living	17	**1.42**
22.	12	P Experiential learning	16	**1.33**
23.	4	OA Outward orientation	16	**1.33**
24.	32	A Pro-environmental attitudes	16	**1.33**
25.	6	OA Gender equality/ empowerment of women	15	**1.25**
26.	38	B Sharing knowledge of CC and/or DRR	15	**1.25**
27.	25	S Risk mapping	14	**1.17**
28.	22	K Food and water security	14	**1.17**
29.	34	A Outward-looking orientation and openness	14	**1.17**
30.	33	A Holistic approach	14	**1.17**
31.	41	B Other pro-environmental behaviours	13	**1.08**
32.	39	B Eating habits	11	**0.92**
33.	37	B CC advocacy	11	**0.92**
34.	35	A Avoiding consumerism	11	**0.92**
35.	27	S IT skills	10	**0.83**
36.	23	K Traditional knowledge	10	**0.83**
37.	21	K Climate injustice	9	**0.75**
38.	11	P Field work	8	**0.67**
39.	30	S Community awareness	7	**0.58**
40.	28	S Writing project proposals	2	**0.17**
41.	29	S Vulnerability /SWOT surveys	0	**0.00**

In assessing the effectiveness of resilience education in Vanuatu, the avowed aim of this thesis, a more pertinent concern is the minimal importance accorded by teachers to "avoiding consumerism", "traditional knowledge" and "field work", ranked 34th, 36th and 38th out of 41 items.

To be effective, resilience education should provide students with the knowledge, understanding, skills and attributes needed to work and live in a way that safeguards their present and future environmental, social and economic well-being (Leal & Pace, 2016). As such, students must gain an understanding of consumerism as one of the driving forces behind GHG emissions and climate change, should experience enquiry-based and cooperative learning, be given the opportunity to undertake fieldwork at community level, and in a Pacific context appreciate the value of traditional knowledge, skills and values in forging sustainability and resilience. According to findings from QC1, teachers perceived that this is not happening.

QC2

The second questionnaire for senior secondary teachers, QC2 (Appendix A2), asked them about pedagogy – teaching, learning and evaluation techniques used in their lessons on resilience. A five-point Likert scale was used to measure responses, ranging from “Never” (-2) to “Always” (+2).

An example of a completed questionnaire is provided in Table 5.22. Responses for all teachers in the sample were aggregated, and total scores calculated by multiplying the number of responses in each column by the Likert score for that category. Thus the score for aspect 1 (“Interactive”) is 2(0) + 7(1) + 3(2) = 13. Average score is total score ÷ no. of teachers.

One learning from Table 5.22 is that the most commonly used teaching techniques are the traditional strategies of lecture, interactive and enquiry, all of which had scores close to 1.0 on a scale of +2 to -2, meaning that their frequency of use can be classified as often. Affective, surrogate experiential and action techniques scored close to 0.5, indicating occasional use. Field experiential, or field work, had a negative score close to -1, meaning that it is rarely used. Thus student-centred techniques involving practical experiences inside and outside the classroom were considered to be much less relevant to learning than teacher-centred techniques. Of course, when completing the questionnaires, teachers may have been focusing on the whole course rather than on its resilience components, but it still seems as though fieldwork is largely being avoided.

Table 5.22 Questionnaire QC2, showing teachers' scores for teaching, learning and evaluation techniques used in resilience lessons at senior secondary level

QC2 Date: November 2021 Number of teachers: 12

	Aspect of resilience education	Never -2	Rarely -1	Some times 0	Often +1	Always +2	Total score	Aver-age score
TEACHING AND LEARNING TECHNIQUES BEING USED								
1.	Interactive - teacher engages students in brainstorming and discussion on a given topic			11	1111111	111	**13**	**1.08**
2.	Surrogate experiential - use of simulations of real life events, e.g. role plays, photographs, films	1		11111	11111	1	**5**	**0.42**
3.	Field experiential - undertaking practical activities outside the classroom, e.g. hazard risk mapping	11111	11	111	11		**-10**	**- 0 83**
4.	Affective - students share their feelings and experiences of disaster events		11	111	11111	11	**7**	**0.58**
5.	Enquiry - students obtain information from outside the classroom, e.g. through interviews, internet sites			111	11111	1111	**13**	**1.08**
6.	Action - active involvement of students in practical sessions		111	1111	11	111	**5**	**0.42**
7.	Lecture - teacher provides information to the students in traditional teaching style		1	1	11111	11111	**14**	**1.17**
EVALUATION TECHNIQUES BEING USED								
8.	Recall - assessing students on their ability to remember and reproduce what they have been taught			11	1111111	111	**13**	**1.08**
9.	Action-oriented - assessing students on how active they are in participating in the learning process, e.g. participating in a role play, demonstrating adaptation techniques	1	111	11111	1	11	**0**	**0.00**
10.	Output-oriented - assessing students on their production of tangible substances, e.g. plans, posters with DRR messages, risk maps	1	1	111111	11	11	**3**	**0.25**
11.	Knowledge acquisition - assessing students' ability to obtain information from other sources, e.g. internet, and to organise this information and present in a meaningful form			111	11111	1111	**13**	**1.08**
12.	Application - assessing students' ability to use knowledge they obtain in class to solve community problems, e.g. interactions with community		111	1	11111	111	**8**	**0.67**
APPROACHES TO EVALUATION								
13.	Class exercises / completion of workbooks			1	1111	1111111	**18**	**1.50**
14.	Written tests/exams			1	11111	111111	**17**	**1.42**
15.	Demonstrations of skills and knowledge			11	1111111	111	**13**	**1.08**
16.	Homework			11	111111	1111	**14**	**1.17**
17.	Teacher follow-ups, e.g. asking questions in the next lesson			1	11111	111111	**17**	**1.42**
18.	Reflections			1	111111	11111	**16**	**1.33**
19.	Measuring oral contributions by students			1	11111	111111	**17**	**1.42**

Regarding evaluation techniques, Table 5.22 suggests that traditional methods of assessing students' progress through recall and research projects are still much more common than alternative assessment strategies focused on student participation in practical activities. The latter, also known as "authentic" or "performance" assessment (Janisch et al, 2007; Dikli, 2003) sees learners as constructors rather than receivers of knowledge. For the sample of Vanuatu teachers in the survey, recall and knowledge acquisition each had a score of 1.08, while output- and action-oriented assessments scored just 0.25 and 0.00 respectively.

For approaches to evaluation, all scored between 1.0 and 1.5, meaning that they are being used fairly frequently, with class exercises or workbooks (1.50) the most common and demonstrations of skills and knowledge (1.08) having the lowest score. Non-traditional approaches such as the measurement of oral contributions, reflections and demonstrations are apparently being employed in classrooms with some degree of regularity, which contrasts with low teacher scores for practical learning and evaluation techniques indicated in Table 5.22. A possible explanation is that the approaches to evaluation are not explained in as much detail in QC2 as are the techniques for teaching/learning and evaluation, so that a teacher may not have been aware of the intended meaning of each non-traditional approach and simply agreed that it was often or always in use.

In summary, Table 5.22 demonstrates that the desired pedagogical approaches advocated in the model for resilience education (Figure 2.14) are largely lacking.

Subject-specific questionnaires

Further insights into the effectiveness of resilience education at senior secondary level were obtained from a third questionnaire given to teachers relating to their experiences with the new common curriculum in Geography, Development Studies or Earth Science. The questionnaire for Earth Science is shown in Figure 5.12.

Question 1 is asked in order to determine class size. Questions 2, 3 and 4 ask the teacher to indicate those elements of the official syllabus that have been covered during the school year 2021, as well as those for Year 12/13 students covered in previous years. Code numbers correspond to those used in the syllabi. Questions 5 and 6 ask for the teacher's perceptions of aspects of resilience that are easy and hard for students to understand. Question 7 refers to educational resources used in teaching and learning about resilience, while Question 8 is an open-ended question on difficulties encountered when teaching about resilience (climate change and disasters) in the manner required by the common curriculum.

Figure 5.12 Questionnaire for teachers of Earth Science in Years 11, 12 and/or 13

Name of school:…………………………… Island : ………………………. Date : ……………………
Name of teacher: …………………… Class(es) you are teaching (*encircle*): Yr 11 Yr 12 Yr 13

1. How many students are studying Earth Science in each class ?
   Year 11 : M F Year 12 : M F Year 13 : M F

2. Which strands and sub-strands of the official curriculum for Earth Science have Year 11 students already covered? *(Please encircle)* :
   11.2.1 Earth realm in peril – ozone layer
   11.2.2 Climate change issues – IEC kit
   11.2.3 Mitigation of climate change – mitigation and adaptation measures
   11.2.4 Disaster risk – impacts of common disasters
   Anything else ? ……………………………………………………………………………………

3. Which strands and sub-strands of the official curriculum for Earth Science have Year 12 students already covered? *(Please encircle)* :
   11.2.1, 11.2.2, 11.2.3, 11.2.4
   12.2.1 Earth realm in peril – natural and enhanced greenhouse effects
   12.2.2 Climate change issues – present and past factors causing climate change
   12.2.3 Mitigation and adaptation in relation to climate change – difficulties in reaching international agreements and the need to give priority to adaptation measures
   12.2.4 Disaster risk reduction – the vulnerability of different groups
   Anything else ? ……………………………………………………………………………………

4. Which strands and sub-strands of the official curriculum for Earth Science have Year 13 students already covered? *(Please encircle)* :
   11.2.1, 11.2.2, 11.2.3, 11.2.4
   12.2.1, 12.2.2, 12.2.3, 12.2.4
   13.2.1 Earth realm in peril – changes in atmospheric concentrations of greenhouse gases
   13.2.2 Climate change issues – impacts of climate change, and future climate change in Vanuatu
   13.2.3 Adaptation in relation to climate change – measures to be taken in Vanuatu at community level
   13.3.4 Disaster risk reduction – how hazards become disasters, and measures to increase resilience
   Anything else ? ……………………………………………………………………………

5. What aspects of climate change and disasters are students finding it easy to understand?

6. What aspects of climate change and disasters are students finding it hard to understand?

7. What educational resources are you using to teach your students about climate change and disasters?

8. Are you finding any difficulties in teaching about climate change and disasters in the way required by the new common curriculum for Years 11-13? Can you give some examples of these difficulties?

Signed :………………………………………………… Date : ……………………………………

A total of 14 teachers teaching 26 classes completed this questionnaire. The most significant results relate to class size, difficulties and educational resources.

The size of classes taking Geography, Development Studies and Earth Science at senior secondary level in the selected schools is indicated in Table 5.23. Overall, there were 589 students in 26 classes, with a mean class size of 22.6. Largest classes were in Development Studies, with a mean size of 30 or over in all three year levels. Smallest classes were for Earth Science, ranging from 19.0 in Year 11 to 13.4 in Year 12 – and these smaller sized cohorts, as mentioned in the discussion on Table 5.10, may contribute towards the subject's greater effectiveness in resilience education. Note that in 2021, the only classes following the new common curriculum at Year 13 level were in French-medium schools.

Table 5.23 Class size and average class size per subject in the sample of senior secondary schools in Vanuatu, November 2021

School	Class size in November 2021 (number of students)								
	Year 11			Year 12			Year 13		
	Geo	DS	ES	Geo	DS	ES	Geo	DS	ES
Blackpalm		56	9		42	7			
Glutri			27			13			18
Hibiscus (Teacher 1)							39		
Hibiscus (Teacher 2)	34	26						30	
Hibiscus (Teacher 3)	19			34			9		
Kauri		13	2		26				
Mangrove			22			9			
Melektri		38	40			36			19
Tamanu			14			2			5
Mean class size	**26.5**	**33.2**	**19.0**	**34.0**	**34.0**	**13.4**	**24.0**	**30.0**	**14.0**

In terms of syllabus coverage in November 2021, 18 (69%) of the 26 classes had covered more than 90% of all required substrands and 8 (31%) had covered between 50-90% of all substrands. The depth of coverage could not be measured.

Twelve teachers submitted their perceptions of those aspects of climate change and disaster risk that their students grasped easily, and those that students found hard to understand, with some teachers stating more than one difficulty (Table 5.24). In general, teachers found that many aspects of climate change and disasters are readily grasped by students because they can be experienced and observed; however, the scientific explanations of causes and processes may pose challenges – It is noteworthy that all teachers' comments referred to knowledge, with no mention of skills, attitudes or behavioural aspects.

Table 5.24 Aspects of resilience perceived by teachers as being easy and hard for their students to understand

Easy for students to understand		Difficult for students to understand	
Aspect of resilience	**Number of teachers identifying this aspect**	**Aspect of resilience**	**Number of teachers identifying this aspect**
Causes and consequences of CC	**5**	Scientific explanations of the causes of climate change	**5**
All issues related to CC, including mitigation and adaptation	**3**	Solutions to impacts of CC and disasters, including strategies for adaptation and mitigation	**4**
Impacts of disasters on agriculture, food security and livehlihoods	**2**	Natural process involved in CC and their interactions	**2**
Greenhouse gases (GHGs) and the greenhouse effect	**1**	Scientific aspects of the atmosphere, including layers, ozone, GHGs, relationship of global warming to CC	**2**
The disasters themselves, because students have experienced them	**1**	Nothing. Everything is understandable	**2**
		Protocols	**1**

Regarding educational resources (Table 5.25), a majority (57%) of the 14 teachers interviewed stated that they were dependent on internet resources for the teaching of resilience issues. Such resources include YouTube; Wikipedia; and graphs, photos, definitions and articles available through Google. Urban schools have no problems in accessing and downloading such materials, but schools in rural areas face problems of poor internet connections, outages of electricity and difficulties with photocopying that pose challenges to teachers and students.

Table 5.25 Educational resources used in teaching climate change and disasters

Educational resource	Number of teachers identifying this resource
On-line/internet resources, including YouTube	**8**
Audio-visual materials (videos, posters, etc.)	**5**
Printed notes prepared by teacher, based upon the learning outcomes provided in official syllabi	**3**
Text books from old curriculum (French)	**2**
Brochures/materials from the Department of Meteorology or NGOs such as Save the Children, World Vision, Red Cross and Wan Smolbag	**2**
Atlas de Vanouatou	**1**
Materials from Resilience courses at the Vanuatu Institute of Technology	**1**
Pictures and Teacher Guide for CC Toolkit (LACCPW)	**1**
Other printed materials unspecified	**1**

The second most important educational resource, identified by 36% of teachers, was categorised as audio-visual materials (videos, posters, etc.). It is not clear as to whether these were obtained on-line or by other means. Three out of 14 teachers produce their own student notes on the basis of learning outcomes provided in official syllabi. Yet since no syllabus provides more than a summary of what a student must be able to do, a teacher must carry out time-consuming research to provide the necessary detail. Also, some learning outcomes would be challenging for teachers to interpret and then produce relevant learning materials for their students. In Table 5.26, for example, outcomes 13GEO3.2.3.2, 12DST4.4.4.2 and 13ESC2.3.3.1 are particularly demanding, with the latter specifically mentioned by one teacher as a difficulty encountered.

Table 5.26 Examples of specific learning outcomes in official syllabi for Geography, Development Studies and Earth Science, 2021

Subject	Strand	Specific learning outcome	
GEOGRAPHY	**Natural Processes**	11GEO1.4.1.4	**Define** climate change
		12GEO1.2.2.7	**Evaluate** the strategies used to reduce the negative impacts of tropical cyclones on people and the environment, with specific examples
		13GEO3.2.3.2	**Compare** the major global patterns of climate change
DEVELOPMENT STUDIES	**Development and Environment**	11DST4.3.3.3	**Explain** how increasing levels of greenhouse gases can lead to global warming
		12DST4.4.4.2	**Explain** how sustainable development can offset the effects of climate change
		13DST4.3.2.2	**Describe** the impacts of climate change on people and the environment
		13DST4.4.2.2	**Give examples of** methods of disaster reduction management, e.g. warnings, building designs
EARTH SCIENCE	**Climate Change and Disaster Risk Reduction**	11ESC2.2.3.4	**Distinguish between** climate change and climate variability
		12ESC2.2.2.2	**List** the consequences of increased evaporation in hot and cold regions
		13ESC2.3.3.1	**Explain** the scientific basis of these measures (adaptation) taken at community level in Vanuatu
		13ESC2.2.4.1	**Predict** a scenario for the likely consequences and impacts of future climatic changes in Vanuatu

Source: MOET, 2018

Other resources used by teachers were textbooks from the previous syllabus for *Science de la Vie et de la Terre* (Life and Earth Science) in French-medium schools, and brochures/materials published by government and non-government agencies such as the Department of Meteorology and Save the Children Australia. The French textbooks provide excellent visual information, but they do not relate to a Pacific context, and as knowledge of climate and disasters expands, are increasingly out-of-date. Printed materials produced by government agencies and NGOs are highly relevant but not easily accessed by teachers in outer-island schools. The last three educational resources identified, each by just one teacher, are also highly relevant and useful for Vanuatu students since they are specifically tailored to a Vanuatu context. The *Atlas du Vanouatou* is a very comprehensive collection of coloured maps containing a wealth of information relevant to Vanuatu students at this level, including details of disasters and climate change, but this publication only exists in hard-copy format in French, and is a tome of reference rather than a textbook. The materials produced for Certificate I and III courses on resilience at VIT cover all aspects of climate change and disasters appearing in senior secondary courses, as well as many more. However, most teachers will be unaware of the bilingual Learner Guides, Learner Workbooks and Facilitator Guides, which for the present only exist in hard copy and have not been published on-line. It is a similar situation for the set of 16 pictures and Teacher Guide for *Learning about Climate Change the Pacific Way / Étudier le changement climatique dans le contexte océanien.* Copies of this bilingual resource are stored in the Vanuatu Curriculum Unit, but most teachers are oblivious to their existence.

Fourteen teachers responded to the final question about difficulties experienced when teaching climate change and disasters in the manner required by the new common curriculum (Table 5.27). Six of them (43%) pointed to the lack of official textbooks, learner guides, teacher guides or other resources that would address course outcomes. Yet another six said that they did not face any real difficulty.

Table 5.27 Difficulties experienced when teaching climate change and disasters in the manner required by the new common curriculum, 2021

Difficulty	Number of teachers identifying this difficulty
No required textbook/learner guide, teacher guide / insufficient resources provided to teach the course content	**6**
No real difficulties / No difficulties, because I'm only teaching Yr 11 DS, and this just deals with the greenhouse effect	**6**
No access to observe the technologies being used in Vila/Santo to address CC through architecture, renewable energy resources, etc.	**1**
Covering the concepts required. There is a need for these concepts to be revised	**1**
I am not qualified to teach this subject (Earth Science)	**1**

5.2.5 Summary and Discussion of Results

In relation to Research Question 1, my findings suggest that formal education on climate and disaster resilience in Vanuatu's senior secondary schools is in process, but not yet effective. The majority of students at this level are not benefiting from exposure to this field of study, and in the three optional subjects that do offer content on resilience, greater depth, stimulation and excitement is needed both in and out of the classroom. Syllabi focus on cognitive learning processes rather than on practical skills and action-oriented behaviours, while teaching and learning materials are insufficient. My model for resilience education implies that effectiveness will result from attributes such as an active, participatory learning environment, experiential learning, a variety of assessment methods, enquiry-based learning, content that prepares students to meet future challenges, a rich range of resources and a sensitivity to individual needs. Evidence from senior secondary students and teachers in 2021 has demonstrated that much still needs to be done. The minority of students taking courses in the three optional subjects, particularly Earth Science, showed positive changes in their knowledge, attitudes and behaviour, but the impact on communities, measured by students' ability to share their learning with others, is likely to be minimal.

CHAPTER 6: RESULTS AND DISCUSSION – RQ1: POST-SECONDARY EDUCATION

6.1 Scope of the Chapter

This chapter will deal with Research Question 1 in relation to education about resilience at post-secondary level in Vanuatu:

How effective is formal education on climate and disaster resilience in Vanuatu in terms of knowledge and skills gained, changes in attitude and behaviour and impacts on individuals and their communities?

Section 6.2 outlines the recency of post-secondary courses on resilience in the Pacific. Section 6.3 considers the TVET (Technical and Vocational Education and Training) Certificates I and III in Resilience offered at the Vanuatu Institute of Technology. Section 6.4 deals with Regional Certificates in Resilience at TVET level, accredited by the Pacific Regional Qualifications Unit in Suva, Fiji, and offered on-line through the University of the South Pacific in Vanuatu and other Pacific countries. Section 6.5 covers the Post-Graduate Diploma in Climate Change offered through the University of the South Pacific. Section 6.6 compares courses across senior secondary and post-secondary levels, while 6.7 evaluates formal education courses in resilience against goals of national, regional and international policies.

6.2 Recency of Post-Secondary Formal Courses on Resilience in the Pacific

Although training courses at the Vanuatu Institute of Teacher Education (VITE) from 2010-2019 included aspects of climate change for teachers at primary and secondary level, and the University of the South Pacific (USP) has offered the Post-Graduate Diploma in Climate Change through its Pacific Centre for Environment and Sustainable Development (PaCE-SD) since 2010 (USP, 2011), the first face-to-face post-secondary course in Vanuatu wholly dedicated to resilience (climate change and disaster risk reduction) was not offered until 2017 at the Vanuatu Institute of Technology. This is a certificate programme within the domain of Technical and Vocational Education and Training (TVET), initially designed for those who had completed Year 10 in Vanuatu schools. Subsequently, TVET courses comprising the Pacific Regional Certificate in Resilience have been in process of development in Fiji, with Certificate IV becoming available for the first time in 2020 through the USP's Emalus Campus in Port Vila. The implementation of these specialised courses in resilience has been largely driven through finance and technical assistance offered by donor agencies such as the European Union, the German Aid Agency GIZ and the Pacific Community (SPC).

6.3 TVET Courses at the Vanuatu Institute of Technology

6.3.1 Course Development

Certificate I in Climate Change and Disaster Risk Reduction (CCDRR), conceived in 2014 for delivery in 35 Rural Training Centres (RTCs) throughout the length of Vanuatu, was not in fact launched until February 2017 at the Vanuatu Institute of Technology (VIT) in the urban setting of Port Vila. Its purpose was to provide practical, hands-on training that enabled participants to work at community level in raising awareness of climate change and disasters and be "agents of change" in building capacity for adaptation and mitigation. In keeping with TVET principles, the course was competency-based, requiring learners to demonstrate concrete skills rather than abstract concepts (Pierce, 2019B). Because of the external funding provided, learners were provided with high-quality full-colour learner guides and workbooks in English and French, scholarships to cover course and boarding fees, and funding to meet costs of frequent visits into the field. The 31 learners ranged in age from 18 to 40, including six seconded from government departments such as Forestry, Agriculture and the National Disaster Management Office. The significance of this first-ever formal course in Resilience is illustrated by the Vanuatu Government's initial submission to the Paris Committee on Capacity Building in 2017, which provided information on capacity-building activities for the implementation of its nationally determined contributions (Republic of Vanuatu, 2017): this submission focused on the TVET course on CCDRR at VIT.

Widespread national and international interest in this course fuelled VIT's decision to offer Certificate I to a new cohort of learners and use the same consultant (myself) to design a more advanced course that would generate a further learning pathway to higher education and greater effectiveness in working at community level. Thus in August 2018, Certificate III in Resilience was launched at VIT, again with external funding, with 22 of the 24 learners drawn from the first two cohorts of the Certificate I course. They completed the programme in December 2018 but did not officially graduate until November 2019, after course accreditation had been granted by the Vanuatu Qualifications Authority. Meanwhile a third cohort of learners had embarked upon Certificate I that same year and continued on to Certificate III in 2020. From 2021 onwards, the two certificate courses have been streamlined into one, with VIT only offering Certificate III in Resilience (Climate Change and Disaster Risk Reduction) in 15 modules (Table 6.1). The first eight modules are "prerequisites" to be completed before embarking on the seven Certificate III modules; a student who exits the programme at that point is awarded the Certificate I CCDRR qualification (VIT, 2021). Table 6.2 reviews the evolution of these courses.

Table 6.1 Units/modules in the Certificates I and III Resilience courses at VIT

2017 to 2020		**2021 onwards**	
Certificate I in CC and DRR		**Certificate III in Resilience**	
Unit	**Title**	**Module**	**Title**
1	CGHR0116 Demonstrate knowledge of hazard risks	**1**	Hazards and Risks
2	CGCK0216 Demonstrate knowledge of climate	**2**	Climate and Climatic Variations
3	CGCV0316 Demonstrate knowledge of climatic variations		
4	CGCC0416 Demonstrate knowledge of the causes of climate change	**3**	The Causes and Effects of Climate Change
5	CGCE0516 Demonstrate knowledge of the effects of climate change		
6	CGMC0616 Demonstrate ways of contributing to the mitigation of climate change	**4**	Mitigation and Adaptation to Climate change
7	CGCA0716 Demonstrate ways of adapting to climate change		
8	CGHV0116 Demonstrate ways in which communities are vulnerable to hazards and climate change	**5**	Identifying A community's Vulnerability
9	CGCR0216 Use traditional knowledge to build community resilience to disasters and climate change	**6**	Traditional Knowledge in Building Resilience
10	CGRM0316 Demonstrate knowledge of disaster risk reduction and climate change mitigation and adaptation	**7**	Disaster Risk Reduction
11	CGCA0416 Promote community action to prepare for climate change and disaster risk reduction		
12	Apply Basic First Aid	**8**	Apply Basic First Aid
Certificate III in Resilience			
1	CGCS0118 Apply appropriate communication skills	**9**	Communication and Workplace Calculations
2	CGPC0218 Perform workplace calculations		
3	CGDH0318 Demonstrate higher-level skills in data presentation and mapping	**10**	Higher-Level Skills in Data Presentation and Mapping
4	CGDK0418 Demonstrate knowledge of the world-wide impacts of climate change	**11**	World-wide Impacts of Climate Change
5	CGIF0518 Analyse institutional frameworks and policies on climate change adaptation and mitigation	**12**	Institutional Frameworks and Policies
6	CGRR0618 Analyse institutional frameworks and policies on disaster risk reduction		
7	CGCB0718 Demonstrate how resilience to climate change and disasters can be developed through better food security and the conservation of biodiversity	**13**	Better Food Security and Conservation of Biodiversity
8	CGSH0818 Demonstrate how resilience to climate change and disasters can be developed through better water security, sanitation and hygiene	**14**	Better Water Security, Sanitation and Hygiene
9	CGRA0918 Design and organise risk assessment (vulnerability and resilience) for one coastal community	**15**	Risk Assessment (Vulnerability and Resilience for a Coastal Community

Table 6.2 Resilience courses offered at the Vanuatu Institute of Technology from 2017

Year	Course	Start	End	Cohort
2017	Certificate I in Climate Change and Disaster Risk Reduction	Feb.	July	1
2018	Certificate I in Climate Change and Disaster Risk Reduction	Sept. 17	July 18	2
2018	Certificate III in Resilience	Aug. 18	Dec.18	1 and 2
2019	Certificate I in Climate Change and Disaster Risk Reduction	March	Dec.	3
2020	Certificate III in Resilience	March	Dec.	3
2021	Certificate III in Resilience (Cert I and III combined)	Feb.	Dec.	4
2022	Certificate III in Resilience (Cert I and III combined)	March	Dec.	5

My research into the effectiveness of resilience education started in October 2019. Data on students' performance and attitudes from the first two cohorts could only be collected retrospectively in December 2019 after they had completed Certificates I and III. But data from the third cohort could be obtained from the start of Certificate III in March 2020 and then as students finished in December 2020. Data from the fourth cohort was obtained as the learners started Certificate 1 in February 2021, then as they completed Certificate I in October 2021 and embarked upon the Certificate III modules. In summary, data has been obtained from three groups of learners – cohorts 1 and 2 combined, cohort 3 and cohort 4. It is not possible to collect student data from the fifth cohort within the life cycle of this thesis.

Questionnaires QS1 and QS4 for measuring learners' reactions to the Certificates I and III courses were the same as those completed by senior secondary students. QS1, on perceptions of materials and course delivery, was answered only once by each learner group, towards the end of their course. QS4, on changes in knowledge, skills, attitudes and behaviour, was completed after the end of the Certificate III course by cohorts 1 & 2; at the start and end of the Certificate III course by cohort 3; and at the start and end of the Certificate I course by cohort 4. Questionnaires QS2 and QS3 were answered by cohorts 1 & 2 and cohort 3. As I could not be physically present in Vanuatu after March 2020 to follow up with individual students and facilitators, it proved impossible to obtain a 100% response rate from each of the groups, and I had to be satisfied with a smaller sample size than originally intended.

6.3.2 Learner Views

QS1: Learner views on course delivery and course characteristics

The process of data collation for QS1 has already been described in Section 5.2.3. Tables 6.3 to 6.6 and Figures 6.1 and 6.2 show the results.

Table 6.3 plots data on course delivery and course characteristics for three separate cohorts of learners and for the three cohorts combined. Learners from the initial Certificates I and III courses that ended in December 2018 scored overall course effectiveness at 1.72 on a scale of +2 to -2: this is by far the highest average score for any of the 20 senior secondary and 3 VIT classes completing QS1, and reflects the advantages experienced by this particular class in terms of pedagogy and educational resources. Tables 6.4 to 6.6 demonstrate that the difference between this score and the next three highest average scores recorded (1.45 for VIT cohort 3, 1.50 for Mangrove College Year 12 Earth Science students in 2021 and 1.42 for Hibiscus College Year 13 Geography students in 2021) is statistically significant, with a 2-tailed significance (p-value) of less than 0.05. Similarly, the score for course delivery for cohorts 1 and 2 at VIT (1.82) was markedly higher than that awarded by cohorts 3 or 4 or by any of the senior secondary classes, with the maximum possible value (2.00) achieved for the facilitator's organisational and communication skills and promotion of cooperative learning (items 6,13 and 19).

Table 6.3 and Figure 6.1 enable us to observe trends over time in the effectiveness of the specialised courses in resilience at VIT. The decline in effectiveness, as measured by learner perceptions, is more marked in course delivery than in course materials and suggests the pre-eminence of the facilitator/teacher in influencing student progress – just as was demonstrated with senior secondary students (Section 5.2.3). Witness the slight increase in average score for effectiveness of course materials between cohorts 1 & 2 and cohort 3 between 2018 and 2020, from 1.52 to 1.58, as against the steep decline in scores between the two groups for effectiveness of the facilitator, from 1.82 to 1.38. In effect, each of the three learner groups has had a different facilitator. By 2021, with the third group of students (cohort 4) progressing through Certificates I and III, the average score for delivery is now 1.05, with the facilitator scoring notably lower scores for punctuality (0.33) and use of visual materials (0.42).

Table 6.3 Average scores for TVET learners' views on effectiveness of delivery and materials in Certificate courses 1 and III in Resilience

Question/Statement		Average scores within a range of -2.0 to +2.0			
		Cohorts 1&2 Cert III 2018 13 learners	Cohort 3 Cert III 2020 12 learners	Cohort 4 Cert I 2021 12 learners	All cohorts Cert I & III 37 learners
1.	The teacher/facilitator is knowledgeable	1.92	1.50	1.25	**1.57**
2.	The teacher/facilitator is well prepared	1.92	1.33	1.00	**1.43**
3.	The teacher/facilitator comes on time	1.69	1.50	0.33	**1.19**
4.	The teacher/facilitator is enthusiastic	1.85	1.50	1.00	**1.46**
5.	The teacher/facilitator is creative	1.92	1.33	1.33	**1.54**
6.	The teacher/facilitator is well organised	2.00	1.50	0.75	**1.43**
7.	The teacher/facilitator uses visual materials	1.85	1.33	0.42	**1.22**
8.	The teacher/facilitator is approachable	1.69	1.25	0.92	**1.30**
9.	The teacher/facilitator treats us as individuals	1.46	1.00	0.58	**1.03**
10.	The teacher/facilitator values my contributions	1.46	1.25	0.83	**1.19**
11.	The teacher/facilitator shows compassion	1.85	1.33	1.08	**1.43**
12.	The teacher/facilitator is helpful	1.92	1.50	1.33	**1.59**
13.	The teacher/facilitator communicates clearly	2.00	1.67	1.33	**1.68**
14.	The teacher/facilitator explains new concepts	1.85	1.50	1.25	**1.54**
15.	The teacher/facilitator makes me think	1.62	1.33	1.33	**1.43**
16.	The teacher/facilitator asks us questions	1.85	1.25	1.50	**1.54**
17.	The teacher/facilitator makes us participate	1.85	1.58	1.58	**1.68**
18.	The teacher/facilitator participates in the activities	1.85	1.33	1.17	**1.46**
19.	The teacher/facilitator promotes cooperative learning	2.00	1.17	1.25	**1.49**
20.	The teacher/facilitator checks up on our progress	1.92	1.50	0.67	**1.38**
21.	The course/lesson stimulates my interest in CC/ DRR	1.69	1.58	0.58	**1.30**
22.	The learning materials are exciting and appropriate	1.62	1.25	0.58	**1.16**
23.	I am encouraged to be responsible for my own learning	1.38	1.67	0.58	**1.22**
24.	I know how to prepare for all kinds of disaster	1.38	1.50	0.75	**1.22**
25.	I know ways to mitigate and adapt to climate change	1.62	1.25	1.08	**1.32**
26.	I learn new skills through the course/lessons	1.69	1.67	1.17	**1.51**
27.	I want to put my learning into action	1.54	1.92	1.17	**1.54**
28.	I am ready to take action on climate change	1.46	1.75	1.17	**1.46**
29.	I am ready to help others understand about disaster risk	1.62	1.75	0.92	**1.43**
30.	The way that the teacher/facilitator delivers the lesson is more important than the learning materials used.	1.23	1.50	0.42	**1.05**

Effectiveness of course delivery (Teacher)	1.82	1.38	1.05	**1.43**
Effectiveness of course materials (Course)	1.52	1.58	0.84	**1.32**
Effectiveness of all aspects (Teacher + Course)	**1.72**	**1.45**	**0.98**	**1.39**

In 2021, course materials are now rated at 0.84, but this may not reflect the reality, since many of the learner responses to items 21, 22 or 23 were invisible on the scans received, so were scored as 0. The overall score for effectiveness of delivery and materials for this fourth cohort in 2021 was 0.98, reflecting a reasonable level of learner satisfaction, but nevertheless ranked 21st out of all 23 scores for classes taking resilience courses at senior secondary and TVET level.

Figure 6.1 Average scores for effectiveness of resilience courses at VIT, 2018-2021

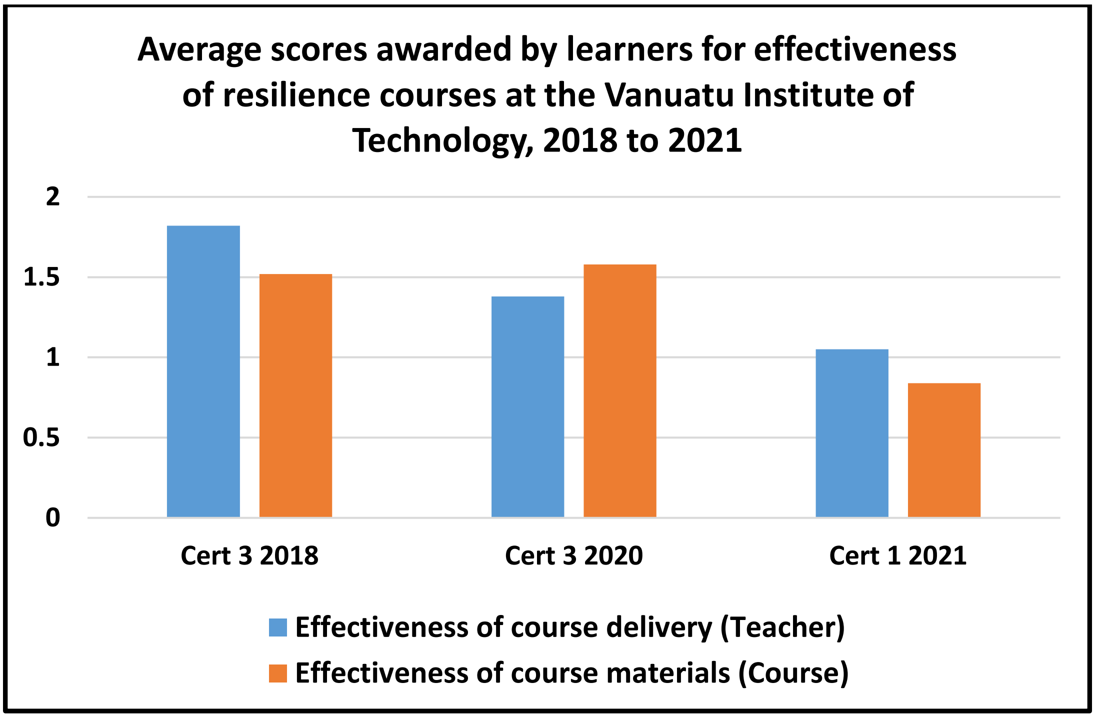


Table 6.4 Determination of validity of difference between average score (all 30 items) for effectiveness of resilience courses awarded by VIT 2018 cohort and VIT 2020 cohort

Average score for all items	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
VIT 2018 cohort	1.7233	30	0.21199					
VIT 2020 cohort	1.4497	30	0.20083					
Diff 2018-2020	0.2737	30	0.31007	0.15789	0.38945	4.834	29	0.000

N: number of items; Conf. Int: confidence interval; t: t-value; df: degrees of freedom

Table 6.5 Determination of validity of difference between average score (all 30 items) for effectiveness of resilience courses awarded by VIT 2018 cohort and Mangrove Yr 12 Earth Science cohort 2021

Average score for all items	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
VIT 2018 cohort	1.7233	30	0.21199					
Mangrove ES Yr 12 2021cohort	1.5070	30	0.29395					
Diff VIT-Mangrove	0.2163	30	0.31546	0.09854	0.333413	3.756	29	0.001

N: number of items; Conf. Int: confidence interval; t: t-value; df: degrees of freedom

Table 6.6 Determination of validity of difference between average score (all 30 items) for effectiveness of resilience courses awarded by VIT 2018 cohort and Hibiscus Yr 13 Geography cohort 2021

Average score for all items	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
VIT 2018 cohort	1.7233	30	0.21199					
Hibiscus Geo Yr 13 2021cohort	1.4147	30	0.23481					
Diff VIT-Hibiscus	0.3087	30	0.25577	0.21316	0.40417	6.610	29	0.000

N: number of items; Conf. Int: confidence interval; t: t-value; df: degrees of freedom

Two practical reasons can be offered for this apparent decline in effectiveness. Firstly, the funding provided by donor partners for the initial Certificates I and III courses (cohorts 1 and 2) ensured that those students had new, up-to-date learner guides and workbooks in full colour, received scholarships for their studies and benefited from generous funding for land and sea transport that enabled them to undertake frequent fieldtrips to locations on Efate and its offshore islands, where they could learn to interact with local communities and put their learning into action (Pierce, 2019B). Figure 6.2 provides an example of such fieldwork. Since 2018, after VIT assumed responsibility for course delivery, all learning materials have been photocopied in black and white, and the French versions of Certificate 1 texts have not been used. Learners must pay their own course fees, and there are no in-house funds for fieldtrips. Through negotiation with a non-government organisation in the United Kingdom, the British Friends of Vanuatu, some financial assistance has been provided for major fieldwork projects in 2020 and 2021, but is modest in comparison with that provided to the first group of learners. Secondly, the initial facilitator for the Certificate I and III programme was the course designer himself, a long-serving and highly motivated educator at secondary and tertiary level in Vanuatu, trilingual in English, French and Bislama. The two facilitators for subsequent cohorts had the benefit of training with the initial facilitator, but have had to contend with the challenges of running courses without the same financial input provided at the start.

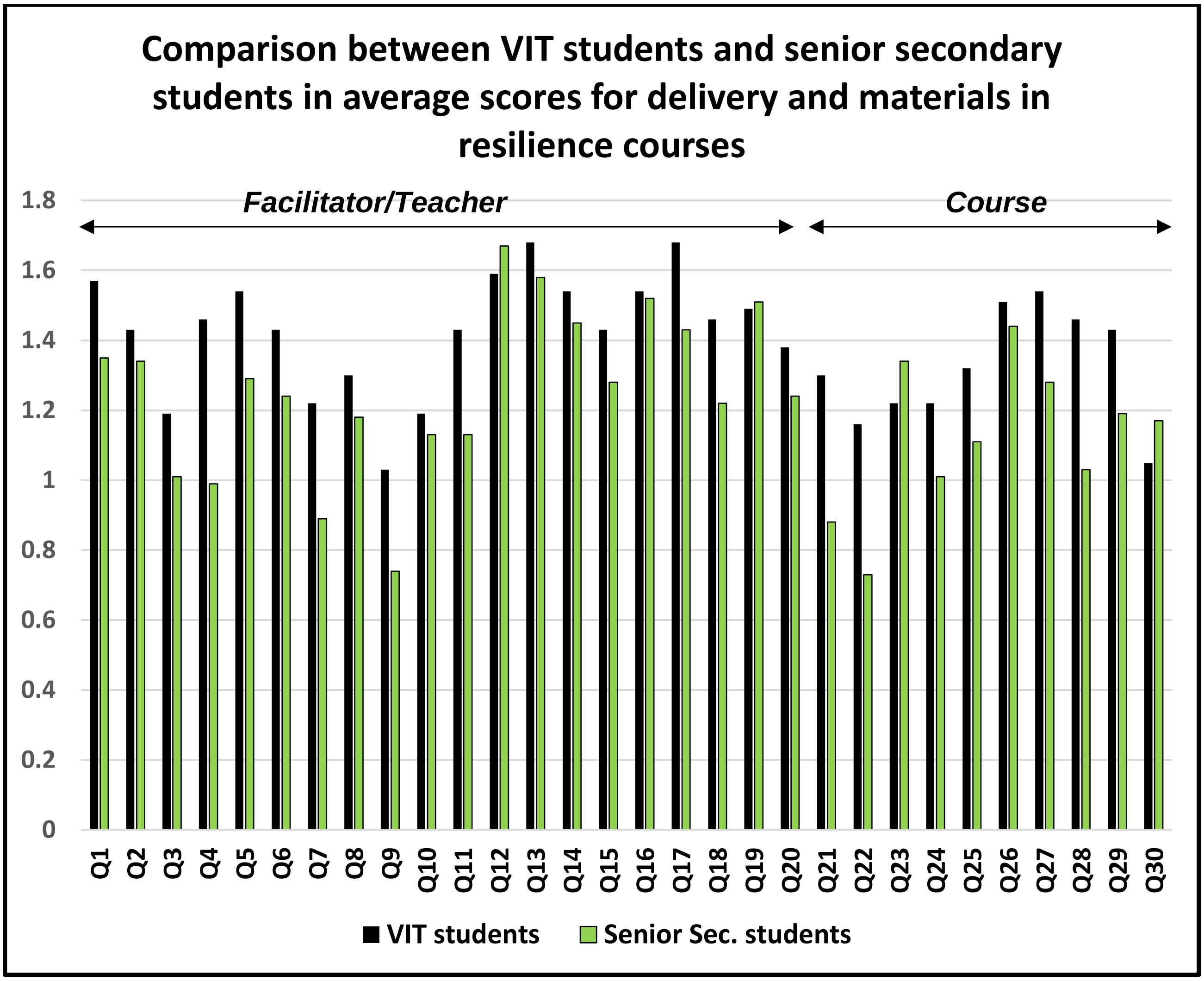
Figure 6.2 Certificate 1 learners presenting their assessment of community vulnerability to the people of Marou village, Emau island, in the local church, December 2017

Author, 2017

If a broader view of the resilience courses at VIT is taken, however, a more positive picture emerges. Figure 6.3 compares responses from all three groups of the VIT learners to individual items in QS1 with responses for all senior secondary students who studied aspects of resilience through programmes in Geography, Development Studies and Earth Science. The scores for VIT learners are those indicated in the extreme right-hand column of Table 6.3, while those for senior secondary students are those from the extreme right-hand column of Table 5.10. Note that the sample size for the former was 37 persons compared with 180 for the latter.

Figure 6.3 shows that average scores awarded by VIT learners were higher in 26 out of 30 items than those awarded by senior secondary students. The difference was greatest in items 4, 7, 9, 11, 21, 22 and 28: thus facilitators at VIT were perceived as using more visual materials and showing more enthusiasm, more compassion and greater capacity to treat students as individuals, while the course was seen as having more exciting learning materials, stimulating greater interest in CC and DRR, and fostering more motivation in students to take action on climate change. The highest scores for individual items were achieved in items 13 and 17 for VIT learners (1.68 for the teacher's ability to communicate and foster learner participation) and item 12 for senior secondary students (1.67 for the teacher's helpfulness).

Figure 6.3 Average scores for effectiveness of resilience courses at VIT and in senior secondary programmes



In relation to responses to the three final questions in QS1, Figures 6.4 to 6.8 trace the evolution of learners' ideas over time by comparing the responses of cohorts 1 & 2 (2018) with cohort 4 (2021). The coding system replicates that developed for use with senior secondary students and is depicted in the same colours as for Figures 5.7, 5.8 and 5.9.

Figure 6.4 Responses of VIT learners in cohorts 1 and 2 (2018) on aspects of resilience education that they enjoy the most

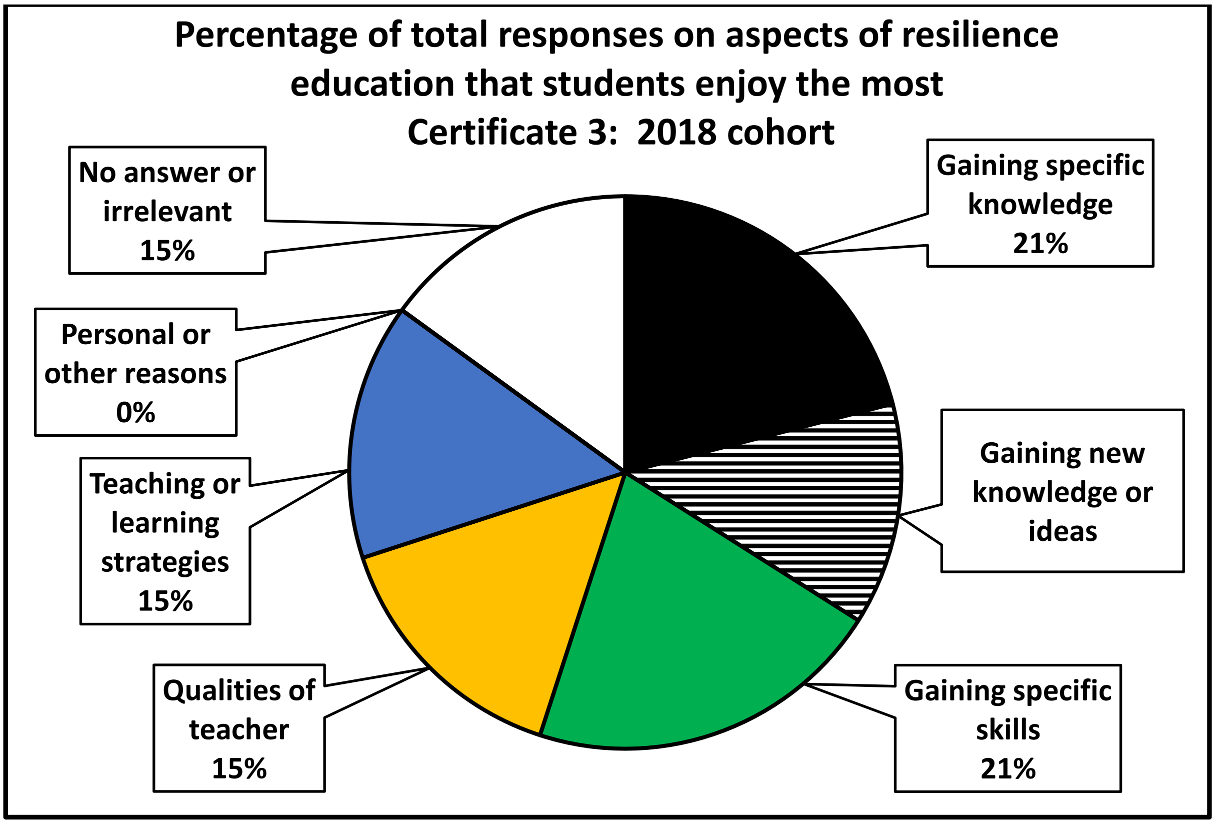
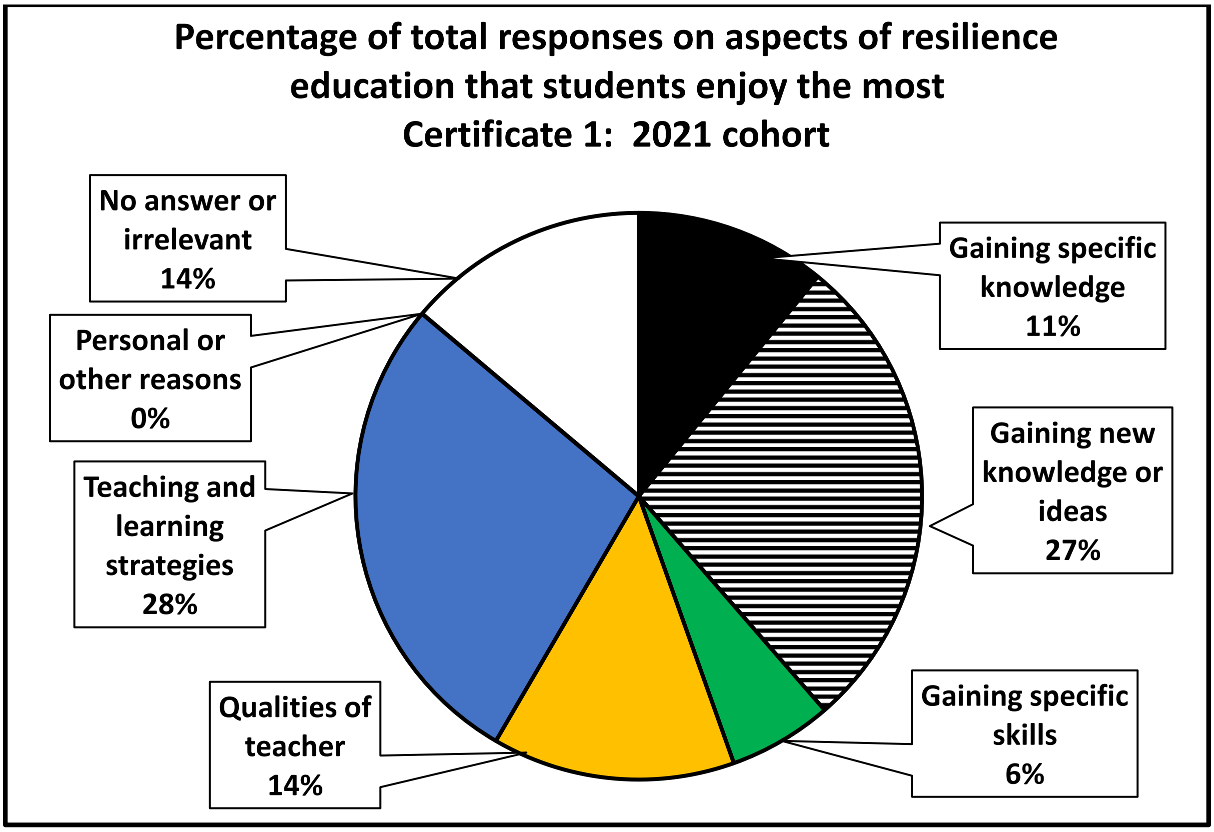


Figure 6.5 Responses of VIT learners in cohort 4 (2021) on aspects of resilience education that they enjoy the most



Figures 6.4 and 6.5 provide learner responses to the question "Give three reasons why you enjoy/enjoyed this course." Of the 2018 cohort, 21% of responses referred to items of specific knowledge gained, 13% to generic knowledge gained and 21% to the acquisition of specific skills. By 2021, generic knowledge was more important than specific knowledge, and the much lower percentage for specific skills (6%) suggests that less emphasis was now being placed on skills such as public speaking, carrying out awareness programmes with local communities and drawing risk maps; on the other hand, teaching and learning strategies such as group work and team building now accounted for 28% of responses as compared with 15% for the 2018 cohort, who by the end of their course may have taken such strategies for granted. In comparison with responses from senior secondary students on resilience education (Figure 5.7), a greater proportion of both VIT cohorts identified teaching or learning strategies as a source of enjoyment (15% and 28% compared with 4%), while personal and other reasons were insignificant. The implication is that the pedagogy used at VIT is more imaginative and student-centred than in Years 11-13 of secondary schools – supported by evidence from QC1 and QC2 (Tables 6.16 and 6.17). Examples of learner responses to this question were as follows:

For specific knowledge:

> Climate change is happening now and we need to take action to help our community.
>
> (Certificate III learner, 2018 cohort)

For generic knowledge:

> We learn more things about the environment.
>
> (Certificate I learner, 2021 cohort)

For specific skills:

> I enjoy drawing hazard risk maps for a community.
>
> (Certificate III learner, 2018 cohort)

> It helps me to stand in front of people and talk without shame or panic.
>
> (Certificate I learner, 2021 cohort)

For a teacher's qualities:

> The teacher and my classmates are enthusiastic.
>
> (Certificate III learner, 2018 cohort)

For teaching and learning strategies:

> We practice what we learn. (Certificate I learner, 2021 cohort)

> Taking part in field trips. (Certificate I learner, 2021 cohort)

Figure 6.6 Responses of VIT learners in cohorts 1 and 2 (2018) on the most important things learnt during resilience education

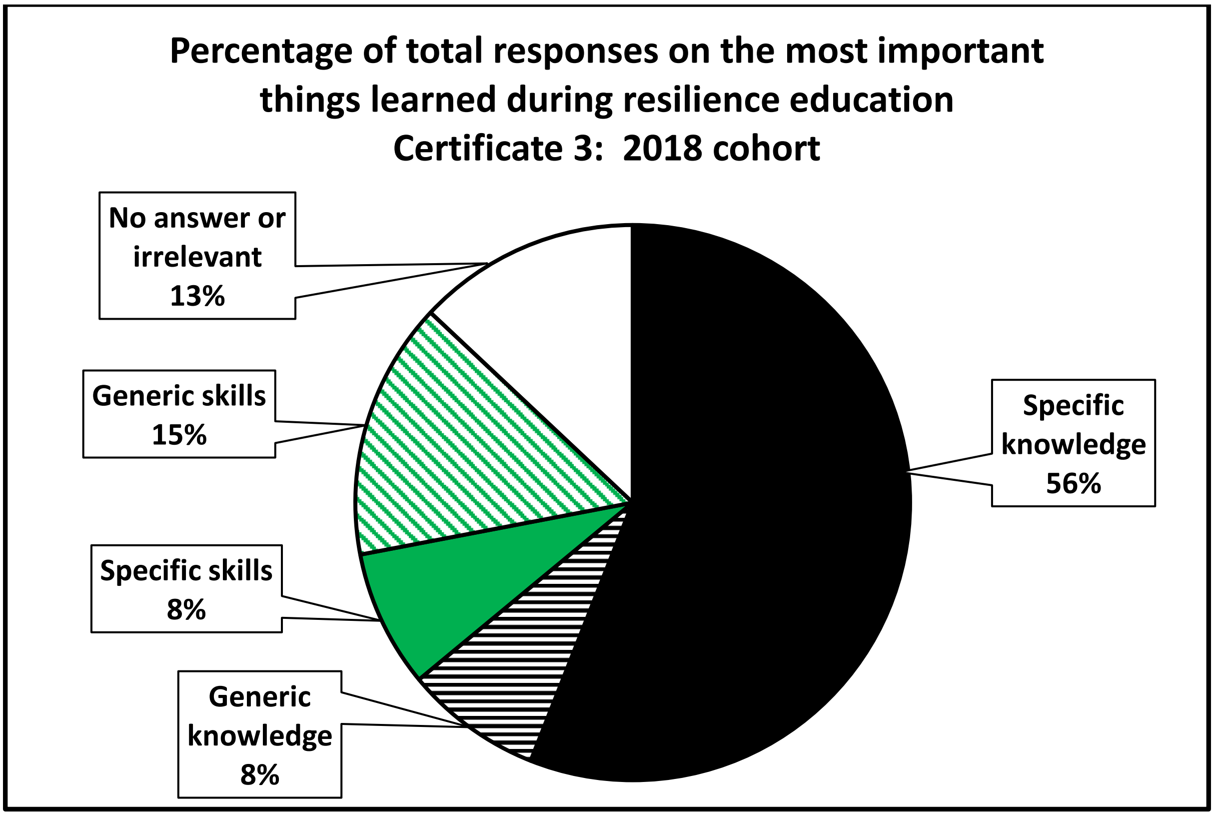
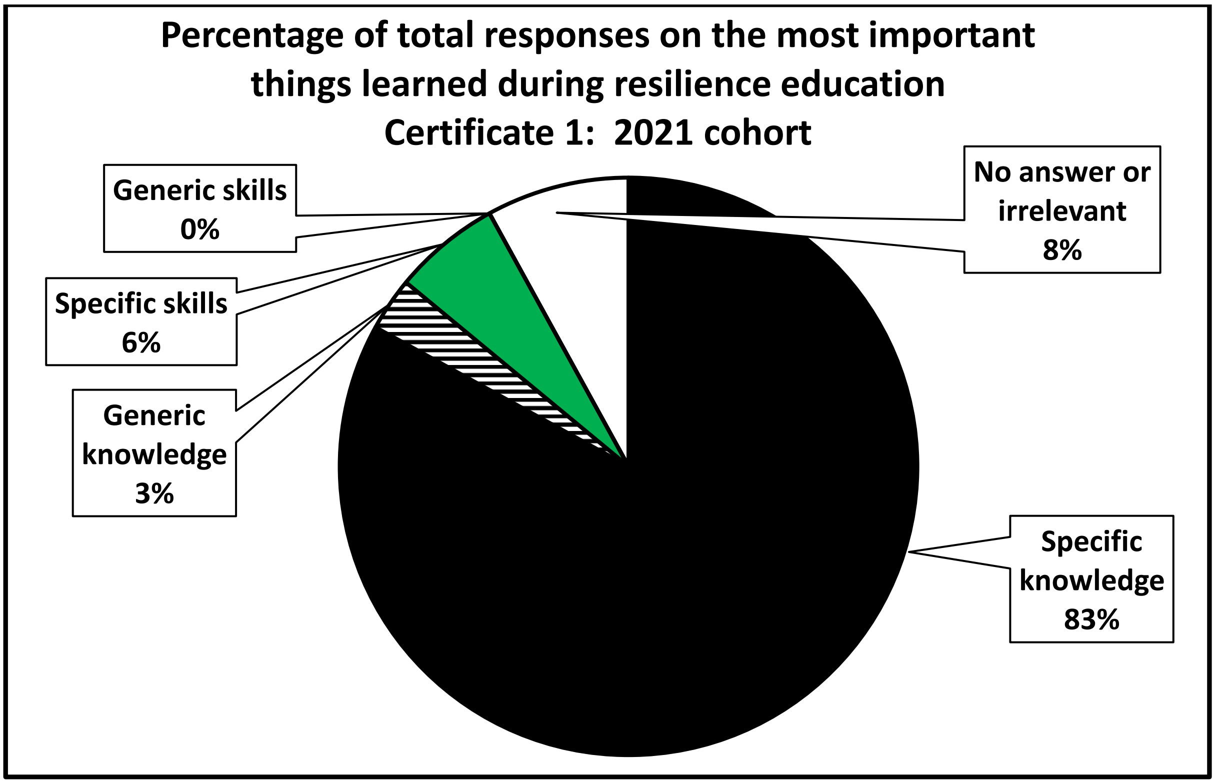


Figure 6.7 Responses of VIT learners in cohort 4 (2021) on the most important things learnt during resilience education



Reponses to the second question, “State the three most important things you have learnt from this course” appear in Figures 6.6 and 6.7. For both cohorts, acquisition of specific knowledge was of greatest significance, comprising 56% of responses from the 2018 group and 83% of those from 2021. But while specific and generic skills made up 23% of 2018 responses, they declined to just 6% by 2021, confirming the trend indicated by answers to the first question. The implication is that as resilience courses continue to be offered at VIT, there is greater emphasis on academic knowledge and less on practical skills gained through field experience. A comparison with responses from senior secondary students (Figure 5.8) reveals a similar situation, with the skills component of resilience courses largely lacking.

Examples of learner responses to question 2 were as follows:

For specific knowledge:

> The importance of traditional knowledge about weather and measures to adapt to disasters.
>
> (Certificate III learner, 2018 cohort)

> As air temperature and ocean temperature increase, the ocean expands, causing sea level to rise.
>
> (Certificate I learner, 2021 cohort)

For generic knowledge:

> Climate change is real and is happening.
>
> (Certificate III learner, 2018 cohort)

For specific skills:

> Learning how to draw maps at scale of different places
>
> (Certificate I learner, 2021 cohort)

For generic skills:

> Teamwork is needed to carry out a task effectively.
>
> (Certificate III learner, 2018 cohort)

The third question – “How could this course be improved?” – elicited slightly different reactions from the two cohorts (Figures 6.8 and 6.9). Desired changes in course content or delivery comprised just over two thirds (70%) of the 2018 responses, but the overwhelming proportion (93%) of responses in 2021. The predominant themes for course improvement were also different. In 2018, learners wanted the course length to be extended, more field trips and practical activities and the course to continue at higher levels.

Figure 6.8 Responses of VIT learners in cohorts 1 and 2 (2018) on how resilience education can be improved

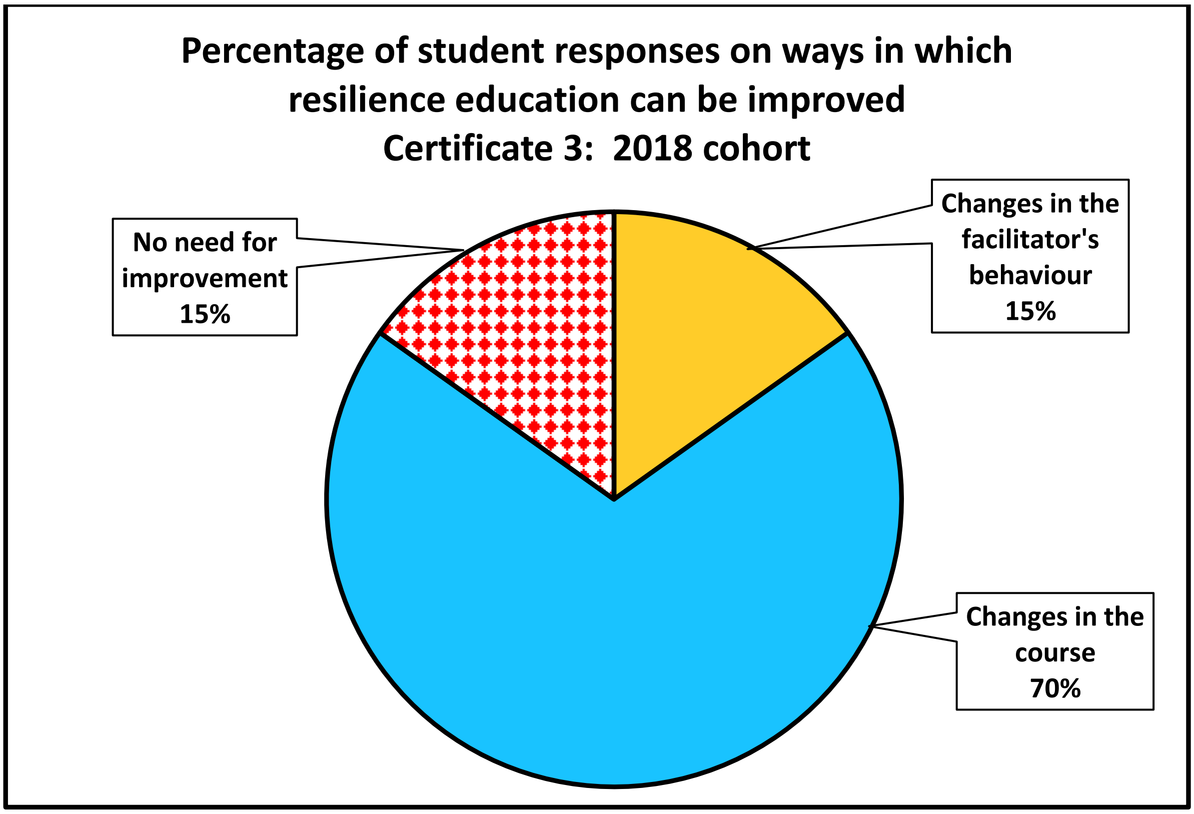
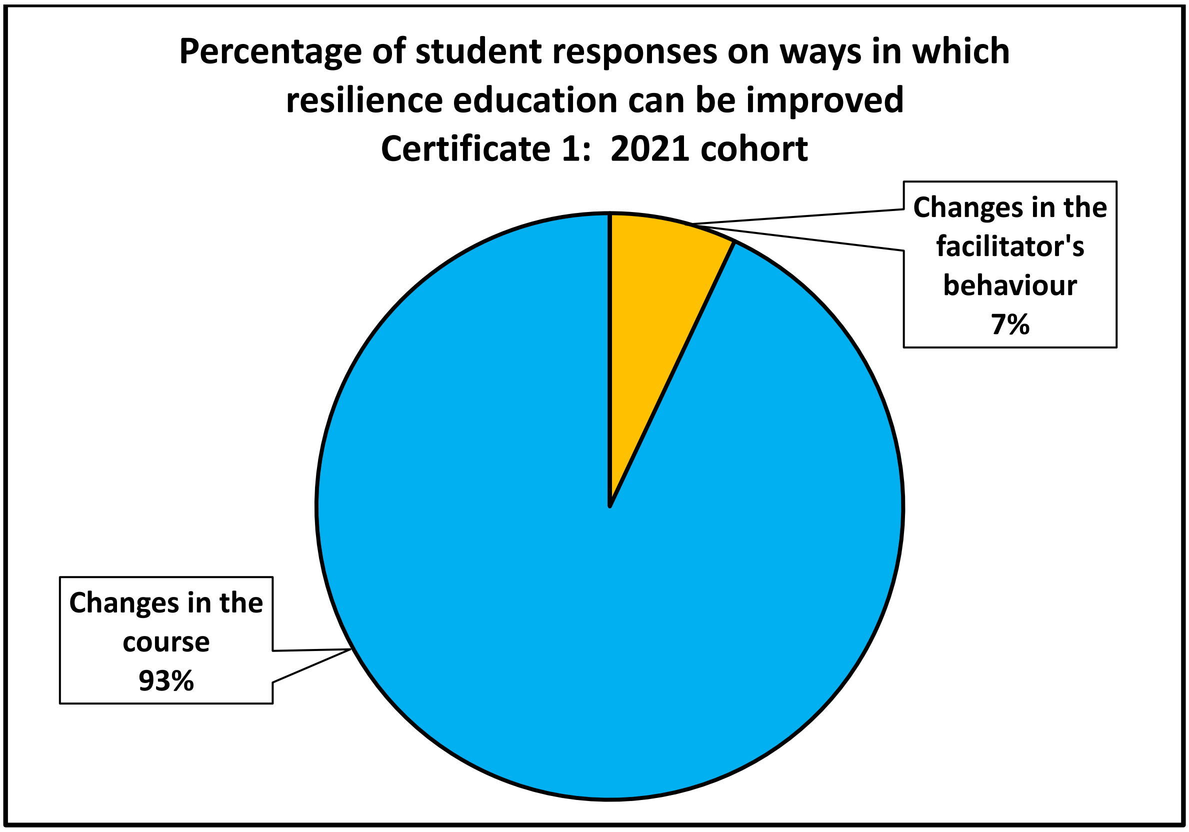


Figure 6.9 Responses of VIT learners in cohort 4 (2021) on how resilience education can be improved



But in 2021 (Figure 6.9), needs related to pragmatic classroom realities: course books to be in colour, updated and in both English and French; equipment to be provided for experiments and meteorological observations; and having bilingual teachers. In comparison, senior secondary students also focused on improvements to the course itself (Figure 5.9), asking for greater usage of visual learning resources and field experience; they also suggested ways in which students themselves might improve their attitudes – an aspect not considered by the VIT learners. The VIT 2018 cohort hoped that future facilitators would be experienced and knowledgeable, while the 2021 cohort wanted the facilitator to attend class. Another contrast between the two VIT cohorts was that in 2018, 15% of responses said that the course had no need for further improvement, while in 2021, this option was not mentioned.

Examples of learner responses to the third question were as follows:

For changes in the facilitator's behaviour:

> Ensure that those who teach this course in the future are experienced and knowledgeable, so as to maintain student interest.
>
> (Certificate III learner, 2018 cohort)

> By the teacher attending class regularly.
>
> (Certificate I learner, 2021 cohort)

For changes in the course:

> Providing equipment/materials to help us know how to carry out surveys in communities and help everyone to be more resilient to climate impacts.
>
> (Certificate I learner, 2021 cohort)

> Ensure that this course is included in Year 13 curricula in schools.
>
> (Certificate III learner, 2018 cohort)

QS2: Learner characteristics

Questionnaire QS2 on learner characteristics attempts to assess the factors influencing a learner's progress in a resilience course that depend upon the learner him/herself, as distinct from the influence of the teacher/facilitator and the course materials. Such factors include the learner's sense of achievement in the course, motivation to take the course, academic level, course fees and preferred learning style. The English version of the questionnaire is shown in Appendix A4.

Because of difficulties in data collection after the start of the COVID-19 pandemic in March 2020, QS2 was only used with two groups of students, VIT cohorts 1 & 2 and cohort 3. Nevertheless, and despite the small sample size (13 learners in each), a comparison of results helps us to investigate whether VIT's espousal of total responsibility for administration and financing of the resilience courses from 2019 onwards has had any effect on student performance.

In processing the data, statements 1-6 and 8-9 were allotted scores on a range of -2 (strongly disagree) to +2 (strongly agree), then total and average score calculated for each statement. For statements 7, 10, 11 and 12, the numbers of responses in each sub-category were simply totalled.

Table 6.7 compares the results for the two groups of learners. For sense of achievement, the 2018 cohort had a higher score than the 2020 cohort for all four statements, but particularly in terms of feedback from the facilitator. Both cohorts scored highly for their perception of new skills being learned. For motivation, the 2018 learners had a higher score for their desire to take and complete the course, but the 2020 learners felt a stronger personal motivation to do so, presumably because they were paying their own fees. The same proportion of learners in each cohort (6 out of 13) took the course because they wanted to learn more about climate change and disaster risk reduction. The remainder of the 2018 cohort did so because of wanting to advance their careers (3) or helping the community (3), and the one person who said that it was part of her job was the assistant facilitator who had been undergoing training. Within the 2020 cohort, the other main grouping were those who wanted to help their community (4 persons).

Table 6.7 shows that in terms of academic level, both cohorts recorded much lower scores for statements 8 and 9 than for the other statements, with the averages slightly higher for the 2018 group: one inference is that this earlier group found the course marginally easier than the later group, but at the same time had a slightly deeper realisation of the complexities involved. The highest stage of education attained for the majority of learners in both groups was certificate level, because all had just completed Certificate I in CCDRR, but the 2018 cohort had three learners who had completed the first year of undergraduate studies and one with a bachelor degree (the assistant facilitator). Prior to Certificate I, all of the 2020 cohort had completed at least Year 12 level and then started at VIT, whereas several of the 2018 cohort had only completed up to Year 10 level. Overall, I infer that that the average academic base for both cohorts was similar.

Table 6.7 Learners' perceptions of factors influencing their progress: comparison between VIT cohorts graduating in 2018 and 2020

Question/Statement		VIT Certificate III 2018 cohort (n=13)		VIT Certificate III 2020 cohort (n=13)	
		Average score -2 to +2	Number of respondents	Average score -2 to +2	Number of respondents
SENSE OF ACHIEVEMENT					
1.	I feel I am progressing well in this course	**1.54**		**1.15**	
2.	I am successful in tests	**1.15**		**1.00**	
3.	I am receiving feedback from the facilitator/teacher on my performance	**1.92**		**1.15**	
4.	I am learning new skills in this course	**2.00**		**1.92**	
MOTIVATION					
5.	I really want/wanted to take and complete this course	**1.85**		**1.69**	
6.	I myself decided to take this course	**1.31**		**1.69**	
7.	I took this course because:				
	• It's part of my job		**1**		**0**
	• I really want to learn more about CCDRR		**6**		**6**
	• It will advance my career		**3**		**1**
	• I want to help my community		**3**		**4**
	• No answer		**0**		**2**
ACADEMIC LEVEL					
8.	A high level of education is needed in order to complete this course	**0.69**		**0.46**	
9.	This course is easy for me	**0.77**		**0.62**	
10.	My highest level of education is				
	• Senior secondary		**0**		**0**
	• Certificate		**9**		**12**
	• Diploma		**0**		**0**
	• University 100 level		**3**		**1**
	• Bachelor degree or equivalent		**1**		**0**
COURSE FEES					
11.	To meet the cost of this course:				
	• I don't need to pay any fees		**1**		**0**
	• I pay my own fees		**0**		**2**
	• My family or friends pay my fees		**0**		**10**
	• I have a scholarship		**12**		**1**
PREFERRED LEARNING STYLE					
12.	My preferred learning style (first preference)is:				
	• Visual or spatial		**8**		**4**
	• Aural		**0**		**2**
	• Verbal		**5**		**5**
	• Physical		**0**		**2**

When considering course fees, however, the two groups were distinctly different: whereas all the 2018 cohort of learners received scholarships that covered all costs, the 2020 cohort had to raise their fees through their own efforts or with family help.

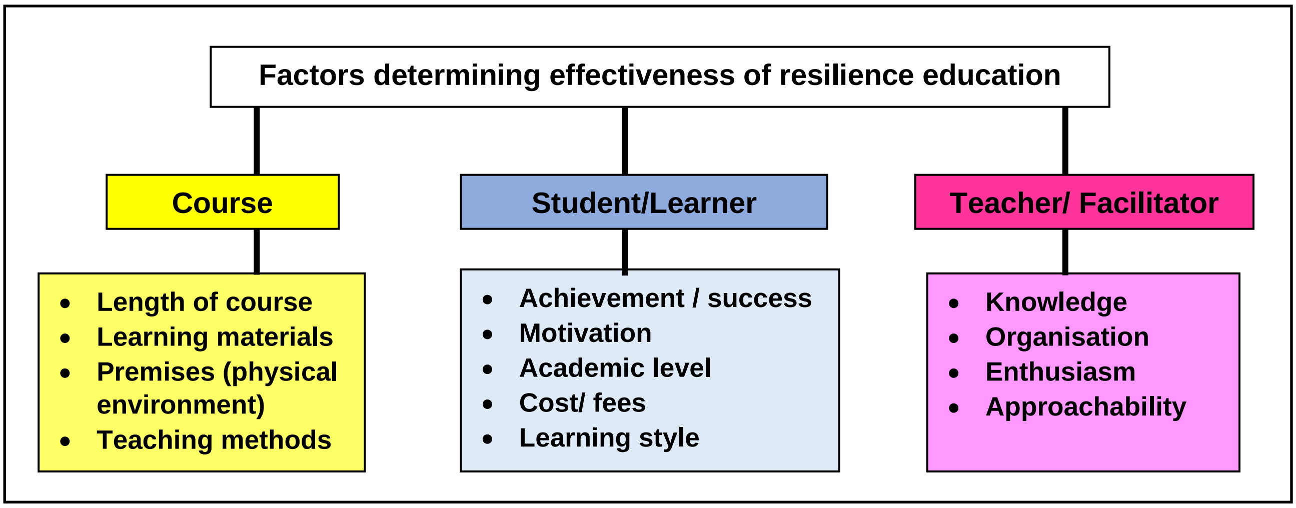
This would have imposed considerable pressure on the learners, since failure to pay up would result in prohibition to continue studying. The final factor influencing learners, preferred learning style, shows a clear pattern for the 2018 cohort, with visual/spatial being the first preference of two thirds of the group, and verbal that of the remaining third; for the 2020 cohort, approximately one third chose visual, one third verbal and the remaining third equally split between aural and physical. One theory for the predominance of visual among the earlier group is that they were exposed to a greater array of visual and spatial learning resources during the Certificate III course than the second group, so this may have influenced their responses – although there is no quantitative data to support this. The whole issue of “sensory learning styles” is appealing but controversial (Cassidy, 2010; Scott, 2010; Arbuthnott & Kratzig, 2015; Dantas & Cunha, 2020), and may not be of relevance to the learning processes in resilience education.

In summary, these findings suggest that when the Vanuatu Institute of Technology assumed full responsibility for the delivery of certificate courses in resilience in 2019, this did have an impact on student progress, causing learners to feel less secure and more liable to financial stress. This compounded the negative impact of now limited funds to support educational resources and field experience, already mentioned under QS1.

QS3: Learner perceptions of factors influencing the effectiveness of resilience education

The aim of questionnaire QS3 is to obtain learners’ views on the relative importance of three key factors in resilience education – the teacher/facilitator, the course itself and the student/learner. It is based on the analytical hierarchy process of comparing factors in pairs (Bodin & Gass, 2004; Badri et al, 2016; Ahmad & Hussain, 2017). Information is provided to the respondent on ways in which these three factors might affect a student’s progress (Figure 6.10), as well as instructions for completing pair-wise comparisons of the three (Appendix A5).

Figure 6.10 Three factors determining the effectiveness of resilience education



QS3 was completed by the same two groups of VIT learners who had answered QS2, again after they had completed Certificate III. The additional question on preferred learning styles enabled a cross-comparison with a similar question asked in QS2. Results are shown in Tables 6.8, 6.9 and 6.10, using a very simplistic form of analysis. For each pair in Table 6.8 (the 2018 cohort), the number of learners selecting each category of importance was totalled, then multiplied by the category number (1 to 9) to give the total number of points scored for each of the two elements in the pair. This process was repeated for the 2020 cohort in Table 6.9. Finally, the point scores for the three elements in the two cohorts were totalled and divided by the total number of participating learners (27) to give an average score for Course, Learner and Facilitator (Table 6.10). Scores for respondents who had indicated that each element of the pair was of equal importance were ignored.

Table 6.8 2018 cohort: learners' pair-wise comparisons of the importance of course, learner and facilitator (n = 14)

<table>
<tr><td rowspan="2">Course</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>Facilitator</td></tr>
<tr><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>7</td><td>1</td><td>1</td><td></td><td></td><td></td><td></td><td>1</td><td>2</td><td></td></tr>
<tr><td colspan="9">Total for Course: 2 learners, 18 points</td><td>Equal: 7 learners</td><td colspan="9">Total for Facilitator : 5 learners, 31 points</td></tr>
<tr><td rowspan="2">Learner</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>Course</td></tr>
<tr><td>1</td><td></td><td>2</td><td></td><td></td><td></td><td>1</td><td>2</td><td>1</td><td>2</td><td>1</td><td>1</td><td></td><td></td><td>3</td><td></td><td></td><td></td></tr>
<tr><td colspan="9">Total for Learner: 6 learners, 30 points</td><td>Equal: 1 learner</td><td colspan="9">Total for Course: 7 learners, 32 points</td></tr>
<tr><td rowspan="2">Facilitator</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>Learner</td></tr>
<tr><td>1</td><td>1</td><td>2</td><td></td><td>1</td><td></td><td>1</td><td>1</td><td>4</td><td>1</td><td>1</td><td></td><td></td><td></td><td>1</td><td></td><td></td><td></td></tr>
<tr><td colspan="9">Total for Facilitator: 7 learners, 41 points</td><td>Equal: 4 learners</td><td colspan="9">Total for Learner: 3 learners, 12 points</td></tr>
</table>

Preferred learning styles: 7 visual, 6 verbal, 1 not stated.

Table 6.9 2020 cohort: learners' pair-wise comparisons of the importance of course, learner and facilitator (n = 13)

Course	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Facilitator
									1						**7**	**2**	**3**	
Total for Course: 0 learners, 0 points									**Equal: 1 learner**	**Total for Facilitator : 12 learners, 92 points**								
Learner	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Course
							1		**1**		**6**	**3**	**2**					
Total for Learner: 1 learner, 3 points									**Equal: 1 learner**	**Total for Course: 11 learners, 40 points**								
Facilitator	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Learner
					1				**1**	**1**	**6**		**3**	**1**				
Total for Facilitator: 1 learner, 5 points									**Equal: 1 learner**	**Total for Learner: 11 learners, 41 points**								

Preferred learning styles: 1 visual, 1 verbal, 11 not stated.

Table 6.10 Average scores for all participants for the importance of course, learner and facilitator (n = 27)

	Total points – both cohorts (T)	Av. score (T/27)
Course	18 + 32 + 0 + 40 = 90	**3.33**
Learner	30 + 12 + 3 + 41 = 86	**3.18**
Facilitator	31 + 41 + 92 + 5 = 169	**6.26**

If the views of all learners from both cohorts are considered (Table 6.10), then the most influential of the three factors is the Facilitator/Teacher, with almost double the average scores awarded for Course and Learner (6.26 compared with 3.33 and 3.18). This supports evidence from Section 6.2.3: QS1 (Table 6.3 and Figure 6.1) and Section 5.2.3: QS1 (Table 5.10 and Figure 5.4) that students/learners at both VIT and in senior secondary schools perceive the teacher as the dominant factor in influencing their progress.

Regarding preferred learning styles, the preferences expressed by the 2018 cohort match those they stated in QS2, with visual and verbal clearly ahead. Among the 2020 cohort, most did not respond to this question, so results are inconclusive.

QS4: Learner views on changes in their knowledge, skills, attitudes and behaviour

QS4 was designed for completion at the start and end of a course in resilience, eliciting views of participants. This was not possible for the 2018 cohort of learners until the start of this research project in October 2019, after they had already graduated from the Certificate III course. However, the 2020 cohort was able to answer QS4 at the beginning and end of their Certificate III in 2020. The 2021 cohort filled up the questionnaire as they commenced the Certificate I programme in March of 2021, and again as they transitioned from Certificate I to III in October that same year. Consequently, there are three groups for whom data has been collected, although as for QS1, it was only possible to obtain responses from approximately two thirds of each group: 13 learners from 2018, 10 from March 2020, 9 from December 2020, 22 from March 2021 and 14 from December 2021 – a total of 68 sets of responses from 45 learners.

The method of assigning numerical values to each of the 27 statements in QS4 and then calculating an average score for each item was identical to that already described for senior secondary students in Section 5.2.3. However, for VIT learners, it is possible to trace trends over a three year period, and for two of the cohorts, to evaluate change between the start and end of a resilience course.

Table 6.11 shows average scores for each item of QS4 for the VIT cohorts of 2018, 2020 (start and end of Certificate III) and 2021 (start and end of Certificate I), as well as average scores aggregated for the four aspects of resilience education – knowledge, skills, attitudes and behaviour. Figure 6.11 compares changes in the average scores for these four aspects between 2018 and 2021.

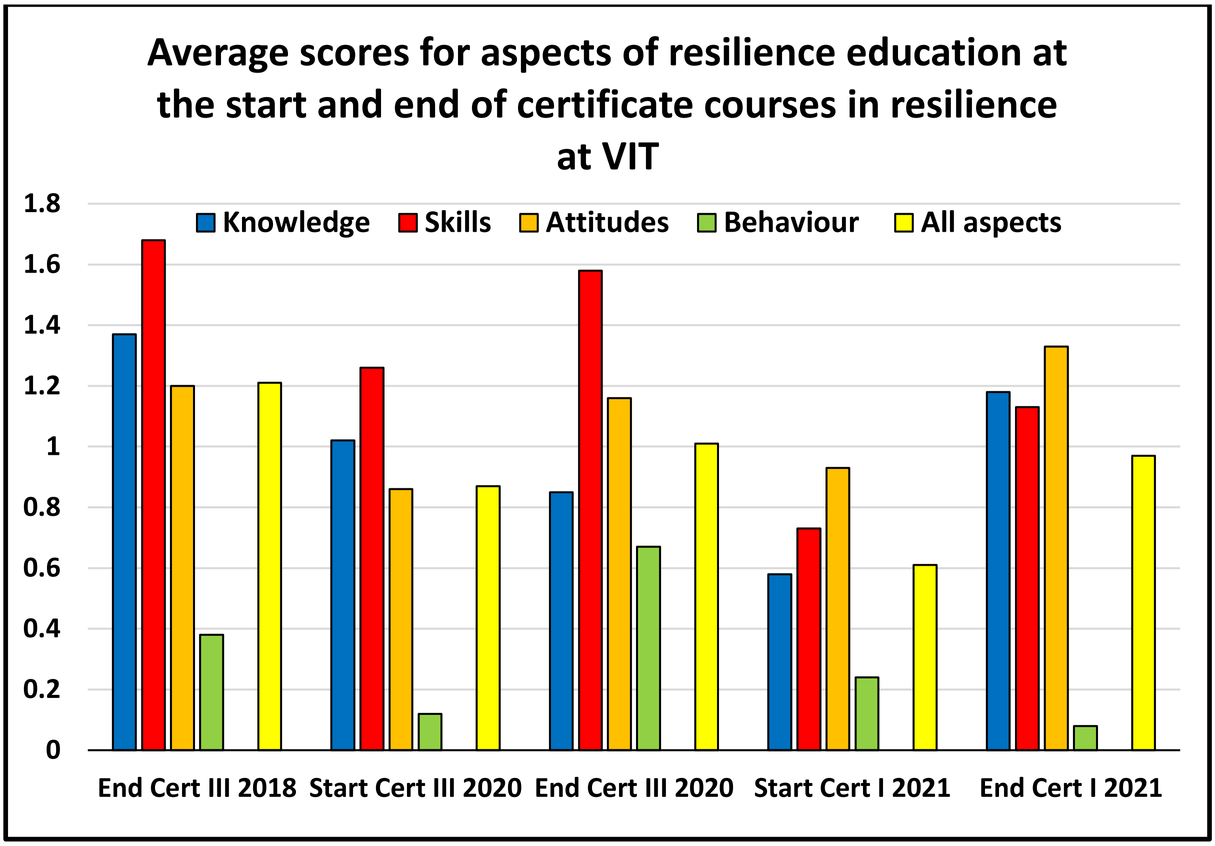
Overall, learners at the end of Certificate III in 2018 had higher scores for knowledge (1.37) and skills (1.68) than any other group, and the highest score for all aspects combined (1.21). Within knowledge statements, they were the only group of VIT and secondary school students to achieve positive scores for two of the three items that required respondents to disagree (Qs 3 and 7), and the highest score for the third item (Q9), suggesting a greater depth in their knowledge than that of other students. By the end of their resilience course, learners in the two later cohorts showed substantial improvements in skills and attitudes, with the 2021 group exceeding all others in attitudes (1.33). Also, the 2020 group recorded a higher score for behaviour (0.67) than any VIT or secondary school class surveyed.

Table 6.11 Average scores for VIT learners 2018-2021 for competencies relating to resilience education

		Question/Statement	Average score by cohort					
			2018 End CIII n=13	2020 Start CIII n=10	2020 End CIII n=9	2021 Start CI n=22	2021 End CI n=14	All End CI / III n=36
KNOWLEDGE	1.	Climate change is happening now, caused mainly by human activities	1.77	1.60	1.11	1.36	1.57	**1.53**
	2.	Ocean temperatures will get warmer in the future	1.77	1.40	1.11	0.05	1.64	**1.56**
	3.	Atmospheric concentrations of CO_2 are now < 400 ppm	0.38	-0.10	-0.89	-0.14	0.00	**-0.08**
	4.	Temperatures are rising most rapidly in the Arctic	1.46	1.00	1.22	0.82	0.86	**1.17**
	5.	Future changes in seasonal rainfall patterns are likely	1.54	1.60	1.67	0.86	1.36	**1.50**
	6.	Tree planting is an effective mitigation measure for CC	1.62	1.70	1.67	0.95	1.64	**1.64**
	7.	The best protection against sea level rise is a sea wall	0.31	-0.70	-1.00	-0.27	0.71	**0.14**
	8.	Ash falls affect food and water security	1.85	1.70	1.78	1.50	1.29	**1.61**
	9.	An earthquake is caused by a tsunami	1.38	0.20	0.44	0.41	0.86	**0.94**
	10.	Traditional knowledge helps us to adapt to CC	1.31	1.40	1.44	0.91	1.64	**1.47**
	11.	Climate change is really just a slow acting disaster	1.31	1.00	-0.11	-0.32	1.07	**0.86**
	12.	Children, women, elderly and handicapped people are the most vulnerable to disasters and climate change.	1.77	1.40	1.78	0.86	1.57	**1.69**
SKILLS	13.	I can give an awareness talk on disaster risk reduction	1.77	1.50	1.67	0.68	1.07	**1.47**
	14.	I can give an awareness talk on climate change	1.69	1.20	1.67	0.86	1.14	**1.47**
	15.	I can go to a community and draw a hazard risk map	1.62	1.20	1.56	0.64	1.36	**1.50**
	16.	I can demonstrate one way of adapting to CC	1.77	1.30	1.56	0.91	1.07	**1.44**
	17.	I can carry out a vulnerability survey in a village	1.54	1.10	1.44	0.55	1.00	**1.31**
ATTITUDES	18.	It is my responsibility to be prepared for disasters	1.46	1.20	1.33	1.45	1.57	**1.47**
	19.	It is the government's responsibility to reduce Vanuatu's carbon footprint	0.08	-0.50	-0.44	-0.41	-0.79	**-0.39**
	20.	I must help my community to prepare for CC	1.54	1.30	1.89	1.41	1.86	**1.75**
	21.	I must help to conserve biodiversity	1.62	1.20	1.67	1.23	2.00	**1.00**
	22.	I must consume more vegetables and fruit and reduce my intake of meat and processed food	1.31	1.10	1.33	0.95	2.00	**0.81**
BEHAVIOUR	23.	I plant tree seedlings	0.23	0.30	0.56	0.23	0.38	**0.22**
	24.	I talk about climate change with my family	0.62	0.30	0.67	0.14	0.46	**0.39**
	25.	I take part in demos to support action on CC	0.69	0.50	0.67	0.45	0.15	**0.42**
	26.	I look after vulnerable people during cyclones	0.77	0.00	1.11	1.00	-0.38	**0.56**
	27.	I assist the CDCCC in my community	-0.38	-0.50	-0.33	-0.64	-1.00	**-0.06**

Knowledge	1.37	1.02	0.85	0.58	1.18	**1.17**
Skills	1.68	1.26	1.58	0.73	1.13	**1.44**
Attitudes	1.20	0.86	1.16	0.93	1.33	**1.24**
Behaviour	0.38	0.12	0.67	0.24	0.08	**0.29**
All aspects	1.21	0.87	1.01	0.61	0.97	**1.07**

Figure 6.11 Average scores for aspects of resilience education at the start and end of certificate courses in resilience at the Vanuatu Institute of Technology 2018 to 2021



A more meaningful picture of the broad impact of VIT's TVET courses on participants is gained by calculating average scores for all three cohorts for individual items, for each category of items and for all aspects together (right-hand column of Table 6.11). An overall aggregate of 1.07 was achieved, which on a scale of -2 to +2 is equivalent to a moderately high level of effectiveness. Skills (1.44) achieved a notably higher score than other aspects.

To explain the high average scores for all five skills, we must acknowledge that the Certificates I and III courses were designed to develop such skills, with specific competencies documented in official documents. Table 6.12 compares the skill set listed in questionnaire QS4 with examples of required competencies from course outlines accredited by the Vanuatu Qualifications Authority.

Table 6.12 Relationship of skills listed in QS4 to required competencies in Resilience at VIT

Skill named in QS4		Module	Competency *(with examples of application)*
13.	I can give an awareness talk on disaster risk reduction	Module 7 Cert I CGRM0316	2.2 Knowledge of the main elements of disaster risk reduction is demonstrated. (*Present information both visually and verbally to individuals and groups on traditional methods of preventing and mitigating disaster risks; the meaning of preparedness, response and recovery; and DRR in a recent natural event.)*
14.	I can give an awareness talk on climate change	Module 4 Cert I CGCA0716	4.3 In consultation with a local community, a display of adaptation and mitigation measures that might be used in that community is prepared. *(Present information both visually and verbally, using hand-drawn illustrations and technology, to explain the difference between greenhouse gas (GHG) mitigation and climate change adaptation … and appropriate climate change adaptation measures for communities in Vanuatu.)*
15.	I can go to a community and draw a hazard risk map	Module 1 Cert I CGHR0116	5.1 There is clear identification of features of a local community that are at risk from natural and human-made hazards. (*Cooperate in a small group to produce a hazard and risk map and description of a community, identifying areas, assets and people at risk).*
		Module 15 Cert III CGRA0918	3.2 A hazard risk map of the chosen community is drawn.
16.	I can demonstrate one way of adapting to CC	Module 4 Cert I CGCA0716	4.4 There is consultation with a local community about the adaptation and mitigation measures it might wish to adopt, and participation in their implementation.
		Module 13 Cert III CGCB0718	3.2 A practical demonstration of at least one of the measures for responding to the impacts of climate change and disasters on food security is given.
17.	I can carry out a vulnerability survey in a village	Module 5 Cert I CGHV0116	4.1 A SWOT analysis of a community's assets of sustainable living is conducted. 4.2 The community's adaptive and coping capacity is assessed.
		Module 15 Cert III CGRA0918	3.3 Interviews are conducted with households and community leaders to collect information on past hazards and assess current vulnerability. 4.3 One or more reports on community vulnerability and resilience are compiled.

Sources: nomenclature of modules – VIT, 2021; competencies – VQA, 2018 & 2019

Table 6.13 compares average scores for the 2018 cohort of VIT learners with those for the two VIT cohorts who completed Certificates I and III (the column headed "All End CIII"), all three VIT cohorts combined ("All End CI/CIII") and with scores for all senior secondary students taking resilience courses in Geography, Development Studies and Earth Science (obtained from Table 5.18). The two right-hand columns of Table 6.13 reveal that VIT learners scored more highly than senior students overall (1.07 compared to 0.61), as well as for knowledge (1.17 to 0.63), attitudes (1.24 to 0.84), behaviour (0.29 to 0.08) and especially skills (1.44 to 0.86). The combined VIT cohorts outperformed the secondary students in eleven out of twelve knowledge items, all skills items, four out of five attitude items and all behaviour items, while secondary students were slightly ahead in knowledge item 1 and attitude item 18.

Table 6.13 Comparison between average scores at the end of resilience courses for VIT learners 2018-2021 and senior secondary students 2021

		Question/Statement	Average score			
			2018 End CIII n=13	All End CIII n=22	All End CI / III n=36	All sen. sec stds n=180
KNOWLEDGE	1.	Climate change is happening now, caused mainly by human activities	1.77	1.50	1.53	1.61
	2.	Ocean temperatures will get warmer in the future	1.77	1.50	1.56	1.08
	3.	Atmospheric concentrations of CO_2 are now < 400 ppm	0.38	-0.14	-0.08	-0.28
	4.	Temperatures are rising most rapidly in the Arctic	1.46	1.36	1.17	0.64
	5.	Future changes in seasonal rainfall patterns are likely	1.54	1.59	1.50	1.11
	6.	Tree planting is an effective mitigation measure for CC	1.62	1.64	1.64	1.02
	7.	The best protection against sea level rise is a sea wall	0.31	-0.23	0.14	-0.81
	8.	Ash falls affect food and water security	1.85	1.82	1.61	1.31
	9.	An earthquake is caused by a tsunami	1.38	1.00	0.94	-0.46
	10.	Traditional knowledge helps us to adapt to CC	1.31	1.36	1.47	0.73
	11.	Climate change is really just a slow acting disaster	1.31	0.73	0.86	0.46
	12.	Children, women, elderly and handicapped people are the most vulnerable to disasters and climate change.	1.77	1.77	1.69	1.12
SKILLS	13.	I can give an awareness talk on disaster risk reduction	1.77	1.73	1.47	0.97
	14.	I can give an awareness talk on climate change	1.69	1.68	1.47	1.01
	15.	I can go to a community and draw a hazard risk map	1.62	1.59	1.50	0.75
	16.	I can demonstrate one way of adapting to CC	1.77	1.68	1.44	0.73
	17.	I can carry out a vulnerability survey in a village	1.54	1.50	1.31	0.81
ATTITUDES	18.	It is my responsibility to be prepared for disasters	1.46	1.41	1.47	1.53
	19.	It is the government's responsibility to reduce Vanuatu's carbon footprint	0.08	-0.14	-0.39	-0.90
	20.	I must help my community to prepare for CC	1.54	1.68	1.75	1.31
	21.	I must help to conserve biodiversity	1.62	1.64	1.77	1.18
	22.	I must consume more vegetables and fruit and reduce my intake of meat and processed food	1.31	1.32	1.57	1.10
BEHAVIOUR	23.	I plant tree seedlings	0.23	0.36	0.37	0.22
	24.	I talk about climate change with my family	0.62	0.64	0.57	0.32
	25.	I take part in demos to support action on CC	0.69	0.68	0.49	0.22
	26.	I look after vulnerable people during cyclones	0.77	0.91	0.43	0.23
	27.	I assist the CDCCC in my community	-0.38	-0.09	-0.43	-0.59

Knowledge	**1.37**	**1.16**	**1.17**	**0.63**
Skills	**1.68**	**1.64**	**1.44**	**0.86**
Attitudes	**1.20**	**1.18**	**1.24**	**0.84**
Behaviour	**0.38**	**0.50**	**0.29**	**0.08**
All aspects	**1.21**	**1.13**	**1.07**	**0.61**

Table 6.14 shows that the difference between the overall scores for all items for VIT learners and senior secondary cycle students was significant. Using the Paired Samples t-test calculated with SPSS, the significant difference is demonstrated by a 2-tailed significance (p-value) less than 0.05, by a t-value of 7.834 – greater than the

critical value of 2.056 for a 95% confidence level – and by the range between lower an upper limits of the 95% confidence level not crossing 0.

Table 6.14 Determination of validity of difference between average score (all 27 items of QS4) for effectiveness of resilience courses for VIT cohorts and senior secondary students

Average score for all items	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
VIT all 3 cohorts	1.0674	27	0.67894					
All senior sec. stds	0.6081	27	0.70433					
Diff VIT-senior sec	0.4593	27	0.30460	0.33876	0.57976	7.834	26	0.000

N: number of items; Conf. Int: confidence interval; t: t-value; df: degrees of freedom

If VIT students are awarding higher scores for their resilience courses than are senior secondary students, the implication is that the former courses are more engaging. Nevertheless, these results need to be treated with caution because of the small sample size of the three VIT groups, which may account for the discrepancies noted in the progression of the 2020 and 2021 cohorts. We are also comparing results from a total of 36 VIT students with those from 180 senior secondary students.

Another factor to be mentioned is the positionality of myself as researcher. Before this research project began in October 2019, I was the consultant who created the Certificate I course in CCDRR and the Certificate III course in Resilience, in consultation with TVET authorities in Vanuatu and with advice from the external aid agencies GIZ and EU-PacTVET. The overall vision was to enable learners to acquire practical competencies in the field of resilience. When I had designed the units/modules and then actually delivered them, I witnessed that the learners did acquire these practical skills and saw at first hand that they could apply them at community level. Later, when deciding to research the whole field of resilience education in Vanuatu, these experiences influenced the design of questionnaires on how a formal learning programme would empower a participant to become an agent of change in his/her community. Hence the focus placed not only on knowledge, but on the ability to transmit this knowledge, and thus on skills, attitudes and behaviour. In particular, questionnaires QC1, QC2 and QS4 were influenced by this positionality. There may have been an unintended bias in the questions that resulted in the VIT respondents achieving higher scores than those from other groups.

6.3.3 Facilitator Views

As for senior secondary students, the views of VIT learners on the effectiveness of their courses can be supplemented by responses from the facilitators. There have been just three such facilitators to date, of whom one was the initial facilitator/course designer, myself.

Tables 6.15 and 6.16 show the results for QC1 and QC2 for resilience courses at VIT and in senior secondary schools. As already mentioned, QC1 is biased in favour of the VIT courses, so that 28 of the 41 items score maximum points. Among individual items, all three facilitators accorded the lowest scores (1.00) for “consumerism” and “eating habits”. The course designer, now the researcher, realizes that in conformity with the proposed model for resilience education (Figures 2.14 and 6.22), these two aspects should have been given higher weighting in course materials.

For QC2, facilitators’ responses are coherent with competency outlines for VIT’s resilience courses, endorsed by the VQA, especially for evaluation techniques and approaches. Table 6.16 demonstrates the contrast between the more student-centred teaching, learning and evaluation techniques used in the VIT resilience courses and the more traditional teaching, learning and evaluation techniques practiced in senior secondary schools. Table 6.17 shows how the techniques of evaluation specified in QC2 are linked to the use of the five evaluation techniques specified in course outlines for all modules in the Certificates I and III Resilience programmes. Notice how “recall” through summative assessment is only one of five evaluation techniques, and how “application” is measured through oral performance and oral/written reflection – both of which reinforce the internalisation of knowledge.

The learning from QC1 and QC2 is that in terms of perceived content, the VIT courses exhibit nearly all the characteristics of a desired educational programme in resilience, and feature a pedagogy that encourages experiential learning and formative assessment. In contrast, the senior secondary courses do not specialise in resilience issues, are more teacher-centred and place greater reliance on summative assessment. The overall effectiveness of each can be gauged by the score of 1.84 for VIT in QC1 as compared with 1.32 for senior secondary. Note, however, that the small size of the VIT facilitator sample may have distorted the results.

Table 6.15 Perceptions of course characteristics by 3 facilitators of Certificates I and III at VIT compared with those of 12 teachers of senior secondary students studying resilience

Does the course promote or teach these aspects of resilience education?			Perceived importance						
			VIT course facilitators (n = 3)						Av. score 12 senior sec. teachers
			High 2	Low 1	None -1	Don't know 0	Total score	Av. score	
Overall attitudes	1.	Moral qualities	11	1			5	1.67	1.42
	2.	Building on individual capacities	111				6	2.00	1.83
	3.	Service to others	111				6	2.00	1.50
	4.	Outward orientation	1	1		1	3	1.00	1.33
	5.	Equal treatment for all	111				6	2.00	1.58
	6.	Gender equality/ empowerment of women	111				6	2.00	1.25
	7.	Motivation to learn	11	1			5	1.67	1.75
Pedagogy	8.	Cooperative learning	11	1			5	1.67	1.92
	9.	Participatory learning	111				6	2.00	1.83
	10.	Constructivism	111				6	2.00	1.83
	11.	Field work	111				6	2.00	0.67
	12.	Experiential learning	111				6	2.00	1.33
Knowledge	13.	Meaning of resilience	111				6	2.00	1.58
	14.	Nature & causes of climate change (CC)	111				6	2.00	1.83
	15.	Nature and causes of disasters	111				6	2.00	1.83
	16.	Vulnerability	111				6	2.00	1.75
	17.	Impacts	111				6	2.00	1.83
	18.	Mitigation	111				6	2.00	1.83
	19.	Adaptation	111				6	2.00	1.67
	20.	Strategies for disaster risk reduction (DRR)	111				6	2.00	1.67
	21.	Climate injustice	111				6	2.00	0.75
	22.	Food and water security	111				6	2.00	1.17
	23.	Traditional knowledge	111				6	2.00	0.83
Skills	24.	Communication skills	111				6	2.00	1.42
	25.	Risk mapping	111				6	2.00	1.17
	26.	Literacy/numeracy	111				6	2.00	1.58
	27.	IT skills	1	11			4	1.33	0.83
	28.	Writing project proposals	111				6	2.00	0.17
	29.	Vulnerability /SWOT surveys	111				6	2.00	0.00
	30.	Community awareness	11	1			5	1.67	0.58
Attitudes	31.	Sustainable living	11	1			5	1.67	1.42
	32.	Pro-environmental attitudes	11	1			5	1.67	1.33
	33.	Holistic approach	11	1			5	1.67	1.17
	34.	Outward-looking orientation and openness	11	1			5	1.67	1.17
	35.	Avoiding consumerism		111			3	1.00	0.92
Behaviour	36.	Conservation of biodiversity	111				6	2.00	1.50
	37.	CC advocacy	111				6	2.00	0.92
	38.	Sharing knowledge of CC and/or DRR	111				6	2.00	1.25
	39.	Eating habits		111			3	1.00	0.92
	40.	Disaster preparedness	111				6	2.00	1.75
	41.	Other pro-environmental behaviours	11	1			5	1.67	1.08

Summary	Overall attitudes	1.76	1.52
	Pedagogy	1.93	1.52
	Knowledge	2.00	1.52
	Skills	1.86	0.82
	Attitudes	1.55	1.20
	Behaviour	1.78	1.24
	All	1.84	1.32

Table 6.16 Perceptions of teaching, learning and evaluation techniques being used by 3 facilitators of Certificates I and III at VIT compared with those by 12 teachers of senior secondary students studying resilience

	Aspect of resilience education	VIT course facilitators (n = 3)							12 sen. sec. teachers Av. score
		Never -2	Rarely -1	Some Times 0	Often +1	Always +2	Total score	Av. score	
	TEACHING AND LEARNING TECHNIQUES BEING USED								
1.	Interactive - teacher engages students in brainstorming and discussion on a given topic				1	11	5	**1.67**	**1.08**
2.	Surrogate experiential - use of simulations of real life events, e.g. role plays, photographs, films				1	11	5	**1.67**	**0.42**
3.	Field experiential - undertaking practical activities outside the classroom, e.g. hazard risk mapping				11	1	4	**1.33**	**- 0 83**
4.	Affective - students share their feelings and experiences of disaster events				11	1	4	**1.33**	**0.58**
5.	Enquiry - students obtain information from outside the classroom, e.g. through interviews, internet sites		1			11	3	**1.00**	**1.08**
6.	Action - active involvement of students in practical sessions					111	6	**2.00**	**0.42**
7.	Lecture - teacher provides information to the students in traditional teaching style			1	1	1	3	**1.00**	**1.17**
	EVALUATION TECHNIQUES BEING USED								
8.	Recall - assessing students on their ability to remember and reproduce what they have been taught					111	6	**2.00**	**1.08**
9.	Action-oriented - assessing students on how active they are in participating in the learning process, e.g. participating in a role play, demonstrating adaptation techniques					111	6	**2.00**	**0.00**
10.	Output-oriented - assessing students on their production of tangible substances, e.g. plans, posters with DRR messages, risk maps					111	6	**2.00**	**0.25**
11.	Knowledge acquisition - assessing students' ability to obtain information from other sources, e.g. internet, and to organise this information and present in a meaningful form				1	11	5	**1.67**	**1.08**
12.	Application - assessing students' ability to use knowledge they obtain in class to solve community problems, e.g. interactions with community				1	11	5	**1.67**	**0.67**
	APPROACHES TO EVALUATION								
13.	Class exercises / completion of workbooks				1	11	5	**1.67**	**1.50**
14.	Written tests/exams				1	11	5	**1.67**	**1.42**
15.	Demonstrations of skills and knowledge				1	11	5	**1.67**	**1.08**
16.	Homework			1		11	4	**1.33**	**1.17**
17.	Teacher follow-ups, e.g. asking questions in the next lesson					111	6	**2.00**	**1.42**
18.	Reflections				11	1	4	**1.33**	**1.33**
19.	Measuring oral contributions by students				11	1	4	**1.33**	**1.42**

Table 6.17 Comparison of evaluation techniques in QC2 with those in VIT course outlines

Evaluation techniques named in QC2		Evaluation techniques in course outlines
8.	Recall - assessing students on their ability to remember and reproduce what they have been taught	• Direct oral questioning combined with third party workplace or community reports of knowledge and performance by the learner • Direct observation during community contact (may be undertaken during field visits and/or using technology such as phone/video) • Review of any written documentation evidencing knowledge and skills (maps, workbook activities) • Oral and/or written reflections by learners • Written holistic/summative assessment.
9.	Action-oriented - assessing students on how active they are in participating in the learning process, e.g. participating in a role play, demonstrating adaptation techniques	
10	Output-oriented - assessing students on their production of tangible substances, e.g. plans, posters with DRR messages, risk maps	
11.	Knowledge acquisition - assessing students' ability to obtain information from other sources, e.g. internet, and to organise this information and present in a meaningful form	
12	Application - assessing students' ability to use knowledge they obtain in class to solve community problems, e.g. interactions with community	

6.3.4 Two Surveys Conducted with the First (2018) Certificate III Cohort

In September 2019, the Australia Pacific Climate Partnership, under the umbrella of Australian Aid, conducted an independent survey of the first cohort of VIT students to complete Certificate III in Resilience at VIT. This was part of a regional Climate Change Resilience Skills Audit to better understand how to reduce the gap between the supply and demand of climate change relevant skills in Pacific island labour markets (APCP & VIT, 2019). The aim was to capture the learners' experiences as they transitioned from their studies into the local labour market, with 20 of the 24 participants interviewed in person or by email.

Key findings from this survey, conducted just over one year after respondents had completed the Certificate III course, were as follows:

- Only four of the 20 graduates (20%) interviewed had obtained full-time paid employment in the public sector, with three of these working in the field of climate and resilience. Another four were working as volunteers.
- Most participants found the job-searching process challenging, but were optimistic that there was a labour market demand for the skills and knowledge gained through Certificate III. The majority of graduates wanted to work for civil

society organisation (90%) or a government department (65%). A strong preference for working in rural rather than urban areas was expressed.

- In terms of skills gained during the Resilience courses, most graduates were confident in applying knowledge of climate change (100%), including adaptation and mitigation, in public speaking (95%) and in community risk mapping (90%). Other demonstrated skillsets included preparation of project proposals and reports (65%), community-level stakeholder engagement (60%) and group facilitation (55%).
- The main skills gaps identified were on project budget management and the navigation of complicated application processes.
- The single largest barrier to entry into the labour market was identified as the lack of a clear pathway into the climate change sector, including internships or attachment programmes that could open up professional opportunities.

The high level of confidence expressed by learners in their skills resonates with the score of 1.68 on a scale of -2 to +2 calculated for skills for this same group when completing questionnaire QS4 (Table 6.11) and confirms the effectiveness of the initial TVET courses in resilience at VIT.

A second survey with the same group of students was conducted through email interviews as part of this research project between July and November 2021, three years after they had completed the Certificate III course. Graduates were asked about the impacts of their training on themselves and on their own communities, but only eight replied. Figure 6.12 displays the main questions asked, while Figures 6.13 to 6.16 and Table 6.18 show responses.

Of the eight graduates responding, four were now in full-time paid employment, one was working as a full-time voluntary community coordinator of resilience projects, two were studying at the University of the South Pacific for a degree in environmental management, and one was at home. The average age was 26.6 years.

Figure 6.12 E-mail questionnaire for Certificate III graduates on the impacts of their training

EMAIL INTERVIEW WITH THE FIRST CERTIFICATES I & III GRADUATES OF RESILIENCE COURSES AT THE VANUATU INSTITUTE OF TECHNOLOGY

1. Could you tell me something about yourself - your age, place of birth, where you grew up, the schools or institutions where you were educated?

2. When you participated in the Certificate I CCDRR course at VIT in 2017 and the Certificate III Resilience course at VIT in 2019, what do you feel are the main things that you learned? Can you write down two or three things under each of these headings?

   KNOWLEDGE (What information or understanding did you gain?)
   SKILLS (What can you do to show that you have gained knowledge, or what were you trained to do?)
   ATTITUDES (What beliefs and opinions did you gain?)
   BEHAVIOUR (What kinds of actions did you learn to take to help improve the environment and become more resilient to CC and Disasters?)

3. Have you been able to use your learnings from the two Resilience courses to help other people become more resilient to climate change and disasters? Can you give some details?

4. Looking back to the courses you took at VIT, do you think that they have helped you in general to have an impact on your local community? Please give some reasons for your answer.

5. Do you think traditional knowledge is important in helping people to become more resilient to climate change and disasters? Why do you say this?

6. a) Do you think that traditional knowledge should be taught in primary and secondary schools in Vanuatu?
   b) Why do you say this?
   c) How do you think it should be done in schools (who should do it, with what classes, etc.?)

7. Is there anything else you would like to tell me about the impact of your training on CCDRR/Resilience on you and on your community?

For question 2, graduates' perceptions of their most important learnings from the Certificates I and III courses are depicted in Figures 6.13 (knowledge), 6.14 (skills), 6.15 (attitudes) and 6.16 (behaviour). Each person could select up to three aspects of each, so in all four charts, the number of responses exceeds number of respondents. In their answers, graduates highlighted the importance of strategies for adaptation and mitigation, drawing on their field experience during Certificates I and III to identify skills and behaviours they had learned – coral re-planting, transplanting vetiver grass, establishing a community conservation area (CConA), revegetating shorelines with mangroves and other species, backyard gardening, recycling, tilapia farming, crop rotation, planting varieties of crops with different fruiting and harvesting seasons, and drawing risk maps. Capacity to explain climate change to others and carry out community awareness programmes also figured prominently among responses. The precision in graduates' thinking, three years after taking the resilience courses at VIT, suggests that their practical training had been effective. For attitudes gained, answers ranged from more personal feelings towards others (cooperation, helpfulness) to opinions on the importance of abstract concepts such as the environment, climate justice and traditional knowledge.

Figure 6.13 Responses from Certificates I and III graduates regarding the most important aspects of knowledge gained

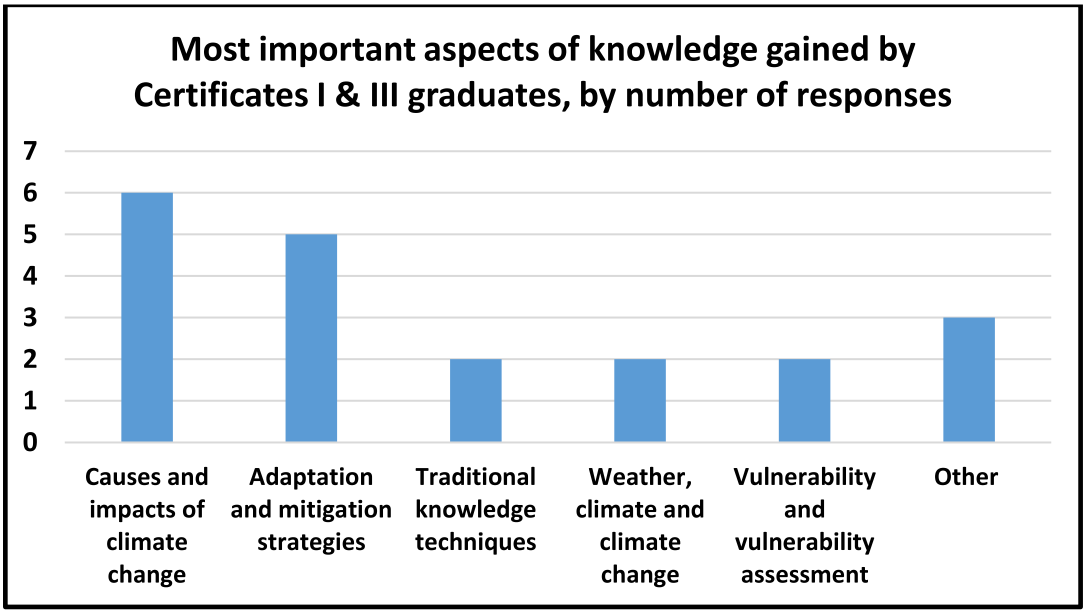


Figure 6.14 Responses from Certificates I and III graduates regarding the most important skills gained during training

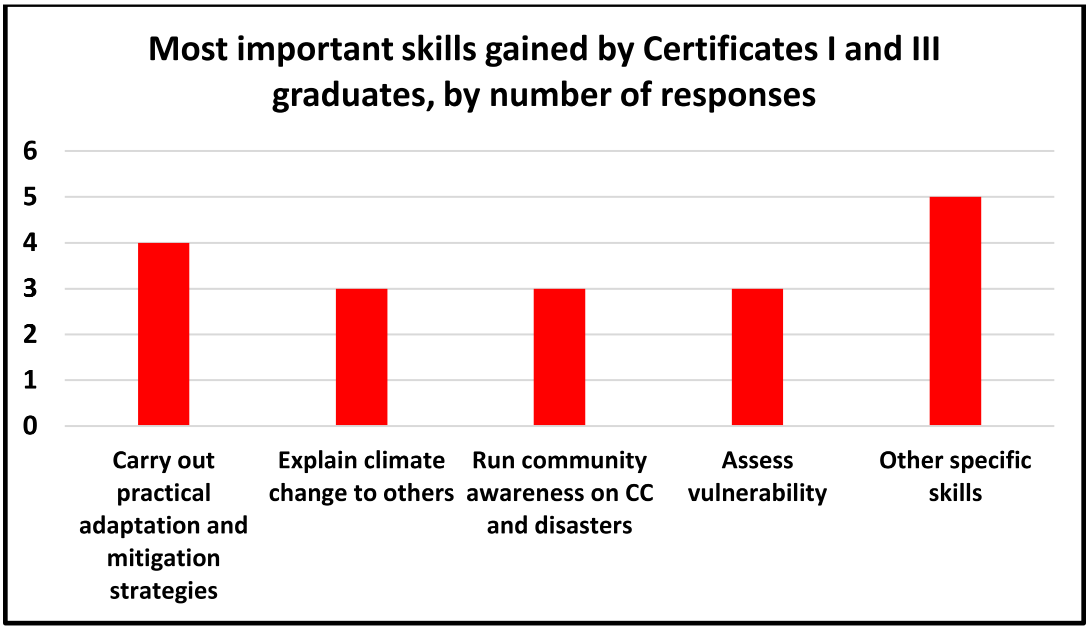


Figure 6.15 Responses from Certificates I and III graduates regarding the most important attitudes learnt during training

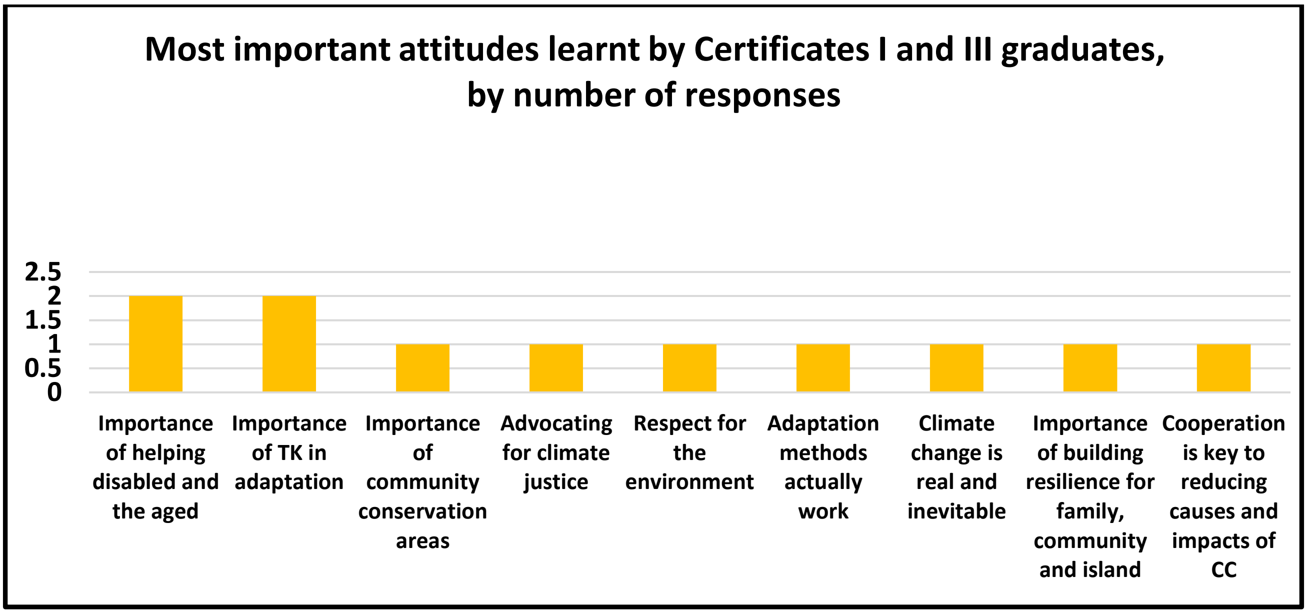
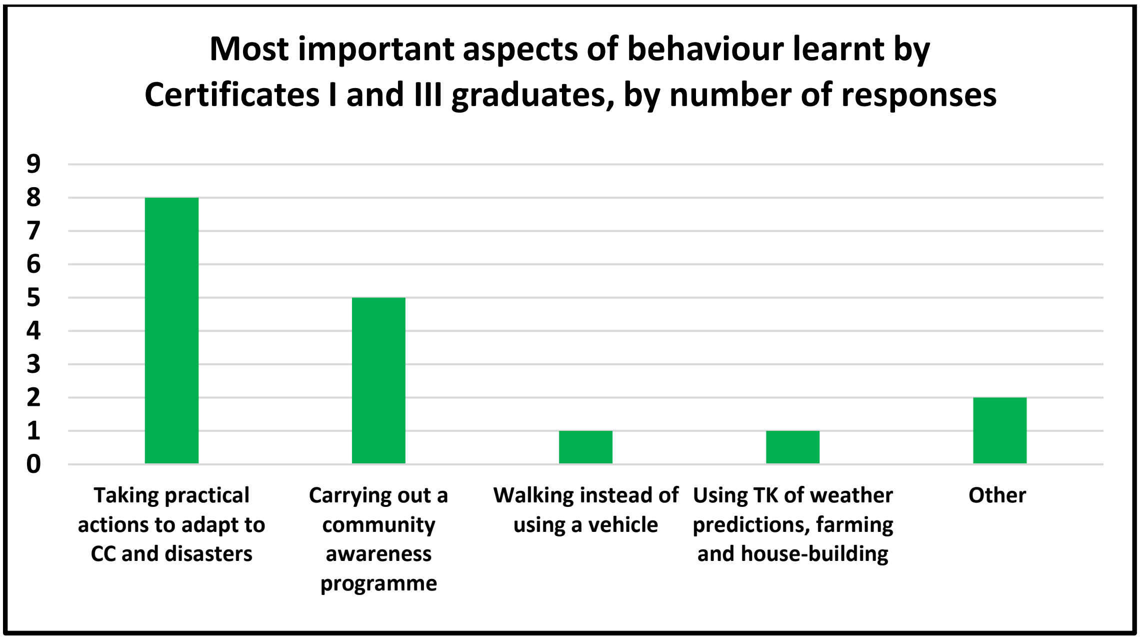


Figure 6.16 Responses from Certificates I and II graduates regarding the most important aspects of behaviour learnt during training



Questions 3 and 4 asked whether graduates' learnings had been used to help others at community level to become more resilient to climate change and disasters. Six graduates referred to knowledge they had shared with their communities, mentioning ways of promoting better food and water security, modern and traditional techniques of food preservation, traditional weather indicators, cyclone-proof housing, relocation of houses to higher ground and adjusting traditional planting seasons to new weather patterns. Five specified actions they had taken in named communities after graduating (Table 6.18), with the last four actions implemented by the same person.

Table 6.18 Examples of actions taken by Certificates I & III graduates to help others become more resilient to climate change

Location	Action
Luganville, Santo	Relocating a family food garden to higher ground because of flood risk
Tongoa & Emau	Conducting an awareness programme for Oxfam on Climate Change adaptation
Port Vila, Efate	Participating in climate action campaigns with the organisation 350 Vanuatu
Port Vila, Efate	Helping to organise a clean-up campaign
Eratap, Efate	Advising people about cyclone-proof housing
Mele, Efate	Making a hazard risk map and presenting it to the village council
West Coast Santo	Helping 12 communities to establish their own CDCCCs and CConAs
West Coast Santo	Organising a water supply project in Kerepua village, so improving food security
West Coast Santo	Establishing the Tabwemasana Community Conservation Area (done after Cert 1)
West Coast Santo	Helping to set up the West Coast Santo Sunset Environment Network

Responses to questions 5 and 6, on traditional knowledge and school curricula, were unanimously positive and will be mentioned in Chapter 7.

Question 8 asked for other observations from graduates about the impact of their resilience education on themselves and on their communities. Four responses stated specific knowledge or skills acquired, four mentioned generic knowledge gained, and three explained how the training had impacted them personally, exemplified by the following statement from one of the two graduates who are now following a degree course:

> I have not just gained knowledge and skills from the course, but the course itself has moulded and shaped me into being a full person, to be confident, passionate, committed and responsible in fighting for whatsoever that's valuable to me, which is preserving and protecting the Earth.
>
> Certificate I/III female graduate, 2018 cohort

Research Question 1 examines the effectiveness of a formal education programme in resilience in terms of impacts on individuals and their communities. The above responses show that this group of eight learners has had an impact on local populations, both during and following their courses. They constituted only one third of the 2018 cohort who completed Certificate III, and it may be that this was a sample of the "willing", unrepresentative of the whole. Nevertheless, their actions demonstrate the effectiveness of the VIT Certificates I/III in Resilience in motivating learners to have an outward-looking orientation and channel their knowledge and skills down to grassroots level.

6.3.5 Summary and Discussion

Overall, we can conclude that the TVET Certificates in CCDRR and Resilience have answered Research Question 1 by demonstrating a high degree of effectiveness on individuals and a degree of impact on communities. Despite a decline in efficacy after the initial courses were delivered, the average performance level for all cohorts in the first four years of the programme shows how their knowledge, attitudes, behaviour and especially skills have advanced as a result of exposure to contextualized learning materials and involvement in practical activities. However, in view of the relatively small output of students involved (approximately 20 graduates per year), the impact of these courses on Vanuatu's rural communities will remain limited unless participation can be numerically and geographically extended.

6.4 Other TVET Courses: Pacific Regional Certificates in Resilience

The Pacific Regional Certificates I to IV in Resilience (Climate Change and Disaster Risk Reduction) at TVET level were developed during 2016-17 at the same time as the Vanuatu's own TVET Resilience courses were being created and delivered at VIT. As in Vanuatu, the Pacific certificates were initiated through the European Union-Pacific Technical and Vocational Education and Training (EU-PacTVET) programme sponsored by the EU, the Pacific Community and the University of the South Pacific (USP). As TVET courses, they were endorsed by the Pacific Regional Resilience Industry Standards Advisory Committee (PRR-ISAC) in Nadi, Fiji, and accredited under the Pacific Community's Education Quality Assessment Programme (EQAP), also based in Fiji. The regional certificates are generic in content at levels I and II, but at levels III and IV have elective strands in specialised fields – agriculture, coastal management, energy and infrastructure, fisheries, forestry, health, tourism and water resources. By 2020, Certificates I and II were combined as Certificate II, and Certificate III became "nested" in Certificate IV. There are now 22 compulsory unit standards in Cert IV (Table 6.19), of which six are at level III; of the remaining 16, nine relate to the elective fields, of which a learner selects just one from Unit CR400F.

Table 6.19 Course content of Certificate IV in Resilience from 2020 onwards

Certificate IV in Resilience	
Unit	**Title**
Generic skills Units	
CG300A	Apply workplace health and safety procedures in the workplace
CG300B	Communicate with a Pacific Island community on matters of Resilience
CG400A	Administer health and safety plans for a team in the workplace
CG400B	Communicate effectively with resilience stakeholders at a local level
Core skills Units	
CR300A	Analyse information to identify climate and disaster related hazards
CR300B	Demonstrate knowledge of risk assessment in a resilience context
CR300C	Demonstrate knowledge of the drivers of climate variability and their effects in the Pacific Region
CR300D	Describe the institutional frameworks used at global, regional, and national levels for resilience
CR400A	Apply knowledge of comprehensive risk and vulnerability assessment
CR400B	Apply knowledge of core sustainability concepts for resilience
CR400C	Support projects in resilience
CR400D	Conduct a simple vulnerability assessment for a community
CR400E	Apply knowledge of institutional frameworks to a Pacific Island Country and a resilience project
CR400F-Ag	Demonstrate knowledge of resilience in an agriculture context
CR400F-Fi	Demonstrate knowledge of resilience in a fisheries context
CR400F-CM	Demonstrate knowledge of resilience in a coastal management context
CR400F-Fo	Demonstrate knowledge of resilience in a forestry context
CR400F-WR	Demonstrate knowledge of resilience in a water resources context
CR400F-He	Demonstrate knowledge of resilience in a health context
CR400F-EI	Demonstrate knowledge of resilience in an energy and infrastructure context
CR400F-To	Demonstrate knowledge of resilience in a tourism context
CR400F-HS	Demonstrate knowledge of resilience in a human settlements context

In 2020, USP began offering Certificate IV online for students in Vanuatu, Solomon Islands, Fiji and Papua New Guinea, with course fees paid by USAid under its Climate Ready and Resilience Education programme. The course was aimed at people already working in a resilience-related field or those with relevant work experience wishing to pursue a career in resilience (PRR-ISAC, 2016).

In March 2020, 43 students embarked upon this semester-long course through USP's Vanuatu campuses, but despite being fully-funded, only 20 successfully graduated. According to the Campus Coordinator of the USP's Pacific Technical and Further Education (TAFE) programmes in Port Vila, the students faced difficulties in completing their assignments since nearly all of them were in full-time employment, and this was one reason why so many dropped out. This was confirmed to me through personal emails from two of the participants, typified by this response:

> I did not complete the course because I'm fully committed to my workload as a Resilience Officer for CARE Vanuatu, and have not had enough time for course work. Sometimes I need to travel for two weeks to TAFEA outer islands where there is no or limited internet connectivity, and so I cannot do my weekly classwork.
>
> (Enrolee in Cert IV in Resilience in March 2020, email interview on 26th January 2022)

A third student invoked other factors:

> I did not continue the Certificate IV course because firstly, I found the academic level too low since I already knew most of the concepts and issues, and secondly, the course did not motivate students to take action and do something about climate change.
>
> (Enrolee in Cert IV in Resilience in March 2020, email interview on 24th January 2022)

Subsequent cohorts of Vanuatu students to take Certificate IV through USP Pacific TAFE have had reduced numbers – 15 in 2021 and a maximum of 20 expected in 2022. All cohorts in USP's operating countries continue to be sponsored by USAid, the European Union and other donor partners.

To gather data on the effectiveness of Certificate IV in Resilience, I sent questionnaires to the 43 participants enrolled in the course in 2020, but received feedback from just six learners and two on-line Fiji-based facilitators. This sample is inadequate, yet enables us to glimpse the challenges and benefits of an on-line learning environment during the COVID-19 pandemic.

To evaluate the effectiveness of the Certificate IV course itself, I used responses to questionnaires QC1 and QC2 from the initial facilitator (midway through the course), the current facilitator and two learners from 2020: one of these completed the questionnaires at the start of the course, without really experiencing its content or methodology; the other learner, a degree holder now employed as an executive for an international NGO, responded insightfully almost 18 months after successfully graduating from the course. Tables 6.20 and 6.21 compare findings with those from the other TVET course surveyed – Certificates I & III at the Vanuatu Institute of Technology (extracted from Tables 6.15 and 6.16).

When assessing the relative importance of various aspects of resilience education in the Certificate IV course (Table 6.20), all four respondents were in full agreement over the high importance of approximately one quarter of all items (11 of 41). The two facilitators were in agreement over the high importance of 25 items and the low importance of fieldwork. In 14 items, the experienced learner differed from the other three by ranking these items of low or no importance. Her assessment appears to be confirmed by the official statement of course content (Table 6.19), which suggests that aspects such as climate injustice, traditional knowledge, risk mapping, basic literacy/numeracy, IT skills and avoidance of consumerism are not part of the Certificate IV course, presumably because the learner is supposed to know them already through Certificate III units or previous experience of resilience education.

If average scores are compared with those for TVET Certificates 1 & III at VIT (Table 6.20), there was broad correspondence in attitudes, lower correspondence for overall attitudes and behaviour, and significant differences in pedagogy, knowledge and especially skills, with Certificates I & III much higher. Also, within pedagogy, the Certificate IV course scored significantly less for fieldwork (0.75 compared to 2.00).

Table 6.20 Perceptions of characteristics of TVET Certificate IV in Resilience at USP and TVET Certificate I/III in Resilience at the Vanuatu Institute of Technology

Does the course promote or teach these aspects of resilience education?			Perceived importance						
			TVET Cert IV @ USP						Av. score TVET Cert I & III @ VIT
			High 2	Low 1	None -1	Don't know 0	Total score (T)	Av. score (T/4)	
Overall attitudes	1.	Moral qualities	FL*	FL			6	1.50	1.67
	2.	Building on individual capacities	FFLL				8	2.00	2.00
	3.	Service to others	FLL	F			7	1.75	2.00
	4.	Outward orientation	FFLL				8	2.00	1.00
	5.	Equal treatment for all	FFL		L		5	1.25	2.00
	6.	Gender equality/ empowerment of women	FLL	F			7	1.75	2.00
	7.	Motivation to learn	FLL	F			7	1.75	1.67
Pedagogy	8.	Cooperative learning	FFLL				8	2.00	1.67
	9.	Participatory learning	FFLL				8	2.00	2.00
	10.	Constructivism	FFL	L			7	1.75	2.00
	11.	Field work	L	FF	L		3	0.75	2.00
	12.	Experiential learning	FFLL				8	2.00	2.00
Knowledge	13.	Meaning of resilience	FFLL				8	2.00	2.00
	14.	Nature & causes of climate change (CC)	FFL	L			7	1.75	2.00
	15.	Nature and causes of disasters	FFL	L			7	1.75	2.00
	16.	Vulnerability	FFLL				8	2.00	2.00
	17.	Impacts	FFL	L			7	1.75	2.00
	18.	Mitigation	FFLL				8	2.00	2.00
	19.	Adaptation	FFLL				8	2.00	2.00
	20.	Strategies for disaster risk reduction (DRR)	FLL	F			7	1.75	2.00
	21.	Climate injustice	FFL		L		5	1.25	2.00
	22.	Food and water security	FFL	L			7	1.75	2.00
	23.	Traditional knowledge	FFL		L		5	1.25	2.00
Skills	24.	Communication skills	FFL	L			7	1.75	2.00
	25.	Risk mapping	FL	F	L		4	1.00	2.00
	26.	Literacy/numeracy	FL	F	L		4	1.00	2.00
	27.	IT skills	FL	F	L		4	1.00	1.33
	28.	Writing project proposals	FLL	F			7	1.75	2.00
	29.	Vulnerability /SWOT surveys	FL	F L			6	1.50	2.00
	30.	Community awareness	FFL		L		5	1.25	1.67
Attitudes	31.	Sustainable living	FFL	L			7	1.75	1.67
	32.	Pro-environmental attitudes	FFL	L			7	1.75	1.67
	33.	Holistic approach	FFL			L	6	1.50	1.67
	34.	Outward-looking orientation & openness	FFLL				8	2.00	1.67
	35.	Avoiding consumerism	FL	F		L	5	1.25	1.00
Behaviour	36.	Conservation of biodiversity	FLL	F			7	1.75	2.00
	37.	CC advocacy	FFL	L			7	1.75	2.00
	38.	Sharing knowledge of CC and/or DRR	FFLL				8	2.00	2.00
	39.	Eating habits	L	FL	F		3	0.75	1.00
	40.	Disaster preparedness	FLL	F			7	1.75	2.00
	41.	Other pro-environmental behaviours	FL			FL	4	1.00	1.67

* **F** = Facilitator **L** = Learner

Summary	Overall attitudes	1.71	1.76
	Pedagogy	1.70	1.93
	Knowledge	1.75	2.00
	Skills	1.32	1.86
	Attitudes	1.65	1.55
	Behaviour	1.50	1.78
	All	1.62	1.84

Table 6.21 Perceptions of teaching, learning and evaluation techniques used in TVET Certificate IV at USP and TVET Certificates I & III at VIT

Aspect of resilience education		TVET Cert IV @ USP							Av. score TVET Cert I & III @ VIT
		Never -2	Rarely -1	Some-times 0	Often +1	Always +2	Total Score (T)	Av. score (T/4)	
TEACHING AND LEARNING TECHNIQUES BEING USED									
1.	Interactive - teacher engages students in brainstorming and discussion on a given topic		L		FFL		2	0.50	1.67
2.	Surrogate experiential - use of simulations of real life events, e.g. role plays, photographs, films	L			FL	F	2	0.50	1.67
3.	Field experiential - undertaking practical activities outside the classroom, e.g. hazard risk mapping	LL		FF			-4	-1.00	1.33
4.	Affective - students share their feelings and experiences of disaster events			L	L	FF	5	1.25	1.33
5.	Enquiry - students obtain information from outside the classroom, e.g. through interviews, internet sites					FFLL	8	2.00	1.00
6.	Action - active involvement of students in practical sessions	LL			FF		-2	-0.50	2.00
7.	Lecture - teacher provides information to the students in traditional teaching style	LL			FF		-2	-0.50	1.00
EVALUATION TECHNIQUES BEING USED									
8.	Recall - assessing students on their ability to remember and reproduce what they have been taught			F	F	LL	5	1.25	2.00
9.	Action-oriented - assessing students on how active they are in participating in the learning process, e.g. participating in a role play, demonstrating adaptation techniques			L	F	FL	5	1.25	2.00
10.	Output-oriented - assessing students on their production of tangible substances, e.g. plans, posters with DRR messages, risk maps				FL	FL	6	1.50	2.00
11.	Knowledge acquisition - assessing students' ability to obtain information from other sources, e.g. internet, and to organise this information and present in a meaningful form				F	FLL	7	1.75	1.67
12.	Application - assessing students' ability to use knowledge they obtain in class to solve community problems, e.g. interactions with community	L			FL	F	2	0.50	1.67
APPROACHES TO EVALUATION									
13.	Class exercises / completion of workbooks	L		F		FL	2	0.50	1.67
14.	Written tests/exams			FF	L	L	3	0.75	1.67
15.	Demonstrations of skills and knowledge				FL	FL	6	1.50	1.67
16.	Homework	F	F			LL	1	0.25	1.33
17.	Teacher follow-ups, e.g. asking questions in the next lesson			FF	L	L	3	0.75	2.00
18.	Reflections		L		F	FL	4	1.00	1.33
19.	Measuring oral contributions by students	L	F		F	L	0	0.00	1.33

* **F** = Facilitator **L** = Learner

For teaching, learning and evaluation techniques and approaches (Table 6.21), the divergence between the four respondents was greater, with full agreement between them achieved in just one item out of 19 – that enquiry learning is constantly being used. The two facilitators agreed with each other in six of the seven teaching/learning techniques and in two of the approaches to evaluation, but in none of the evaluation techniques. For teaching, learning and evaluation techniques, the two learners tended to be harsher in their judgements than the facilitators, for example downgrading the incidence of fieldwork, practical sessions and lectures. Perhaps the widely diverging assessments arose because of different understandings of terms used, for example “application”, “homework”, “teacher follow-ups” and “measuring oral contributions by students”. The extreme variation between responses may suggest that the results cannot be meaningfully interpreted: certainly, they showed minimal correspondence to scores for TVET Certificates I & III at VIT, with only aspects 4 (affective learning), 11 (knowledge acquisition) and 15 (demonstrations of skills and knowledge) having some equivalence.

In summary, evidence from survey respondents shows that Certificate IV in Resilience is more effective than Certificates I & III in the promotion of attitudes, has similar effectiveness regarding overall attitudes for building climate and hazard resilience, but lags behind in fostering practical skills and fieldwork at community level, as well as in knowledge, behaviour and pedagogical approaches. For knowledge, one reason could be that questionnaire QC1 was designed to measure the range of information expected from any course in resilience rather than to pick up the nuances of theoretical knowledge that appear in higher level courses. For skills and pedagogical approaches, these become more visible in a face-to-face course than in on-line studies. However, my findings need to be treated with caution. Firstly, data was collected from very small samples: for Certificates I & III, only three informants – the course designer/ initial facilitator and two later facilitators – while for Certificate IV, just four, all with diverging opinions on the teaching, learning and evaluation techniques used. Secondly, it is perhaps unfair to judge Certificate IV by the measures listed in questionnaire QC1, since the aim of this course is to provide training for people already working in the field of resilience, focusing on risk assessment and the administration of projects to address risk reduction and adaptation in specialized fields.

Turning now to evaluation by the learners themselves of the effectiveness of Certificate IV in terms of course materials and delivery and through knowledge, skills, attitudes and behaviours gained, we must again acknowledge that data collection came from a very small sample size – just six participants.

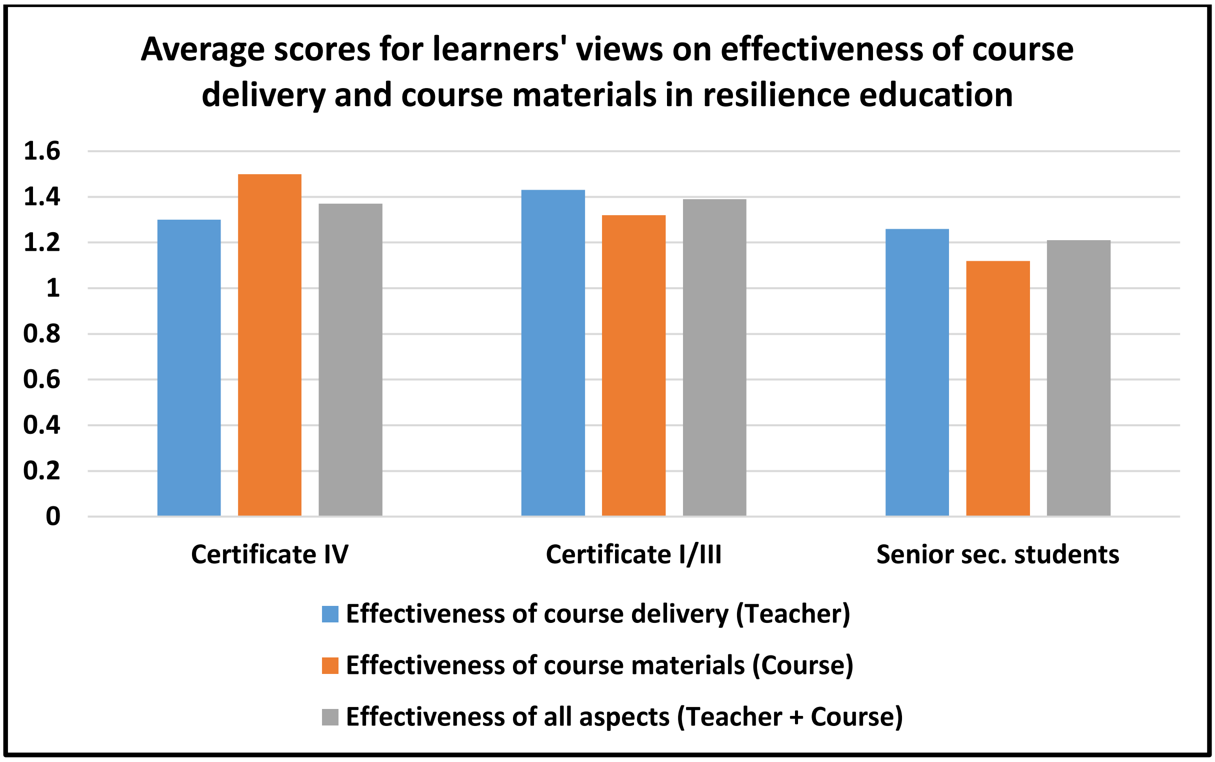
Regarding the effectiveness of materials and course delivery (Table 6.22 and Figure 6.17), as measured by questionnaire QS1, Certificate IV Resilience learners' overall assessment of their course was 1.37 on a scale of +2 to -2 – a similar score to that given by learners in Certificates 1 and III at the Vanuatu Institute of Technology (1.39). However, in contrast to the VIT learners and senior secondary school students, their score for course materials (1.50) was significantly higher than their score for facilitator effectiveness (1.30). This is not surprising since in 2020, Certificate IV was delivered on-line only, with the Fiji-based facilitator unable to make planned visits for face-to-face sessions with the Vanuatu group because of travel restrictions. This is also reflected by statement 30, for which the response of Certificate IV learners (-0.40) demonstrates their view that learning materials are much more important than the facilitator's delivery – while scores for the other two groups underline the importance of the teacher as opposed to materials. Also, the only other negative score for Certificate IV learners was for the teacher's use of use of visual materials in delivery (-0.20), again in contrast with scores for the other two groups. For Certificate IV learners, nearly all other characteristics of course materials (statements 21 to 29) gained much higher scores than those awarded by Certificate I/III learners and school students, implying that for them, these aspects of the programme were highly effective.

Table 6.22 Average scores for Certificate IV learners' views on effectiveness of course delivery and course materials in resilience education, compared with those of learners taking Certificates I / III and senior secondary students

	Question/Statement	Average scores within a range of -2.0 to +2.0		
		TVET Certificate IV learners n = 5	TVET Certificate I & III learners n = 37	Senior secondary students n = 180
1.	The teacher/facilitator is knowledgeable	1.20	1.57	1.35
2.	The teacher/facilitator is well prepared	1.80	1.43	1.34
3.	The teacher/facilitator comes on time	1.20	1.19	1.01
4.	The teacher/facilitator is enthusiastic	1.60	1.46	0.99
5.	The teacher/facilitator is creative	1.80	1.54	1.29
6.	The teacher/facilitator is well organised	1.40	1.43	1.24
7.	The teacher/facilitator uses visual materials	-0.20	1.22	0.89
8.	The teacher/facilitator is approachable	1.20	1.30	1.18
9.	The teacher/facilitator treats us as individuals	0.60	1.03	0.74
10.	The teacher/facilitator values my contributions	1.40	1.19	1.13
11.	The teacher/facilitator shows compassion	1.40	1.43	1.13
12.	The teacher/facilitator is helpful	2.00	1.59	1.67
13.	The teacher/facilitator communicates clearly	1.40	1.68	1.58
14.	The teacher/facilitator explains new concepts	1.80	1.54	1.45
15.	The teacher/facilitator makes me think	1.80	1.43	1.28
16.	The teacher/facilitator asks us questions	1.00	1.54	1.52
17.	The teacher/facilitator makes us participate	1.60	1.68	1.43
18.	The teacher/facilitator participates in the activities	0.00	1.46	1.22
19.	The teacher/facilitator promotes cooperative learning	1.80	1.49	1.51
20.	The teacher/facilitator checks up on our progress	1.20	1.38	1.24
21.	The course/lesson stimulates my interest in CC/ DRR	1.80	1.30	0.88
22.	The learning materials are exciting and appropriate	1.60	1.16	0.73
23.	I am encouraged to be responsible for my own learning	1.80	1.22	1.34
24.	I know how to prepare for all kinds of disaster	1.20	1.22	1.01
25.	I know ways to mitigate and adapt to climate change	1.80	1.32	1.11
26.	I learn new skills through the course/lessons	1.80	1.51	1.44
27.	I want to put my learning into action	1.80	1.54	1.28
28.	I am ready to take action on climate change	1.80	1.46	1.03
29.	I am ready to help others understand about disaster risk	1.80	1.43	1.19
30.	The way that the teacher/facilitator delivers the lesson is more important than the learning materials used.	-0.40	1.05	1.17

Effectiveness of course delivery (Teacher)	**1.30**	**1.43**	**1.26**
Effectiveness of course materials (Course)	**1.50**	**1.32**	**1.12**
Effectiveness of all aspects (Teacher + Course)	**1.37**	**1.39**	**1.21**

Figure 6.17 Comparison of average scores for learners' views on effectiveness of course materials and course materials in resilience education taking place through USP, VIT and senior secondary schools



Questionnaire QS1 also posed three open-ended questions to the five learners. For the first, "Give three reasons why you enjoyed this course", the most common category of response was an appreciation of teaching and learning strategies used, exemplified by the promotion of cooperative learning within country (albeit on-line), and flexibility in timing for submission of assessments. With the second question, "State the three most important things you have learned from the course", the acquisition of specific knowledge had the greatest number of responses, just as with Certificates I & III at VIT. Learners felt that the writing of a project proposal and risk assessment report had been the most significant, with cost-benefit analysis and safety in the work place also mentioned. Regarding the final question, "How could this course be improved", three of the five learners wanted to have face-to-face sessions in order to clarify understanding, while the other two had no response.

For the evaluation of knowledge, skills, attitudes and behaviour through questionnaire QS4, (Figure 6.18 and Table 6.23), the overall average score for all aspects awarded by Certificate IV learners (1.13) was slightly higher than that given by Certificate I/III learners (1.07) and greatly exceeded that of senior secondary students (0.61). In comparison with Certificate I/III learners, the Certificate IV group had significantly higher scores in skills and attitudes, were slightly higher for behaviour, and lower for knowledge. The high score for skills contrasts markedly with the findings shown in Table 6.20, where skills are perceived by facilitators as being the weakest of course characteristics. Perhaps the reason for this discrepancy is that while specific practical skills for conducting community awareness of climate change and disasters, mitigation and adaptation techniques, risk mapping and conducting vulnerability surveys are not formally part of the Certificate IV course, the learners participating in the survey of that course perceived that they already had those skills through their work experience or previous exposure to resilience education.

Figure 6.18 Comparison of average scores in knowledge, skills, attitudes and behaviour for learners in resilience courses at USP, VIT and senior secondary schools

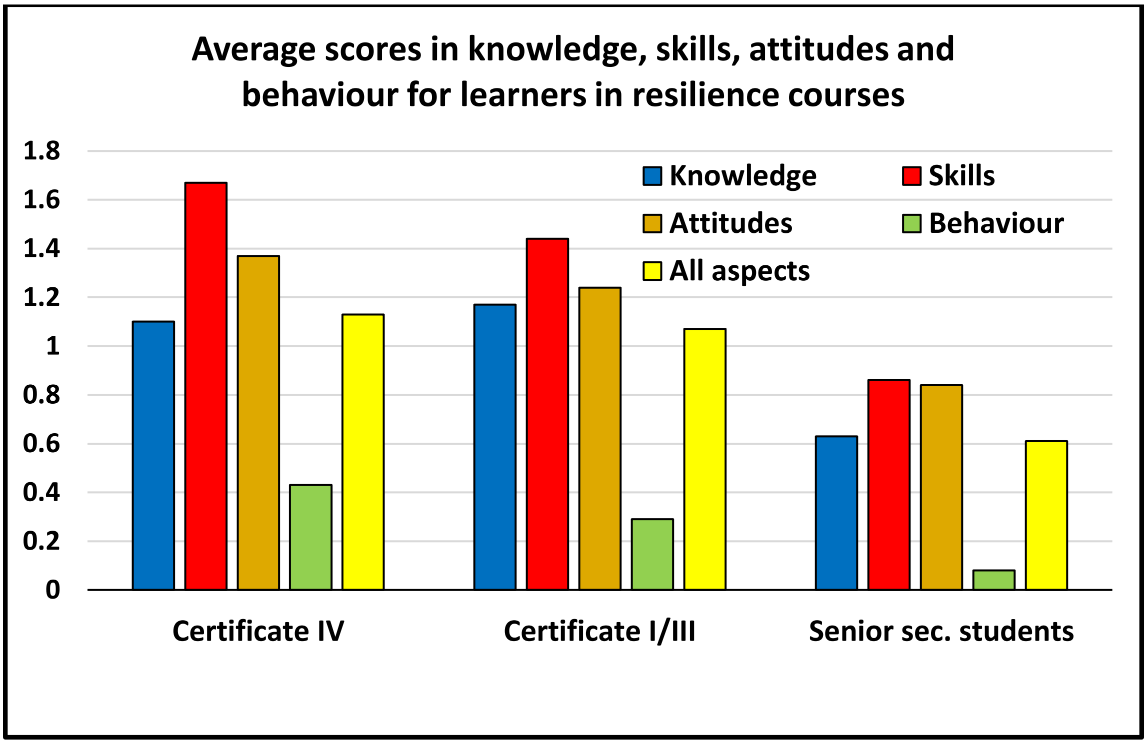


Table 6.23 Average scores in knowledge, skills, attitudes and behaviour for Certificate IV USP learners of resilience as compared with those for Certificate I/III VIT learners and senior secondary students

		Question/Statement	Average score		
			TVET Certificate IV learners n = 6	TVET Certificates I & III learners n = 36	Senior secondary students n = 180
KNOWLEDGE	1.	Climate change is happening now, caused mainly by human activities	1.67	1.53	1.61
	2.	Ocean temperatures will get warmer in the future	1.83	1.56	1.08
	3.	Atmospheric concentrations of CO_2 are now < 400 ppm	-1.67	-0.08	-0.28
	4.	Temperatures are rising most rapidly in the Arctic	1.83	1.17	0.64
	5.	Future changes in seasonal rainfall patterns are likely	1.83	1.50	1.11
	6.	Tree planting is an effective mitigation measure for CC	1.67	1.64	1.02
	7.	The best protection against sea level rise is a sea wall	-0.67	0.14	-0.81
	8.	Ash falls affect food and water security	1.83	1.61	1.31
	9.	An earthquake is caused by a tsunami	0.33	0.94	-0.46
	10.	Traditional knowledge helps us to adapt to CC	1.50	1.47	0.73
	11.	Climate change is really just a slow acting disaster	1.00	0.86	0.46
	12.	Children, women, elderly and handicapped people are the most vulnerable to disasters and climate change.	2.00	1.69	1.12
SKILLS	13.	I can give an awareness talk on disaster risk reduction	1.67	1.47	0.97
	14.	I can give an awareness talk on climate change	1.67	1.47	1.01
	15.	I can go to a community and draw a hazard risk map	1.67	1.50	0.75
	16.	I can demonstrate one way of adapting to CC	1.50	1.44	0.73
	17.	I can carry out a vulnerability survey in a village	1.83	1.31	0.81
ATTITUDES	18.	It is my responsibility to be prepared for disasters	2.00	1.47	1.53
	19.	It is the government's responsibility to reduce Vanuatu's carbon footprint	-0.33	-0.39	-0.90
	20.	I must help my community to prepare for CC	1.83	1.75	1.31
	21.	I must help to conserve biodiversity	1.83	1.77	1.18
	22.	I must consume more vegetables and fruit and reduce my intake of meat and processed food	1.50	1.57	1.10
BEHAVIOUR	23.	I plant tree seedlings	-0.50	0.37	0.22
	24.	I talk about climate change with my family	1.00	0.57	0.32
	25.	I take part in demos to support action on CC	1.17	0.49	0.22
	26.	I look after vulnerable people during cyclones	0.00	0.43	0.23
	27.	I assist the CDCCC in my community	0.50	-0.43	-0.59

Knowledge	**1.10**	**1.17**	**0.63**
Skills	**1.67**	**1.44**	**0.86**
Attitudes	**1.37**	**1.24**	**0.84**
Behaviour	**0.43**	**0.29**	**0.08**
All aspects	**1.13**	**1.07**	**0.61**

Among individual items, the Certificate IV group scored highly for awareness of the most vulnerable sections of society (Q12) and acceptance of individual responsibility for disaster preparation (Q18), but fell behind the other two groups in behaviours such as tree planting (Q23) and actually looking after the vulnerable during cyclones (Q26). Otherwise, they outshone the other cohorts in aspects of behaviour such as advocacy for action on climate change (Q25), talking about climate change with the family (Q24) and assisting the CDCCC in their community (Q27). Note that many of the Cert IV cohort were active members of the Vanuatu Climate Action Network (VCAN) who participated in public demonstrations; they were also older and already in employment. Nevertheless, these findings must be treated with caution because of the small size of the Certificate IV sample compared to that of the other groups.

Overall, and in response to Research Question 1, the on-line Certificate IV course in resilience offered through the University of the South Pacific was judged to be effective – by those who completed it – in terms of knowledge, attitudes and skills, and to a lesser extent in behaviours fostered. While the on-line learning environment promotes independent learning, the range of pedagogical techniques is necessarily more limited than with the face-to-face courses presently being conducted through the Vanuatu Institute of Technology, and there is notably less emphasis on practical and field experience. It can also be argued that the number of those who stand to benefit from Certificate IV courses will be much less than the volume of students completing the VIT courses, especially if the funding from overseas donor partners is eventually withdrawn.

6.5 Post-Graduate Diploma in Climate Change

For several years, the University of the South Pacific has offered an on-line one-year Postgraduate Diploma in Climate Change through its Pacific Centre for Environment and Sustainable Development (PaCE-SD), designed for professional planners in economic and social development and/or the natural environment. It is also suitable for graduates aiming to enhance understanding of climate-related issues.

From 2020 onwards, participants are asked to specialise in one of three themes. The Science Emphasis stream focuses on scientific aspects of climate change globally and in the Pacific, providing a strong quantitative understanding of observations, climate and earth system modelling, GIS and remote sensing. The Adaptation and Management Emphasis stream studies impacts, vulnerabilities, solutions, adaptation and management, providing students with skills in documenting the social and physical impacts of climate change and disasters, community and ecosystem-based adaptation, and environmental assessment. The Disaster and

Resilience Emphasis stream concentrates on identifying, understanding and applying risk management to build resilience and reduce risks arising from climate change and hazards, and enables learners to perform strategic planning (PACE-USP, 2022).

To collect data on the PGDCC, I reached out during 2020 to mature ni-Vanuatu who had completed this programme during recent years and asked them to complete not only the usual questionnaires on student experiences, QS1 to QS4, but also those on the course itself, QC1 and QC2, normally given to course facilitators or designers. My reasoning was that those who had reached this level and were already working in a professional capacity or pursuing academic research would be more than capable of evaluating the characteristics and pedagogical aspects of the course. Only four responded to my request: all had completed their PGDCC prior to 2020, when only one course was offered, so did not need to choose between the three streams now mandated. The inadequate size of the sample is acknowledged, but is counterbalanced in part by the qualitative data obtained from respondents.

For course characteristics (Tables 6.24, 6.25 and Figure 6.19), the average score awarded by respondents for the PGDCC was 1.87 on a scale of -2 to + 2, indicating that this course was seen to cover nearly all desired aspects of resilience education. Indeed, the four respondents were unanimous in their judgement that 26 out of 41 features (63%) are of high importance. All six categories of features had scores of between 1.5 and 2, with behaviour (1.67) the lowest but still relatively high. In comparison with TVET programmes, the PGDCC had higher scores than Certificate IV in all six categories. Relative to Certificates I and III at VIT, they were higher for attitudes and overall attitudes, lower for knowledge and behaviour, and similar for the other categories, with no significant difference overall (1.87 compared to 1.84) (Table 6.26). For individual items, PGDCC learners rated only four as of lesser importance – moral qualities (1), climate injustice (21), IT skills (27) and eating habits (39).

One of the PGDCC learners shared detailed perceptions of how particular aspects of resilience education had helped build participants' capacities. A selection of her views appears in Table 6.25, and illustrates the potential impact that this course can have on learners' knowledge, skills, attitudes and especially behaviour.

Table 6.24 Perceptions of characteristics of the PGDCC at USP PACE-SD and TVET Certificate IV at USP-TAFE

Does the course promote or teach these aspects of resilience education?			Perceived importance						
			PGDCC @ USP PACE-SD						Av. score TVET Cert IV @ USP
			High 2	Low 1	None -1	Don't know 0	Total score (T)	Av. score (T/4)	
Overall attitudes	1.	Moral qualities	111		1		5	1.25	1.50
	2.	Building on individual capacities	1111				8	2.00	2.00
	3.	Service to others	1111				8	2.00	1.75
	4.	Outward orientation	1111				8	2.00	2.00
	5.	Equal treatment for all	1111				8	2.00	1.25
	6.	Gender equality/ empowerment of women	111	1			7	1.75	1.75
	7.	Motivation to learn	1111				8	2.00	1.75
Pedagogy	8.	Cooperative learning	1111				8	2.00	2.00
	9.	Participatory learning	1111				8	2.00	2.00
	10.	Constructivism	1111				8	2.00	1.75
	11.	Field work	1111				8	2.00	0.75
	12.	Experiential learning	111	1			7	1.75	2.00
Knowledge	13.	Meaning of resilience	1111				8	2.00	2.00
	14.	Nature & causes of climate change (CC)	1111				8	2.00	1.75
	15.	Nature and causes of disasters	1111				8	2.00	1.75
	16.	Vulnerability	1111				8	2.00	2.00
	17.	Impacts	1111				8	2.00	1.75
	18.	Mitigation	1111				8	2.00	2.00
	19.	Adaptation	1111				8	2.00	2.00
	20.	Strategies for disaster risk reduction (DRR	1111				8	2.00	1.75
	21.	Climate injustice	11	11			6	1.50	1.25
	22.	Food and water security	111	1			7	1.75	1.75
	23.	Traditional knowledge	111	1			7	1.75	1.25
Skills	24.	Communication skills	1111				8	2.00	1.75
	25.	Risk mapping	1111				8	2.00	1.00
	26.	Literacy/numeracy	1111				8	2.00	1.00
	27.	IT skills	11	11			6	1.50	1.00
	28.	Writing project proposals	1111				8	2.00	1.75
	29.	Vulnerability /SWOT surveys	1111				8	2.00	1.50
	30.	Community awareness	1111				8	2.00	1.25
Attitudes	31.	Sustainable living	111	1			7	1.75	1.75
	32.	Pro-environmental attitudes	111	1			7	1.75	1.75
	33.	Holistic approach	1111				8	2.00	1.50
	34.	Outward-looking orientation/ openness	1111				8	2.00	2.00
	35.	Avoiding consumerism	111	1			7	1.75	1.25
Behaviour	36.	Conservation of biodiversity	111	1			7	1.75	1.75
	37.	CC advocacy	111	1			7	1.75	1.75
	38.	Sharing knowledge of CC and/or DRR	1111				8	2.00	2.00
	39.	Eating habits	11	1	1		4	1.00	0.75
	40.	Disaster preparedness	111	1			7	1.75	1.75
	41.	Other pro-environmental behaviours	111	1			7	1.75	1.00

Summary	Overall attitudes	1.86	1.71
	Pedagogy	1.95	1.70
	Knowledge	1.91	1.75
	Skills	1.93	1.32
	Attitudes	1.85	1.65
	Behaviour	1.67	1.50
	All	1.87	1.62

Figure 6.19 Perceptions of characteristics of the PGDCC at USP PACE-SD, TVET Certificate IV at USP-TAFE and Certificate I & III at VIT

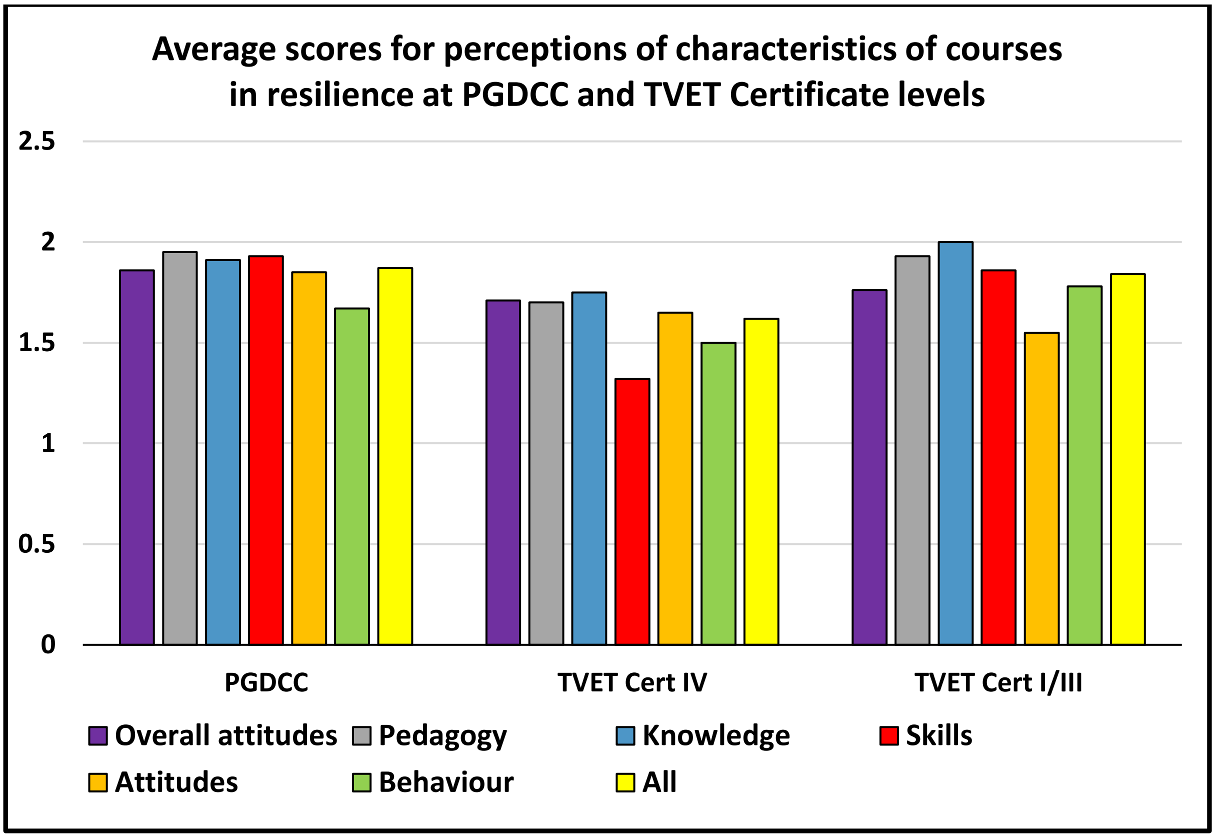


Table 6.25 One respondent's perceptions of how various aspects of the PGDCC course impact on learners

Aspect of course	Impact on the learner
Moral qualities	Influence willingness to make personal choices to mitigate the impact of future climate change
Building on individual capacities	Builds a students' capacity to identify their own solutions to problems so that they can build safe and secure communities
Service to others	Helps students to recognize others' weaknesses and disadvantages so that they can offer help
Equal treatment for all	Students learn that climate change and disasters are no respecter of persons, so everyone must be treated equally
Gender equality/ empowerment of women	Helps students understand the important role of women in dealing with climate change and disasters
Cooperative learning	Students learn to work in groups with others and learn together.
Field work	Helps students to understand impacts of climate change on the environment/communities and identify strategies to address them
Traditional knowledge	Where there is reference to TK in the modules, this should be given more emphasis
Communication skills	Provides students skills to communicate in lay language to communities, as well as in formal academic language
Risk mapping	For the Community Integrated Vulnerability Assessment. we were able to do risk mapping for our study area
Literacy/numeracy	The Climate Science module provided us with skills to read maps, diagrams, tables and graphs and to describe and explain them.
IT skills	We gained these when having to describe and explain weather and climate observations in the Climate Science module
Writing project proposals	The Climate Finance module provided us the opportunity to write a budget proposal for a community
Community awareness	The Impacts, Vulnerability and Adaptation module gave us the change to carry out community awareness on CC and measures for mitigation and adaptation.

Pro-environmental attitudes	A public display during USP Open Day had spectators worried about what is happening in the oceans (e.g. coral bleaching)
Holistic approach	We learnt to identify holistic solutions to the problems of CC
Avoiding consumerism	Most modules teach students how anthropogenic activities are contributing to global warming, so they think twice before indulging in consumerism.
Conservation of biodiversity	The course has ingrained in us that anthropogenic activities are the culprit, so we must act now to protect biodiversity
CC advocacy	Anyone who has completed this course will pursue this, whether on a large scale (community) or small scale starting at home
Sharing knowledge of CC and/or DRR	Same as for CC advocacy. I've even gone to the extent of joining the newly formed CDCCC in my community.
Eating habits	These have definitely changed to eating less meat and processed food and more locally-grown food
Disaster preparedness	We have gained skills in how to prepare for disaster, not only for ourselves but also for our communities.
Other pro-environmental behaviours	Waste separation and management, using renewable energy, home gardens, planting more trees, using public transport, recycling and reusing, planting more trees and flowers, avoidance of products made from rare species

Table 6.26 Determination of validity of difference between overall average scores for perception of course characteristics for the PGDCC and VIT Certificates I & III

Average score for perception of course characteristics	Mean	N	Standard Deviation	95% Conf. Int.		t	df	Signif. (2-tailed)
				Lower	Upper			
PGDCC	1.8659	41	0.22429					
VIT Cert I & III	1.8380	41	0.28955					
Diff PGDCC-VIT	0.0278	41	0.27328	-0.05845	0.11406	0.651	40	0.518

N: number of items; Conf.Int: confidence interval; t: t-value; df: degrees of freedom

In regard to perceptions of teaching and learning techniques (Table 6.27), PGDCC learners scored six of the seven categories more highly than did the Certificate IV learners, but agreed that field experiential and action-oriented strategies were least used, and lectures not used at all. Evaluation techniques and approaches had similar levels of use, although the PGDCC course had a greater focus on measuring application of knowledge and ability to reflect on learning gained. Neither course aims to measure oral contributions by learners, since emphasis is placed on on-line enquiry. However, as mentioned by the learner in Table 6.25, the capacity to communicate "in lay terms" with people in local communities, as well as with those in academia, is an important skill that would improve if oral assessment were to be included as an element of student evaluation for this course – as is done in the Certificates I and III courses at VIT.

Table 6.27 Perceptions of teaching, learning and evaluation techniques used in PGDCC and TVET Certificate IV at USP

	Aspect of resilience education	PGDCC @ USP							Av. score TVET Cert IV @ USP
		Never -2	Rarely -1	Some-times 0	Often +1	Always +2	Total Score (T)	Av. score (T/4)	
	TEACHING AND LEARNING TECHNIQUES BEING USED								
1.	Interactive - teacher engages students in brainstorming and discussion on a given topic				11	11	6	1.50	0.50
2.	Surrogate experiential - use of simulations of real life events, e.g. role plays, photographs, films					1111	8	2.00	0.50
3.	Field experiential - undertaking practical activities outside the classroom, e.g. hazard risk mapping		1			111	5	1.25	-1.00
4.	Affective - students share their feelings and experiences of disaster events				1	111	7	1.75	1.25
5.	Enquiry - students obtain information from outside the classroom, e.g. through interviews, internet sites				1	111	7	1.75	2.00
6.	Action - active involvement of students in practical sessions			1	1	11	5	1.25	-0.50
7.	Lecture - teacher provides information to the students in traditional teaching style	1		1	11		0	0.00	-0.50
	EVALUATION TECHNIQUES BEING USED								
8.	Recall - assessing students on their ability to remember and reproduce what they have been taught				11	11	6	1.50	1.25
9.	Action-oriented - assessing students on how active they are in participating in the learning process, e.g. participating in a role play, demonstrating adaptation techniques			1	11	1	4	1.00	1.25
10.	Output-oriented - assessing students on their production of tangible substances, e.g. plans, posters with DRR messages, risk maps				11	11	6	1.50	1.50
11.	Knowledge acquisition - assessing students' ability to obtain information from other sources, e.g. internet, and to organise this information and present in a meaningful form				1	111	7	1.75	1.75
12.	Application - assessing students' ability to use knowledge they obtain in class to solve community problems, e.g. interactions with community				11	11	6	1.50	0.50
	APPROACHES TO EVALUATION								
13.	Class exercises / completion of workbooks	1		1		11	2	0.50	0.50
14.	Written tests/exams		1		1	11	4	1.00	0.75
15.	Demonstrations of skills and knowledge				1	111	7	1.75	1.50
16.	Homework	1	1			11	1	0.25	0.25
17.	Teacher follow-ups, e.g. asking questions in the next lesson	1		1	1	1	1	0.25	0.75
18.	Reflections					1111	8	2.00	1.00
19.	Measuring oral contributions by students		11	1		1	0	0.00	0.00

Regarding PGDCC learners' assessments of their own experiences of course delivery and materials (Table 6.28), their overall score for the effectiveness of all aspects was 1.73 – the highest of the four groups who completed QS1 (Figure 6.20)

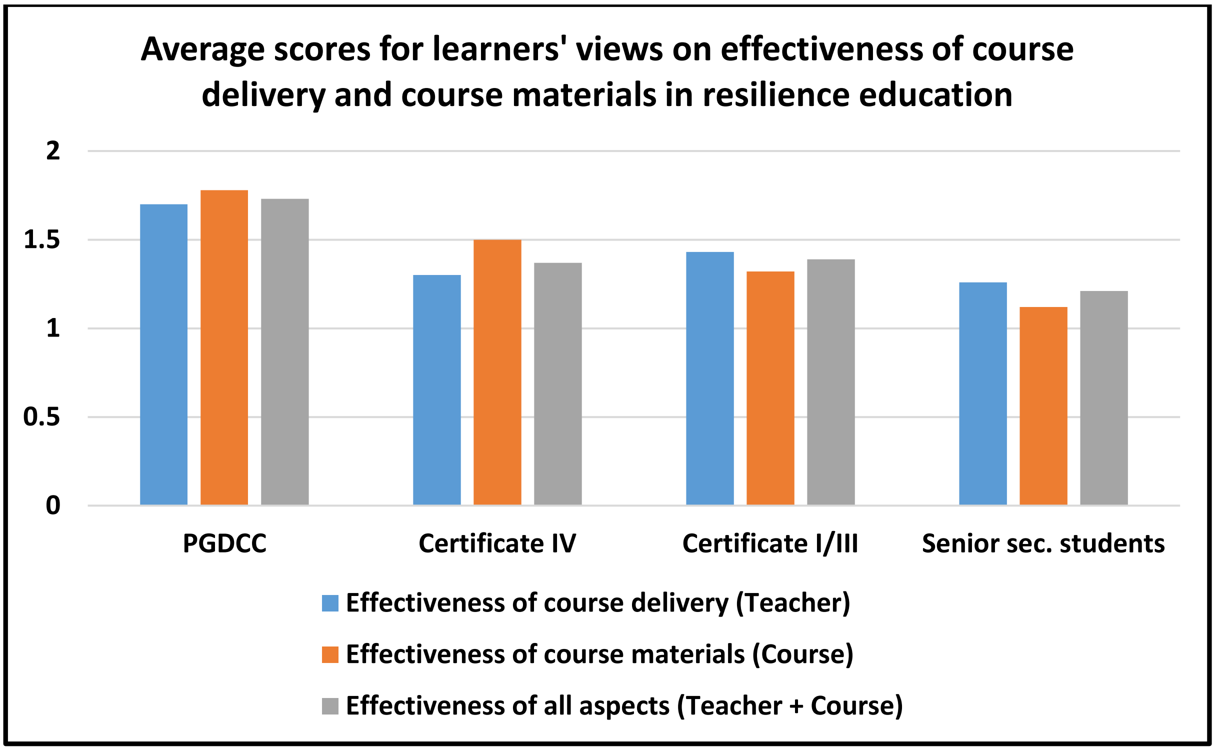
Table 6.28 Average scores for PGDCC learners' views on effectiveness of course delivery and course materials in resilience education, compared with those of learners taking TVET Certificate IV and TVET Certificates I / III

Question/Statement		Average scores within a range of -2.0 to +2.0		
		PGDCC learners n = 4	TVET Certificate IV learners n = 5	TVET Certificate I & III learners n = 37
1.	The teacher/facilitator is knowledgeable	1.75	1.20	1.57
2.	The teacher/facilitator is well prepared	1.50	1.80	1.43
3.	The teacher/facilitator comes on time	1.25	1.20	1.19
4.	The teacher/facilitator is enthusiastic	1.50	1.60	1.46
5.	The teacher/facilitator is creative	1.50	1.80	1.54
6.	The teacher/facilitator is well organised	1.25	1.40	1.43
7.	The teacher/facilitator uses visual materials	1.50	-0.20	1.22
8.	The teacher/facilitator is approachable	2.00	1.20	1.30
9.	The teacher/facilitator treats us as individuals	2.00	0.60	1.03
10.	The teacher/facilitator values my contributions	2.00	1.40	1.19
11.	The teacher/facilitator shows compassion	1.75	1.40	1.43
12.	The teacher/facilitator is helpful	2.00	2.00	1.59
13.	The teacher/facilitator communicates clearly	1.75	1.40	1.68
14.	The teacher/facilitator explains new concepts	1.75	1.80	1.54
15.	The teacher/facilitator makes me think	1.75	1.80	1.43
16.	The teacher/facilitator asks us questions	2.00	1.00	1.54
17.	The teacher/facilitator makes us participate	1.75	1.60	1.68
18.	The teacher/facilitator participates in the activities	1.50	0.00	1.46
19.	The teacher/facilitator promotes cooperative learning	1.75	1.80	1.49
20.	The teacher/facilitator checks up on our progress	1.75	1.20	1.38
21.	The course/lesson stimulates my interest in CC/ DRR	2.00	1.80	1.30
22.	The learning materials are exciting and appropriate	1.50	1.60	1.16
23.	I am encouraged to be responsible for my own learning	1.75	1.80	1.22
24.	I know how to prepare for all kinds of disaster	1.75	1.20	1.22
25.	I know ways to mitigate and adapt to climate change	1.50	1.80	1.32
26.	I learn new skills through the course/lessons	2.00	1.80	1.51
27.	I want to put my learning into action	2.00	1.80	1.54
28.	I am ready to take action on climate change	1.75	1.80	1.46
29.	I am ready to help others understand about disaster risk	2.00	1.80	1.43
30.	The way that the teacher/facilitator delivers the lesson is more important than the learning materials used.	1.50	-0.40	1.05

Effectiveness of course delivery (Teacher)	**1.70**	**1.30**	**1.43**
Effectiveness of course materials (Course)	**1.78**	**1.50**	**1.32**
Effectiveness of all aspects (Teacher + Course)	**1.73**	**1.37**	**1.39**

Course materials (1.78) were seen as marginally more effective than the facilitator (1.70), and the only individual statement that scored less than 1.5 was Q6, on the facilitator's organizational abilities (1.25).

Figure 6.20 Average scores for PGDCC learners' views on effectiveness of course delivery and course materials in resilience education, compared with those of learners taking TVET Certificate IV. TVET Certificates I / III and senior secondary students



The positive view of delivery and materials was reflected in answers to the three open-ended questions posed in QS1. In giving reasons why they enjoyed the course, the most common category of response was for appreciation of teaching and learning strategies used. When identifying important aspects learnt from the course, the foremost category was for acquiring specific skills, exemplified by abilities to conduct a community vulnerability assessment and to create budget proposals for specific climate change projects. For suggesting ways in which the course could be improved, respondents focused on changes in the course itself, advocating fieldwork and traditional knowledge as core components and internships for work experience.

Figure 6.21 and Table 6.29 show PGDCC learners' assessments of knowledge, skills, attitudes and behaviours gained through completion of the course. Again, the overall score for all aspects (1.44) was the highest for any cohort completing QS4, and was markedly higher than the others for behaviour (1.45). This is a group of people who plant trees, discuss climate change with their families, take part in demonstrations to support action on climate change and assist the Community Disaster and Climate Change Committee (CDCCC) in their community. On the other hand, this group had the lowest score for Q19, indicating their belief that the responsibility for reducing Vanuatu's carbon footprint lies with the government rather than the individual, whereas one would expect that the PGDCC would engender feelings of individual and local community empowerment to do this. Of course, we must acknowledge that the sample of learners was far too small and may have distorted the results.

Figure 6.21 Average scores for PGDCC learners in knowledge, skills, attitudes and behaviour, compared with those for learners taking TVET Certificate IV, TVET Certificates I / III and senior secondary students

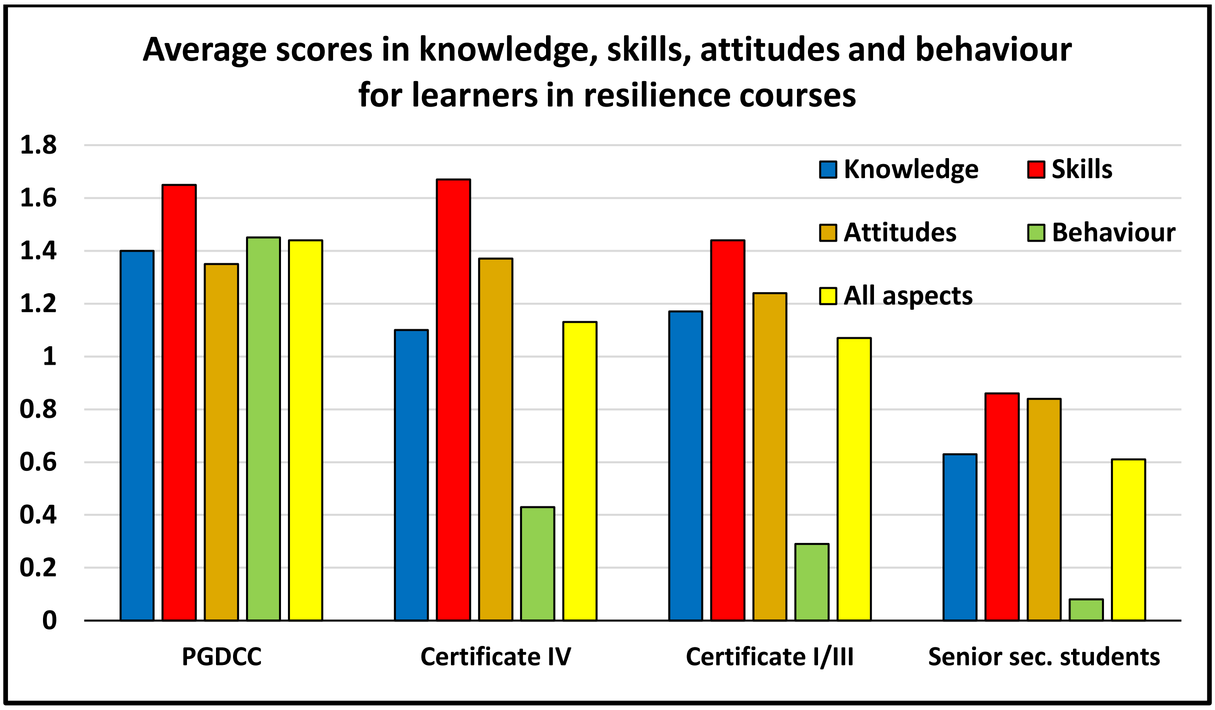


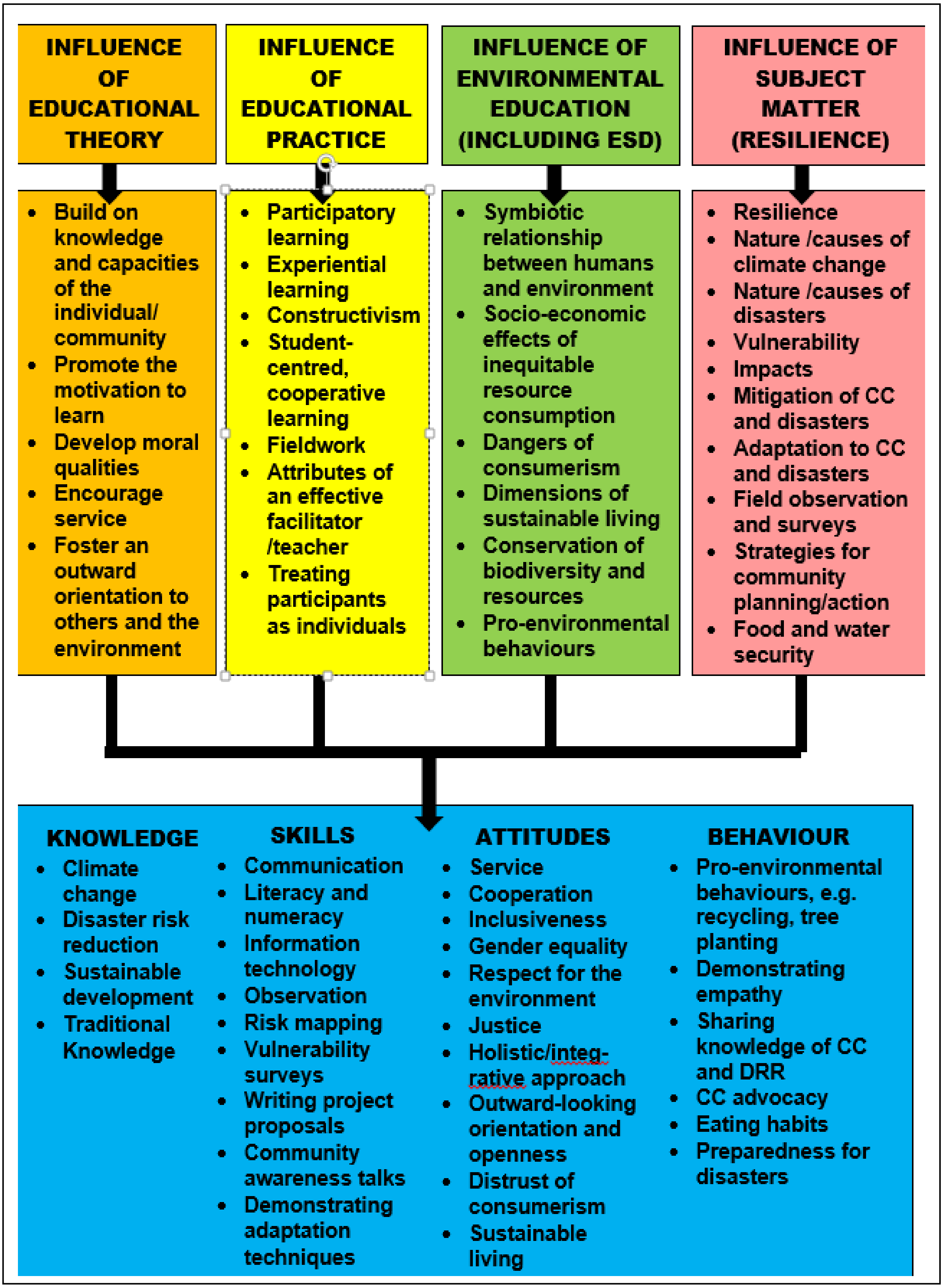
Table 6.29 Average scores in knowledge, skills, attitudes and behaviour for PGDCC learners of resilience as compared with those for Certificate IV USP and Certificate I/III learners

Question/Statement			Average score		
			PGDCC learners n = 4	TVET Certificate IV learners n = 6	TVET Certificates I & III learners n = 36
KNOWLEDGE	1.	Climate change is happening now, caused mainly by human activities	2.00	1.67	1.53
	2.	Ocean temperatures will get warmer in the future	1.75	1.83	1.56
	3.	Atmospheric concentrations of CO_2 are now < 400 ppm	0.50	-1.67	-0.08
	4.	Temperatures are rising most rapidly in the Arctic	1.75	1.83	1.17
	5.	Future changes in seasonal rainfall patterns are likely	1.75	1.83	1.50
	6.	Tree planting is an effective mitigation measure for CC	1.75	1.67	1.64
	7.	The best protection against sea level rise is a sea wall	0.00	-0.67	0.14
	8.	Ash falls affect food and water security	2.00	1.83	1.61
	9.	An earthquake is caused by a tsunami	1.00	0.33	0.94
	10.	Traditional knowledge helps us to adapt to CC	2.00	1.50	1.47
	11.	Climate change is really just a slow acting disaster	0.25	1.00	0.86
	12.	Children, women, elderly and handicapped people are the most vulnerable to disasters and climate change.	2.00	2.00	1.69
SKILLS	13.	I can give an awareness talk on disaster risk reduction	1.50	1.67	1.47
	14.	I can give an awareness talk on climate change	1.75	1.67	1.47
	15.	I can go to a community and draw a hazard risk map	1.50	1.67	1.50
	16.	I can demonstrate one way of adapting to CC	1.75	1.50	1.44
	17.	I can carry out a vulnerability survey in a village	1.75	1.83	1.31
ATTITUDES	18.	It is my responsibility to be prepared for disasters	2.00	2.00	1.47
	19.	It is the government's responsibility to reduce Vanuatu's carbon footprint	-0.75	-0.33	-0.39
	20.	I must help my community to prepare for CC	2.00	1.83	1.75
	21.	I must help to conserve biodiversity	2.00	1.83	1.77
	22.	I must consume more vegetables and fruit and reduce my intake of meat and processed food	1.50	1.50	1.57
BEHAVIOUR	23.	I plant tree seedlings	1.50	-0.50	0.37
	24.	I talk about climate change with my family	1.25	1.00	0.57
	25.	I take part in demos to support action on CC	1.50	1.17	0.49
	26.	I look after vulnerable people during cyclones	1.25	0.00	0.43
	27.	I assist the CDCCC in my community	1.75	0.50	-0.43

Knowledge	**1.40**	**1.10**	**1.17**
Skills	**1.65**	**1.67**	**1.44**
Attitudes	**1.35**	**1.37**	**1.24**
Behaviour	**1.45**	**0.43**	**0.29**
All aspects	**1.44**	**1.13**	**1.07**

In summary, evidence from a small cohort of learners who completed the Post-Graduate Diploma in Climate Change demonstrates that in relation to Research Question 1, it is an effective form of resilience education. It covers almost all aspects proposed in my initial model for an educational programme on resilience (reproduced as Figure 6.22 and summarized through questionnaire QC1), with the possible exception of traditional knowledge and climate injustice.

Figure 6.22 Model of a proposed educational programme on resilience



As an on-line course, the PGDCC is valued for its ability to promote independent learning and skills related to project administration and risk assessment, but at the same time may not be fostering the key role of fieldwork and in-depth interactions with local communities that is a requirement of TVET courses in resilience at the Vanuatu Institute of Technology. In comparison with other TVET programmes and senior secondary courses in resilience, it is perceived to be more effective in terms of both course materials and course delivery, with average scores of 1.78 and 1.70 respectively on a scale of -2 to + 2; it also outperforms the other groups when overall scores for knowledge, behaviour and all aspects together are considered.

At the same time, we must be conscious of two factors. Firstly, these conclusions are based upon a very small convenience sample. Secondly, the number of ni-Vanuatu candidates completing the PGDCC each year is limited, restricted to those with proven academic ability at bachelor level who can acquire the necessary funding. For example, just 7 enrolled in the course in 2020, and 10 in 2021 (Tangarasi, K., 2022). Thus the potential number of Vanuatu nationals who could benefit from this course is much less than that at TVET and secondary school level.

6.6 Comparison of Senior Secondary and Post-Secondary Courses

In exploring the effectiveness of formal education courses in resilience at senior secondary and post-secondary levels, I offer two final tables of comparison.

Table 6.30 shows the characteristics of the four courses investigated, measured against the desired attributes of the model for resilience education (Figure 6.22) that serves as a benchmark for evaluating responses to Research Question 1. Average scores are on a scale of +2 to -2, and may well be inaccurate because of the small sample size. But according to this table, the two courses that most closely reach the standards of the model and have the highest overall level of effectiveness are the PGDCC (1.87) and TVET Certificates 1/III at VIT (1.84). Scores for senior secondary classes are well below those of all other groups, particularly for skills (0.82).

Table 6.30 Characteristics of resilience courses as perceived by teachers and facilitators in senior secondary classes, TVET Certificates I/III, TVET Certificate IV and the PGDCC

Does the course promote or teach these aspects of resilience education?			Perceived importance: Average score			
			Senior secondary classes (n=12)	TVET Cert I/III @ VITE (n=3)	TVET Cert IV @ USP (n=4)	PGDCC @ USP PACE-SD (n=4)
Overall attitudes	1.	Moral qualities	1.42	1.67	1.50	1.25
	2.	Building on individual capacities	1.83	2.00	2.00	2.00
	3.	Service to others	1.50	2.00	1.75	2.00
	4.	Outward orientation	1.33	1.00	2.00	2.00
	5.	Equal treatment for all	1.58	2.00	1.25	2.00
	6.	Gender equality/ empowerment of women	1.25	2.00	1.75	1.75
	7.	Motivation to learn	1.75	1.67	1.75	2.00
Peda-gogy	8.	Cooperative learning	1.92	1.67	2.00	2.00
	9.	Participatory learning	1.83	2.00	2.00	2.00
	10.	Constructivism	1.83	2.00	1.75	2.00
	11.	Field work	0.67	2.00	0.75	2.00
	12.	Experiential learning	1.33	2.00	2.00	1.75
Knowledge	13.	Meaning of resilience	1.58	2.00	2.00	2.00
	14.	Nature & causes of climate change (CC)	1.83	2.00	1.75	2.00
	15.	Nature and causes of disasters	1.83	2.00	1.75	2.00
	16.	Vulnerability	1.75	2.00	2.00	2.00
	17.	Impacts	1.83	2.00	1.75	2.00
	18.	Mitigation	1.83	2.00	2.00	2.00
	19.	Adaptation	1.67	2.00	2.00	2.00
	20.	Strategies for disaster risk reduction (DRR)	1.67	2.00	1.75	2.00
	21.	Climate injustice	0.75	2.00	1.25	1.50
	22.	Food and water security	1.17	2.00	1.75	1.75
	23.	Traditional knowledge	0.83	2.00	1.25	1.75
Skills	24.	Communication skills	1.42	2.00	1.75	2.00
	25.	Risk mapping	1.17	2.00	1.00	2.00
	26.	Literacy/numeracy	1.58	2.00	1.00	2.00
	27.	IT skills	0.83	1.33	1.00	1.50
	28.	Writing project proposals	0.17	2.00	1.75	2.00
	29.	Vulnerability /SWOT surveys	0.00	2.00	1.50	2.00
	30.	Community awareness	0.58	1.67	1.25	2.00
Attitudes	31.	Sustainable living	1.42	1.67	1.75	1.75
	32.	Pro-environmental attitudes	1.33	1.67	1.75	1.75
	33.	Holistic approach	1.17	1.67	1.50	2.00
	34.	Outward-looking orientation and openness	1.17	1.67	2.00	2.00
	35.	Avoiding consumerism	0.92	1.00	1.25	1.75
Behaviour	36.	Conservation of biodiversity	1.50	2.00	1.75	1.75
	37.	CC advocacy	0.92	2.00	1.75	1.75
	38.	Sharing knowledge of CC and/or DRR	1.25	2.00	2.00	2.00
	39.	Eating habits	0.92	1.00	0.75	1.00
	40.	Disaster preparedness	1.75	2.00	1.75	1.75
	41.	Other pro-environmental behaviours	1.08	1.67	1.00	1.75

Summary	Overall attitudes	1.52	1.76	1.71	1.86
	Pedagogy	1.52	1.93	1.70	1.95
	Knowledge	1.52	2.00	1.75	1.91
	Skills	0.82	1.86	1.32	1.93
	Attitudes	1.20	1.55	1.65	1.85
	Behaviour	1.24	1.78	1.50	1.67
	All	1.32	1.84	1.62	1.87

Table 6.31 Perceptions of teaching, learning and evaluation techniques used in senior secondary classes, TVET Certificates I/III at VIT, TVET Certificate IV at USP, and PGDCC at USP

Aspect of resilience education		Average score on a scale of +2 to -2			
		Senior secondary classes (n=12)	TVET Cert I/III @ VIT (n=3)	TVET Cert IV @ USP (n=4)	PGDCC @ USP PACE-SD (n=4)
TEACHING AND LEARNING TECHNIQUES BEING USED					
1.	Interactive - teacher engages students in brainstorming and discussion on a given topic	1.08	1.67	0.50	1.50
2.	Surrogate experiential - use of simulations of real life events, e.g. role plays, photographs, films	0.42	1.67	0.50	2.00
3.	Field experiential - undertaking practical activities outside the classroom, e.g. hazard risk mapping	- 0 83	1.33	-1.00	1.25
4.	Affective - students share their feelings and experiences of disaster events	0.58	1.33	1.25	1.75
5.	Enquiry - students obtain information from outside the classroom, e.g. through interviews, internet sites	1.08	1.00	2.00	1.75
6.	Action - active involvement of students in practical sessions	0.42	2.00	-0.50	1.25
7.	Lecture - teacher provides information to the students in traditional teaching style	1.17	1.00	-0.50	0.00
EVALUATION TECHNIQUES BEING USED					
8.	Recall - assessing students on their ability to remember and reproduce what they have been taught	1.08	2.00	1.25	1.50
9.	Action-oriented - assessing students on how active they are in participating in the learning process, e.g. participating in a role play, demonstrating adaptation techniques	0.00	2.00	1.25	1.00
10.	Output-oriented - assessing students on their production of tangible substances, e.g. plans, posters with DRR messages, risk maps	0.25	2.00	1.50	1.50
11.	Knowledge acquisition - assessing students' ability to obtain information from other sources, e.g. internet, and to organise this information and present in a meaningful form	1.08	1.67	1.75	1.75
12.	Application - assessing students' ability to use knowledge they obtain in class to solve community problems, e.g. interactions with community	0.67	1.67	0.50	1.50
APPROACHES TO EVALUATION					
13.	Class exercises / completion of workbooks	1.50	1.67	0.50	0.50
14.	Written tests/exams	1.42	1.67	0.75	0.75
15.	Demonstrations of skills and knowledge	1.08	1.67	1.50	1.50
16.	Homework	1.17	1.33	0.25	0.25
17.	Teacher follow-ups, e.g. asking questions in the next lesson	1.42	2.00	0.75	0.75
18.	Reflections	1.33	1.33	1.00	1.00
19.	Measuring oral contributions by students	1.42	1.33	0.00	0.00

Table 6.31 shows teachers' and facilitators' perceptions of teaching, learning and evaluation techniques used in the four types of course. For teaching/learning techniques, there is a clear difference between the more student-centred approaches

of the PGDCC and TVET Certificate I/III courses and the more traditional approach adopted in senior secondary classes. Fieldwork is lacking for senior secondary classes and in TVET Certificate IV. For evaluation techniques, senior secondary classes have by far the lowest scores for action-oriented and output-oriented methods. For approaches to evaluation, the two online courses, by their intrinsic nature, make less use of class exercises and homework than the face-to-face courses, and do not measure oral contributions from learners. In terms of building graduates' capacity to interact with local communities, evaluation techniques and approaches suggest that the most effective training is through Certificates I/III at VIT.

6.7 Formal Education on Resilience in Relation to Frameworks and Policies

Having considered the effectiveness of courses on climate and disaster resilience at all levels of formal education from a pedagogic point of view, we will look at their effectiveness within a broader context. I will examine the extent to which current educational curricula are meeting the goals of national, regional and international frameworks and policies on resilience.

6.7.1 Policies and Frameworks on Resilience

Vanuatu's Climate Change and Disaster Risk Reduction Policy (VCCDRRP) 2016-2030 has been developed within the context of international policies such as the Sendai Framework for Disaster Risk Reduction 2015-2030, the Paris Agreement of 2015 and the United Nations Sustainable Development Goals 2015-2030, and of regional policies such as the Framework for Resilient Development in the Pacific (FRDP) 2017-2030 (Government of Vanuatu, 2015). The broad goals of the relevant policies are summarized in Table 6.32.

The vision of the VCCDRRP is that 'Vanuatu is a resilient community, environment and economy' (Government of Vanuatu, 2015, p.2). Its implementation involves the mainstreaming of CCA and DRR into all sector policies, plans and strategies, including the Vanuatu National Curriculum Statement (VNCS). However, the VNCS was published in 2010, well before any of the above policies were produced; there is no specific mention of DRR, and CC is only cited briefly in the context of environmental education for sustainability (MOE, 2010, p.44). The VCCDRRP itself makes reference to capacity-building for resilient development through formal education (Table 6.33). The NSDP's environmental pillar refers to climate and disaster resilience (Table 5.5 in Chapter 5), with education on CC and DRR in public schools mentioned in ENV. 3.4.1.

Table 6.32 Broad goals of national, regional and international policies on resilience

Policy	Overall goals	Reference
Vanuatu's national policies		
Vanuatu Climate Change and Disaster Risk Reduction Policy (VCCDRRP) 2016-2030	Vanuatu's strategic goal for climate change and disaster risk reduction is 'resilient development', which includes activities that enable and strengthen capacities to absorb and quickly bounce back from climate and/or disaster shocks and stresses.	Government of the Republic of Vanuatu, and Secretariat of the Pacific Community, 2015, p.8.
National Sustainable Development Plan (NSDP) 2016-2030 ("The People's Plan")	Vanuatu's goals for resilient development are given under three pillars of sustainability - Society, Environment and Economy. Goal ENV 3.4: A strong and resilient nation in the face of climate change and disaster risks posed by natural and man-made hazards.	Department of Strategic Policy, Planning and Aid Coordination, Republic of Vanuatu, 2016, pp.9, 14.
Regional (Pacific) policies		
Framework for Resilient Development in the Pacific (FRDP)	Goal 1: Strengthened Integrated Adaptation and Risk Reduction to Enhance Resilience to Climate Change and Disasters Goal 2: Low Carbon Development Goal 3: Strengthened Disaster Preparedness, Response and Recovery	Pacific Community et al, 2016, p.3
International policies		
Paris Agreement (COP 21)	Its goal is **to limit global warming** to well below 2, **preferably to 1.5 degrees Celsius**, compared to pre-industrial levels. Article 82 calls upon all Parties to ensure that education, training and public awareness, as reflected in Article 6 of the Convention and in Article 12 of the Agreement, are adequately considered in their contribution to capacity-building. The Paris Committee on Capacity-Building (PCCB) aims to address current and emerging gaps and needs in implementing and further enhancing capacity-building in developing countries.	UNFCCC, 2015, p.2 UNFCCC, 2015, p.12 UNFCCC, 2020
Sendai Framework	'Substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.'	UNDRR, 2015, p.11, # 16
Sustainable Development Goal SDG13 (Climate Action)	SDG13 aims to 'take urgent action to combat climate change and its impacts.' It includes 13.3: Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.	UNDESA, 2015, p.27

Source: Author and agencies indicated

Table 6.33 References in the VCCDRRP to capacity-building in schools

Aspect of capacity-building	Reference
Including traditional knowledge (of early warning and coping mechanisms) in formal and informal school curricula.	7.3.2, p.14
Incorporating lesson learned (on disaster risk reduction) into school curricula and information education programmes	7.3.4, p.15
Incorporating an integrated curriculum approach (on climate change and disaster risk reduction) to formal and non-formal education programmes	7.4.2, p.18

Source: Government of Vanuatu, 2015, pp.14,15,18

The lack of detailed guidance on resilience education in national policies contrasts with the objectives of regional and international policies. There are clear references to capacity-building through formal school education in the FRDP (Table 6.34), the Sendai Framework (Table 6.35) and the document Strategic Approach to Capacity Development for Implementation of the Sendai Framework (Table 6.36).

Table 6.34 References in the FRDP to capacity-building in schools

Goal	Agency	Priority action	Page no. & code
1. Strengthened integrated adaptation and risk reduction to enhance resilience to climate change and disasters	National and sub-national governments and administrations	Strengthen knowledge on the causes, local impacts and responses to climate change, hazards and disasters, and build capacity for local adaptation and other risk management measures, through formal and non-formal education systems, including for loss and damage.	p.15 i) q)
		… utilise appropriate awareness, communication, education and information materials for communities, media, schools, training providers and universities.	p.16 i) r)
	Regional organisations & development partners	Facilitate and support training for development of gender-responsive and inclusive disaster risk management and climate change adaptation strategies at regional and national levels.	p.17 iv) f)
2. Low carbon development	Civil society and communities	Lead and contribute to awareness campaigns and capacity building in schools and communities, to promote and facilitate energy and ecosystem conservation and the increased use of renewable energy, through changes in attitudes and behaviour.	p.20 ii) b)
3. Strengthened disaster preparedness, response and recovery	National and sub-national governments and administrations	Support existing and additional capacity-building and awareness raising for governments and communities (including churches and schools), to improve their disaster preparedness, response and recovery capabilities, acknowledging they are often the first responders in the event of a disaster.	p.23 i) f)

Source: SPC et al, 2016, pp.15-17,20,23

Table 6.35 Specific references to formal education on DRR in the Sendai Framework

Objective	Code / page number
Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience.	17 (p.11)
Promote the incorporation of disaster risk knowledge, including disaster prevention, mitigation, preparedness, response, recovery and rehabilitation, in formal and non-formal education, as well as in civic education at all levels, as well as in professional education and training.	24 (l) (p.14)
Promote national strategies to strengthen public education and awareness in disaster risk reduction, including disaster risk information and knowledge, through campaigns, social media and community mobilization, taking into account specific audiences and their needs.	24 (m) (p.14)
Children and youth are agents of change and should be given the space and modalities to contribute to disaster risk reduction, in accordance with legislation, national practice and educational curricula	36 (a) (ii) (p.22)

Source: UNDRR, 2015, pp.11,14,22

Table 6.36 Actions to promote capacity development for DRR through education

• Encourage/empower schools (primary, secondary and university) to incorporate resilience programmes that address risk through a multitude of means (e.g., changing the organizational culture, DRR lessons in the curriculum, and instituting enterprise risk management)
• Provide teachers with curriculum materials and training of trainer courses to enable broad-reaching exposure of risk reduction education and messaging.
• Incentivize and support the mainstreaming of DRR into standard curricula.
• Provide the materials and support that enables embedding of DRR materials and messages into existing professional training programmes, including employee on-boarding, staff technical training, and other avenues for entry across all government and societal sectors.

Source: UNDRR, 2020, p.53

Vanuatu, as a signatory to the Paris Agreement, made its first submission to the PCCB in 2017, providing information on capacity-building activities for the implementation of its nationally determined contributions (NDCs) (Republic of Vanuatu, 2017). This submission focused on the first-ever post-secondary Technical Vocational Education and Training (TVET) course on climate change and disaster risk reduction at the Vanuatu Institute of Technology. Efforts to teach school students about resilience were not mentioned.

Vanuatu's own set of 15 SDGs, outlined in its NSDP, are aligned with the United Nations 17 SDGs and the 2030 Agenda for Sustainable Development. SDG 13 is expressed as policy objective ENV 3.4 (Table 6.32). A review of the implementation of the 2030 Agenda (Republic of Vanuatu, 2019) states that 'steady progress' has been made with the implementation of SDG 13 (ibid, pp. 22-23). Regarding resilience education, Table 6.37 summarizes the findings from this review (ibid, pp. 77-79), indicating that 'as of 2017, the National Curriculum at all levels now incorporates climate and disaster modules'.

Table 6.37 Vanuatu's NSDP policy objectives on resilience education aligned to SDG targets and indicators

SDG target	SDG indicator	Vanuatu's NSDP objectives and achievements
Goal 13: Take urgent action to combat climate change and its impacts		
13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning	13.3.1 Number of countries that have integrated mitigation, adaptation, impact reduction and early warning into primary, secondary and tertiary curricula. 13.3.2 Number of countries that have communicated the strengthening of institutional, systemic and individual capacity-building to implement adaptation, mitigation and technology transfer, and development actions	ENV 3.4.1 Percentage of public schools using the climate change and disaster risk reduction modules in national curriculum at all levels. • As of 2017: National curriculum at all levels now incorporates climate and disaster modules

Source: Republic of Vanuatu, 2019, pp.77-79

6.7.2 A Mismatch Between Policies and Reality

Article 82 of the Paris Agreement of 2015 calls upon all parties, including Vanuatu, to ensure that education contributes to capacity-building for resilience to CC. The Sendai Framework urges the incorporation of disaster risk knowledge in formal and non-formal education, encourages primary and secondary schools to incorporate DRR lessons in the curriculum, advocates the provision of curricular material to teachers, and reminds us that children and youth are agents of change who should be given space and means to contribute to disaster risk reduction. The 2030 Agenda for Sustainable Development includes Target 13.3 to improve education, awareness-raising and human and institutional capacity on CC mitigation, adaptation, impact reduction and early warning, stating that this will be indicated when a country has integrated those aspects into primary, secondary and tertiary curricula.

On a regional level, the Framework for Resilient Development in the Pacific urges the strengthening of knowledge on causes, impacts and responses to CC, hazards and disasters, as well as capacity-building for adaptation and risk management measures, to take place through formal and non-formal education systems. It asks for capacity-building on the use of renewable energy and ecosystem conservation to occur in schools and communities, and it emphasizes the key role of training and education in building resilient communities.

Within the context of these international and regional policies on resilience, Vanuatu has developed its VCCDRRP and NSDP, each setting objectives for the fifteen year period to 2030. The VCCDRRP asks for school curricula to adopt an integrated approach to CC and DRR, and to include traditional knowledge of early warning and coping mechanisms and lessons learned on disaster risk reduction. The NSDP includes resilience education under objective ENV 3.4, stating that public schools should use CC and DRR modules in the national curriculum at all levels.

Thus there is clear evidence that key international and regional policies stress the importance of educating students at all levels about resilience issues – mentioned also by Mochizuki and Bryan (2015, pp.7-8) and Reid (2019) – and that this is echoed in general terms by Vanuatu's own policies on climate change, disasters and sustainability. However, a closer look at what is actually happening in Vanuatu schools at the start of 2022, seven years into the life-span of these policies, reveals that the reality on the ground is different. Four reasons are suggested.

Firstly, although the VCCDRRP says that CC and DRR have been mainstreamed into the National Curriculum Statement (NCS), this statement pre-dates the VCCDRRP: thus DRR is not cited, and CC is only mentioned briefly. All current primary and secondary curricula are being developed on the basis of the NCS, and the guidelines for curriculum writers on resilience issues are minimal. The 2019 review of progress towards Vanuatu's implementation of SDG and NDSP goals states that the National Curriculum has since 2017 incorporated climate and disaster modules at all levels of schooling. This is not correct, since even in 2022 these modules only exist or are planned for years 5, 6, 11, 12 and 13.

Secondly, the implementation of revised curricula is slow. In 2022, new primary curricula have been rolled out as far as Year 6, but junior secondary curricula are still being written, and senior secondary curricula are only being taught to Year 13 level in French-medium schools, without any official teaching resources. Thus while students in Years 5, 6, 11 and 12 in all schools are learning about CC and disasters, those in other years are dependent on out-of-date curricula in which resilience issues have minor significance.

Thirdly, the most effective education on CC and disasters appears in curricula at senior secondary level, by which time most students are no longer in school: statistics from 2021 show that students in Year 13 are just 18% of the number who started in Year 1 in 2009. Furthermore, such education is confined to three optional subjects - Geography, Earth Science and Development Studies - each taken by one third or less of all who reach this level. Thus the number of students benefiting from the most effective resilience education is only a minor proportion of the total.

Fourthly, Chapters 4 and 5 of this thesis demonstrate that the content of school curricula on resilience education, in terms of knowledge, skills, attitudes and behavioural traits gained, must also be questioned. While upper primary curricula in Social Science and Science teach basic knowledge and involve skill-sets and field experience, the number of teaching hours over this three year period is only 1% of total classroom time. At the upper end of secondary school, learners in three optional subjects have more learning hours on resilience issues, but syllabi make no mention of fieldwork or practical training on adaptation or mitigation strategies. Indeed, none of the syllabi include teaching approaches that promote participatory, field and affective learning, nor attitudes such as the avoidance of consumerism, a holistic approach to the environment and the value of traditional knowledge, nor behaviours such as climate change advocacy and environmental stewardship. In short, the effectiveness of resilience education at all levels depends not only upon the amount of curricular time, but also on materials used, pedagogy, teacher enthusiasm and commitment, and student motivation.

This current mismatch between policies and classroom reality suggests that in relation to Research Question 1, the effectiveness of formal education on resilience, at least at school level, is limited. If 'educational effectiveness' is seen as the degree to which an education system and its components and stakeholders achieve desired goals (Burusic et al, 2016), then formal learning about climate and disaster resilience in Vanuatu is just beginning.

CHAPTER 7: RESULTS AND DISCUSSION - RQ2: TRADITIONAL KNOWLEDGE

7.1 Scope of the Chapter

This chapter deals with Research Question 2:

To what extent are traditional knowledge, skills and values relevant to climate and disaster resilience in Vanuatu?

I start in Section 7.2 by reviewing literature on the nature of traditional knowledge, skills and values and their significance to Pacific island groups such as Vanuatu, showing how they constitute one of the principal drivers of resilience to climate change and disasters. This is illustrated in 7.3 through reference to a recent hazard event in Vanuatu – Tropical Cyclone Harold in April 2020.

It will then be appropriate to present, analyse and compare data collected from a sample of providers and receivers of traditional knowledge living in Vanuatu with that from a sample of ni-Vanuatu students studying at the University of the South Pacific in Suva, Fiji. In Section 7.4 I examine the characteristics of these two participating groups, summarize the methodology used and suggest limitations in the data collected. Section 7.5 makes comparisons between the two groups regarding their awareness of traditional environmental signs and resilience strategies, and the extent to which they have used traditional knowledge in their own lives. Section 7.6 considers traditional values and attitudes that build resilience. Sections 7.7, 7.8 and 7.9 discuss data on the intergenerational transmission of traditional knowledge, skills and values, reasons for its apparent erosion over time and the implications of this decline. Section 7.10 summarizes the role of traditional knowledge, skills and values in resilience.

This leads in Section 7.11 to consideration of the extent to which traditional knowledge is included within existing formal educational curricula in Vanuatu, distilling opinions from students and resilience personnel on its relevance.

In conclusion (Section 7.12), I use the research findings to advocate greater coverage of traditional knowledge, skills and values in school curricula at primary and secondary level, suggesting how this might be achieved through the integration of traditional and modern strategies for mitigation and adaptation into formal syllabi.

7.2 The Significance of Traditional Knowledge, Skills and Values

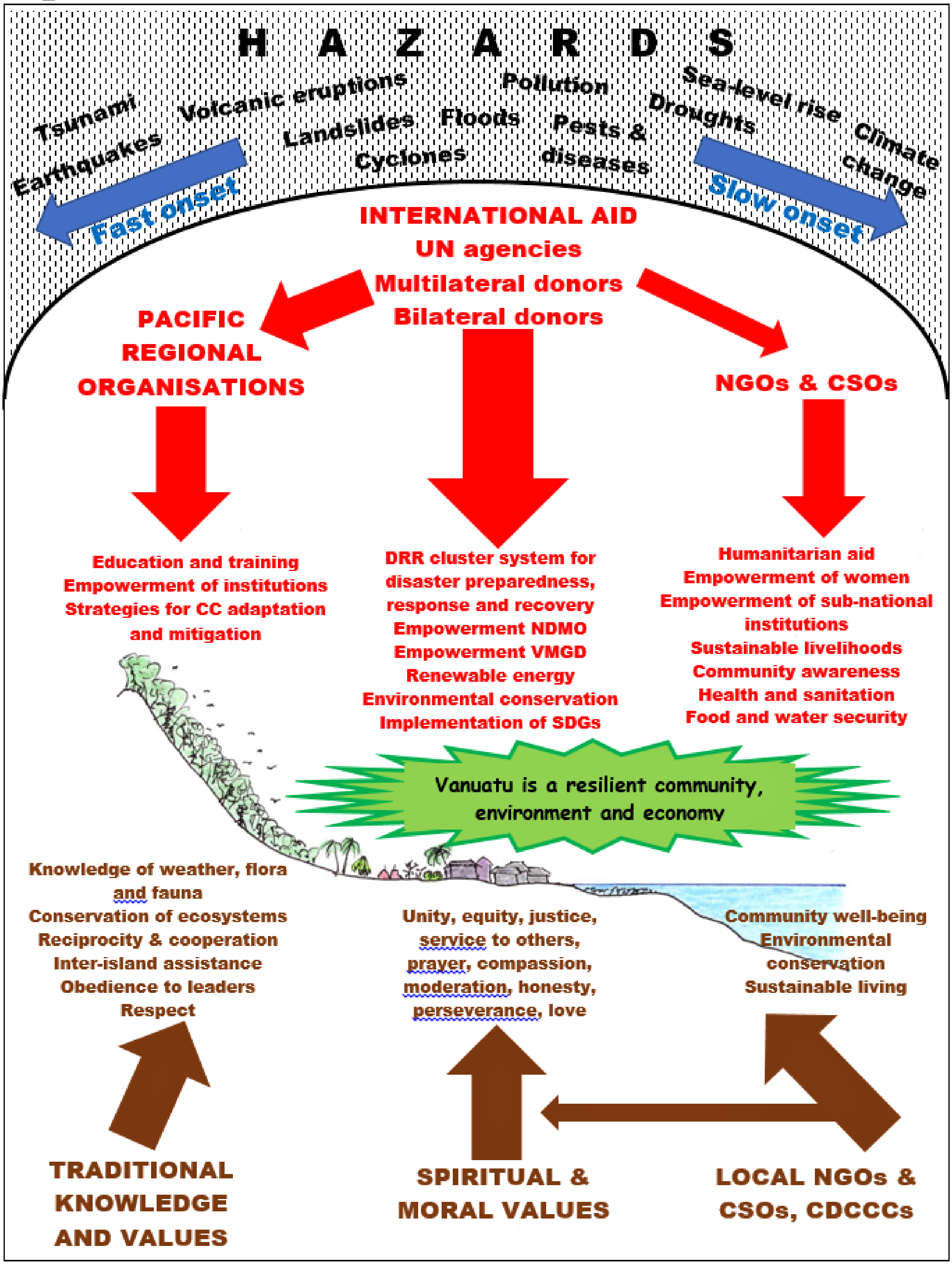
Traditional knowledge (TK) refers to knowledge that has been transmitted inter-generationally within a particular cultural community, primarily through oral means - stories, songs, rituals, memories, experiences and skills (Rai & Khawas, 2019, p.3), including practical demonstration of agricultural practices. Traditional knowledge is also known as traditional wisdom, traditional environmental knowledge (TEK) and indigenous and local knowledge (ILK). It is a key factor in sustainable development, especially when integrated with non-indigenous information sources (Walshe & Nunn, 2012; Nakamura & Kanemasu, 2019). Numerous articles emphasise its role in building resilience through the sustainable management of natural ecosystems and resources (Berkes et al, 2000; Thaman, 2000), and more recently, its capacity for helping communities to mitigate the effects of climate change and extreme weather conditions, especially cyclones (Lefale, 2010; Leonard et al, 2013). In the Pacific islands, McMillen et al (2014) point out that ILK systems are critical to understanding resilience and adaptation because of the islands' long exposure to environmental variability: over thousands of years, islanders have developed adaptive responses to living in marginal habitats for food production that face periodic severe disturbances from drought, cyclones, tsunamis and volcanic eruptions.

In Vanuatu, there is a clear role for traditional values, ecological knowledge and skills in building resilience, or adaptive capacity. This is emphasized in the Vanuatu Climate Change and Disaster Risk Reduction Policy 2016-2030 (VCCDRRP), which stresses the need to build on, share and expand existing TK of early warning and coping mechanisms (Government of Vanuatu, 2015), and is confirmed by case studies drawn from various islands across the archipelago (McNamara & Prasad, 2014; Campbell, 1990; Granderson, 2017; Mondragon, 2018; Pascht, 2019). These studies demonstrate how resilience to climate change and disasters at local level is generated through: close observations of, and interactions with, the local environment; traditional techniques of agriculture, fishing and house-building; oral transmission of past experiences; and “social capital” – networks and relationships among and between families, friends and communities that provide support and resource-sharing. However, while traditional strategies have built resilience to hydro-meteorological, geological and biological hazards disasters in Vanuatu since the first colonisation of the archipelago some three thousand years ago, they may not be so effective in the future, when climate change increases the severity of extreme weather events (McNamara & Prasad, 2014; Nakamura & Kanemasu, 2019).

The vision of the VCCDRRP is that ‘Vanuatu is a resilient community, environment and economy’ (Government of Vanuatu, 2015, p.2). The hypothetical model shown in Figure 7.1 suggests how that resilience might be achieved, considering external and internal “drivers” that are involved. The principal hydro-meteorological, geological and biological hazards are symbolised by torrential rain at the top. Protection is offered through an umbrella of foreign aid (in red), representing financial and technical flows coherent with the UN’s 17 Sustainable Development Goals. The ostensible aim of this top-down assistance is the empowerment of communities in building resilience to natural hazards by reducing disaster risk and adapting to climate change impacts, both direct and indirect, such as sea level rise, loss of food and water security and biodiversity, coastal erosion, and urban migration.   But I postulate that resilience is also nurtured through bottom-up, largely voluntary processes within civil society (in brown) – ordinary people, environmental groups and faith-based organisations seeking the well-being of communities and building on millennia of experience. TK provides knowledge of weather, flora and fauna, living in balance with natural resources and the conservation of ecosystems; at the same time, it promotes values such as reciprocity, cooperation, inter-community and inter-island assistance, respect for one another and a symbiotic interrelationship between humans and their environment.

External financial assistance may come and go, but it is ultimately the fostering of self-supporting dynamic and equitable communities that use ecosystem services sustainably which will ensure enduring resilience to environmental change

Figure 7.1 Suggested model of the drivers of resilience in Vanuatu



7.3 Traditional Knowledge and a Recent Hazard Event: Cyclone Harold

Between 2015 and 2020, Vanuatu experienced two of the most violent cyclones in its recorded history – TC Pam on 13-14 March 2015 and TC Harold on 4-7 April 2020, both at category 5 (SPC, 2016; FAO, 2020). Cyclone Harold (Figure 7.2) wreaked havoc in Sanma Province (the islands of Santo, Malo and Aore), with 80-90% of homes and 50% of schools destroyed, and on the island of Pentecost, where 90-95% of homes[4] were destroyed (Ober & Bakumenko, 2020). More than 160,000 people, or more than half of Vanuatu's population, were affected (OCHA, 2020), and some 17,500 ha of cropland were damaged, ruining staple foods ready for harvesting (FAO, 2020).

TC Harold arrived just three weeks after the Vanuatu Government had declared a state of emergency due to the start of the COVID-19 pandemic. The National Disaster Management Office (NDMO), already trying to cope with major ashfalls afflicting Tanna, immediately decided that the response to TC Harold would be localised: no foreign aid workers were permitted to fly in to alleviate the suffering in affected areas, and strict decontamination and quarantine measures were imposed on incoming relief supplies received from Australia, New Zealand, France and China. As a result, distribution of emergency food, water, tarpaulins and tools to needy communities was delayed by weeks, even months, compounded by damage to inter-island vessels, erosion of roads and the sheer remoteness of many villages (Mcdonald, 2020), especially along the west coast of Santo and the eastern seaboard of Pentecost. Communities were forced to adopt local responses to the emergency, such as managing food security through traditional resilience strategies and values.

To illustrate how traditional knowledge and values assisted communities to overcome some of the impacts of TC Harold along the remote west coast of Santo – one of the areas to suffer most from the cyclone's impacts as it remained offshore for almost three days – I will refer to two eye-witness reports. The first is from an on-line interview with a graduate of the first Certificate I & III courses in Resilience at the

[4] Most of these homes would be traditional buildings constructed of leaves and branches – easily destroyed in a cyclone, but then readily rebuilt.

Vanuatu Institute of Technology (VIT), who had already returned to his home village of Kerepua and been instrumental in promoting awareness in this and surrounding settlements of resilience strategies, including traditional techniques, as well as the creation of a local marine and land conservation area that extends from the reef at Kerepua to high montane forests around Mt.Tabwemasana, Vanuatu's highest mountain. He co-founded the Santo Sunset Environment Network (SSEN), whose goal is to ensure the protection and conservation of ecosystems and biodiversity through traditional knowledge and customary practices in the 25 villages along the West Coast. For response to and recovery from TC Harold, he reported that impact assessments were conducted for the whole west coast area, a detailed report was sent to the NDMO, and a locally-constituted team established and trained Community Climate Change and Disaster Risk Committees (CDCCCs) in 14 villages ready for the coordination of future disaster preparedness, response and recovery. Community awareness was carried out on health, hygiene, forestry and environmental conservation, and people were encouraged to plant quick-growing ("three months") crops such as kumala.

When asked how TK helped the community to be resilient during the passage of TC Harold, the respondent said:

> We relied on traditional weather indicators. When clouds were moving rapidly across the sky, the *manuinalane* (cyclone birds) were flying in from the sea and our poultry stopped making a noise when roosting in the late afternoon, my father predicted that the cyclone would be very strong, and he was right. We undertook traditional preparations such as lashing down our houses, baking taro and *laplap* in underground ovens ready for food shortages after the cyclone, and moving the family to the safety of the kitchen, which has low roofing. We also knew that if there was fine weather in the middle of the cyclone, then winds would return with even more force.
>
> (VIT graduate in Resilience, personal communication, 8th August 2020)

According to the report submitted to the NDMO (Bartlett, 2020), TC Harold completely destroyed over 600 homes, badly damaged nearly all infrastructure and wiped out the agricultural and productive sector livelihoods of over 2,590 people across 25 communities. All primary and junior secondary schools were either totally destroyed or rendered completely inoperable, leaving more than 500 students with no educational opportunity in the foreseeable future. Even before TC Harold struck, West Coast Santo was highly food insecure, largely due to a severe drought which lasted for most of 2019 and into 2020. Planting was delayed by four months and only commenced in February 2020. Staple crops like manioc, taro and sweet potato were not yet ready when the cyclone struck. Banana, the other staple food, was completely decimated and would not be available for at least 8 months. Livestock that broke out of their fences ate much of the remaining food, as no fencing materials were available for repairs. The cyclone damaged many existing water systems, breaking pipes, burying source springs and shattering storage tanks. Because of slow and insufficient external relief, emergency operations were managed by a team of volunteers from the SSEN, Edenhope Foundation and the Area Council, who helped communities to self-organise and begin their own response and recovery work using their inherent resilience and a wealth of TK practices. Some of these traditional practices include: constructing cyclone-resilient homes from wild cane and black palm, with low roofs supported by posts dug deeply into the ground and held together with strong bush ropes (lianas) and protected by large logs placed on roofs at the start of the cyclone season, and the house aligned north-south so that the long side is facing strong westerly winds; observing environmental signs of forthcoming cyclones and taking the necessary precautions - cloud movements, formations and colours, abundance of fruit, abnormal animal behaviour; collecting and preserving food before a cyclone arrives; using wild yams as disaster food; making home-made salt through the evaporation of sea water for preserving meat and fish; and accessing fresh water through storage in dry bamboo segments and knowledge of perennial upland springs.

The report also suggests that much of this traditional knowledge is confined to old people, with younger people not spending time with their elders to imbibe this wisdom. Thus most communities along the west coast of Santo no longer have many traditional cyclone-proof houses, and as a result of TC Harold, which was described by older people as being much stronger than anything they had previously experienced during their lifetimes, there is widespread interest to revive, re-learn and put into practice such traditional resilience and coping strategies (Bartlett, 2020).

Although these two communications from western Santo on the role of traditional knowledge in building resilience to cyclones cannot be considered as representative of Vanuatu as a whole, we shall see that they support two major findings from my own research. Firstly, the traditional cyclone indicators (weather observations, changes in flora, abnormal animal behaviour, cyclone birds) and traditional coping measures for cyclones (distinctive houses, long-term and short-term ways of assuring food and water security) are the same as those identified by both cohorts of survey respondents, and correspond to those identified by other authors (e.g. Nakamura & Kanemasu, 2019; Le Dé et al, 2018; Granderson, 2017; Mondragon, 2018; McNamara & Prasad, 2014). Secondly, much of this traditional knowledge is held by older people, who are unable to pass it on inter-generationally because young people are either not there or not interested, an observation made by some of the older Vanuatu-based survey sample; additionally, over one third of the USP sample said that young people's use of efficient modern technology (especially mobile phones and the internet) leads to a reluctance to rely on traditional warning signs or strategies.

7.4 Survey of Traditional Knowledge: Methodology and Limitations

The main part of this survey was carried out between March and August 2020 through field interviews and questionnaire completion with providers and recipients of traditional knowledge from eight islands of Vanuatu, and questionnaire completion by ni-Vanuatu students at the University of the South Pacific (USP) in Suva, Fiji (Tables 7.1 and 7.2). These two categories will be distinguished as the "Vanuatu-based" and the "USP-based" groups. Further field interviews in Vanuatu were undertaken in December 2020 on Pentecost and in March 2021 on Epi.

Vanuatu-based participants were selected by convenience sampling. The aim was to interview known holders of traditional knowledge, as well as recipients of such knowledge, from as many islands and age groups as possible. There were separate questionnaires for providers and receivers, with acknowledgement that providers are also receivers and might wish to answer both sets of questions. Structured interviews were conducted in the field in Bislama, the lingua franca of Vanuatu, or in one of the 106 indigenous languages used in the country. The 48 respondents came from the islands of Mota, Santo, Ambae, Pentecost, Efate, Epi, Tanna and Aneityum, with one third of them coming from Santo (Table 6.2). Nearly all (88%) were aged 30 and over, with 50% aged 60 years and over. The majority (77%) were male. Twenty six respondents (54%) classified themselves as providers, 17 (35%) as receivers and 5 (10%) as both providers and receivers. Interviewers, comprising myself and seven trained research assistants, were known to the interviewees and not regarded as "outsiders" from whom information would be withheld. An exception was for five elderly interviewees in North Pentecost, who would only reveal generalised information about traditional environmental signs and strategies, requiring a sum of money to be paid before revealing further details – and this did not happen.

For the USP-based participants, my ni-Vanuatu research assistant, himself a doctoral candidate in the USP's Pacific Centre for Environment & Sustainable Development (PaCE-SD), appealed for volunteers among the ni-Vanuatu student body, and 74 came forward, of whom 66 were full-time students. In that sense, the sample was also one of convenience. Most islands of Vanuatu were represented in this sample, with the majority of respondents coming from Santo, Ambae and Malekula. Unlike the first sample, 82% of USP participants were under 30 years old, with a more equitable balance between males (47%) and females (53%). Sixty-six classified themselves as both providers and receivers of traditional knowledge. The same number preferred not to be interviewed by the research assistant, but asked to complete the questionnaires by themselves, responding in either English or Bislama.

The purpose in having two distinct participant groups was to distinguish between older respondents who have lived entirely or for long periods in a rural setting, and younger respondents who have spent much of their school lives undergoing formal education in secondary and tertiary establishments removed from the village[5], having little contact with natural ecosystems and the possibility of alienation from their cultural roots**.** However, the following limitations of the survey mean that results cannot be considered as representative of Vanuatu society as a whole:

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[5] After primary school (Year 6), nearly all students must leave their village to continue education at secondary level in another location. In 2020, there were 482 primary schools (Years 1-6) and 114 secondary schools (Years 7-14) in Vanuatu (MOET, 2021, p. 8). Of those who complete junior secondary school (Years 7-10), 62% move to a senior secondary school in an urban or non-village rural location, and only 37% actually complete Year 13, the entry point for university (ibid, p. 17). I estimate that the average 20-year-old student who arrives at USP is likely to have spent at least 7 years (one third of his/her life) away from home influences.   For a student who has been born in Port Vila or Luganville and completed primary and secondary education in an urban school, estimated at 24% of all students (ibid, p. 15), it is likely that he/she has had little direct exposure to his/her cultural roots in the parents' village(s) of origin.

Firstly, questionnaire completion in Vanuatu was carried out in a slightly different way to that with respondents at USP in Fiji. In Vanuatu, questionnaires were completed in a face-to-face situation, with 43 of the 48 participants interviewed in their home village, and 5 in either Port Vila or Luganville with respondents who maintain a close connection with their home island. In all cases, the interviewers already had family or friendship ties with the respondents, and it is assumed that information would have been shared freely. In Fiji, questionnaires for a minority of respondents (8) were completed through face-to-face interviews with the research assistant, but the majority of students preferred to complete questionnaires on their own. It is not thought that such respondents deliberately concealed traditional knowledge of weather signs or coping strategies, nor of traditional values, but questions may not have been understood in a uniform manner and there may have been misconceptions. This difference between the two groups in the method of questionnaire completion may have influenced the responses.

Secondly, because convenience sampling was used, and since the majority of the USP sample were young people who have reached a university level of education (Table 7.1), we cannot say that either sample is representative of all old or young people in Vanuatu. Instead, the findings are more indicative of how young adults who have spent most of their lives exposed to education at secondary and tertiary level in spaces remote from their home villages may not have the same knowledge, skills or values as those who remained in a rural setting.

Thirdly, there is not an even representation of the 48 Vanuatu respondents by geographic area, with one third of them coming from the one island of Santo, and the majority of those from its west coast (Table 7.2 and Figure 7.2). Similarly, 37 of the respondents were male, and only 11 were female. This skewed representation may have distorted the results, especially since among the 74 USP respondents, the research assistant endeavoured to ensure an equitable gender balance (Table 7.1)

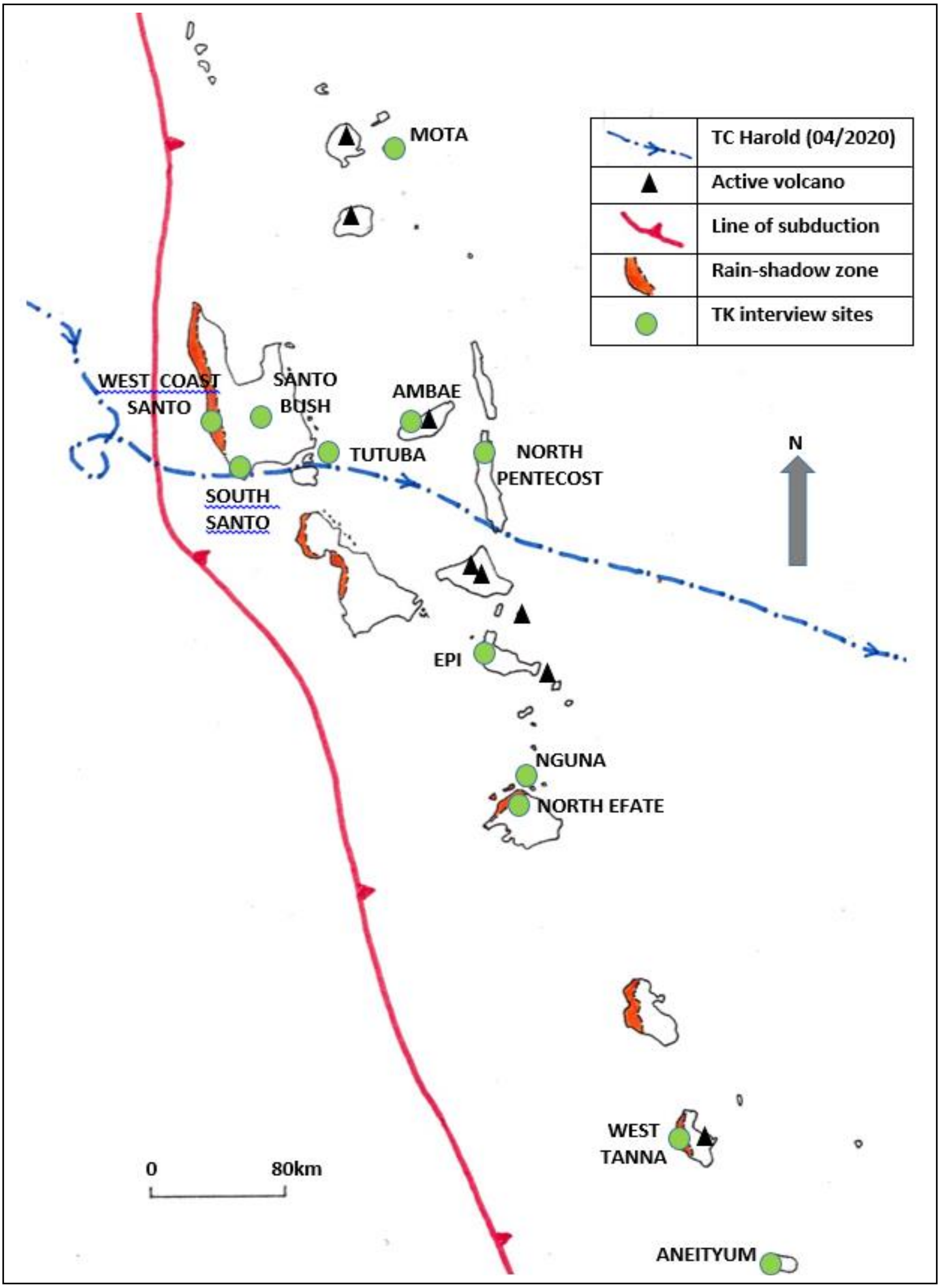
Table 7.1 Age and gender of respondents

Age group (years)	Vanuatu-based respondents			USP-based respondents		
	M	F	T	M	F	T
10-19	-	-	-	-	1	1
20-29	1	5	6	28	32	60
30-39	1	2	3	3	4	7
40-49	4	1	5	1	2	3
50-59	9	1	10	-	-	-
60-69	8	1	9	-	-	-
70-79	8	1	9	-	-	-
80 +	6	-	6	-	-	-
Not stated	-	-	-	3	-	3
TOTAL	37	11	48	35	39	74

Table 7.2 Home island and gender of respondents

Home island	Vanuatu-based respondents			USP-based respondents		
	M	F	T	M	F	T
Banks	1	-	1	1	-	1
Santo (west coast)	11	1	12	-	-	-
Santo (other)	4	1	5	9	6	15
Malo	-	-	-	4	-	4
Maewo	-	-	-	2	2	4
Ambae	2	-	2	6	9	15
Pentecost	5	3	8	2	4	6
Malakula + offshore	-	-	-	8	8	16
Ambrym	-	-	-	1	1	2
Paama	-	-	-	-	1	1
Epi	4	4	8	-	-	-
Shepherds	-	-	-	-	1	1
Efate + offshore	6	-	6	1	3	4
Erromango	-	-	-	-	1	1
Tanna	4	1	5	1	1	2
Aniwa	-	-	-	-	-	-
Futuna	-	-	-	-	1	1
Aneityum	-	1	1	-	-	-
Not stated	-	-	-	-	1	1
TOTAL	37	11	48	35	39	74

Figure 7.2 Location of sites where TK data was collected in Vanuatu, and salient environmental features



Author, 2022

Survey data was collected using two questionnaires, one for "providers" (Appendix A10) and one for "receivers" (Appendix A11). These questionnaires were intended as a guide for having a semi-structured interview with the respondent. Questions were open-ended, giving the interviewee freedom to share his/her knowledge and views. To help ensure a degree of uniformity, questions were provided in both Bislama and English, with the understanding that as far as possible, an interviewer would translate questions into the indigenous language of the locality, thereby getting more accurate information. Two separate sets of instructions were issued to interviewers, one for use with providers (Appendix A12/13) and one for receivers (Appendix A14/15). The general guidance given was that a provider would normally be a person known in the local community as one who was knowledgeable about traditional matters – generally an older man or woman – while a receiver might be a younger person, possibly, but not necessarily, related to the provider. Each assistant had the discretion to decide which interview questionnaire to use, acknowledging that sometimes the interviewee might choose to do both.

When my research assistant used the questionnaires with ni-Vanuatu students at USP in Fiji, 66 participants preferred to answer the questions themselves, without being interviewed. As mentioned, 66 completed both provider and receiver questionnaires.

Once initial responses were received, a preliminary coding system was devised for each question, based upon emerging patterns. This was essential when classifying the multiplicity of answers on traditional signs of, and traditional strategies for, environmental change and disasters (QTK1: Q1 & Q2; QTK2: Q3), for traditional values important for resilience (QTK1: Q8; QTK2: Q8), and for changes in the transmission of TK (QTK1: Q7). The content of these broad categories was modified as further responses arrived. For example, when dealing with traditional disaster signs and strategies, the majority of responses concerned cyclones, so that it was more meaningful to separate these out from other disasters and also invoke a time element, distinguishing between short-term and long-term phenomena and plans. Later, a similar approach was taken for droughts, the other principal hydro-meteorological hazard faced in Vanuatu. Thematic analysis was then carried out on the basis of these revised categories. This approach typifies mixed methods research, with themes arising from data collected through qualitative methods, then supported by quantitative data.

7.5 Survey Results: Traditional Resilience Signs and Strategies

A key finding of the research comes from respondents' answers to questions on whether they could state any traditional environmental signs of approaching hazards and describe any traditional strategies for being resilient to such hazards. These signs and strategies were offered by the respondents themselves, without interviewers having to use checklists or prompts.

Data is differentiated according to three categories – tropical cyclones, droughts, and all hazards.

7.5.1 Tropical Cyclones

Table 7.3 and Figure 7.3 show results for traditional cyclone signs, while Table 7.4 and Figure 7.5 provide data for traditional cyclone resilience strategies.

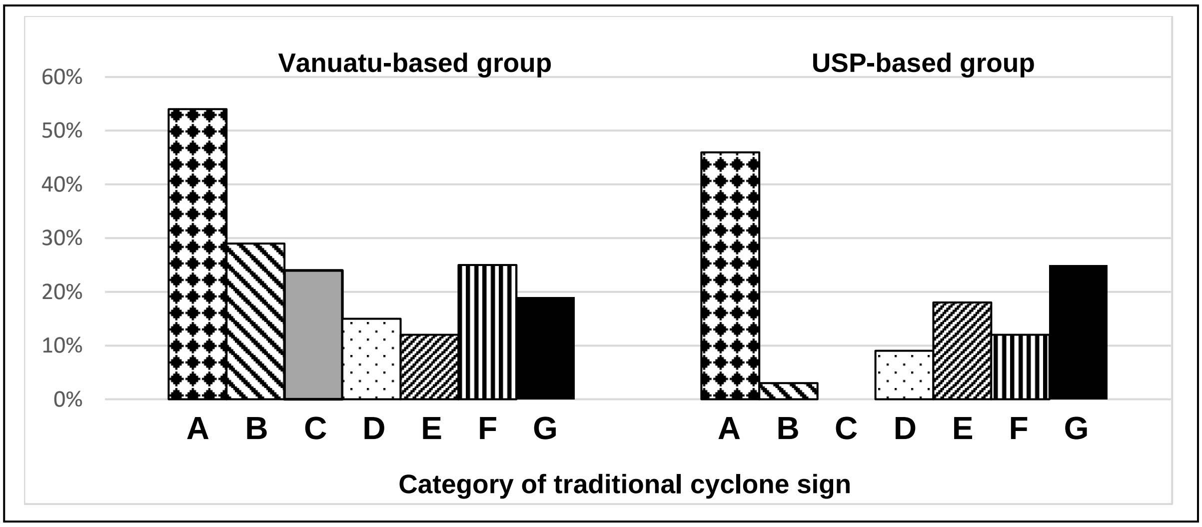
As expected, Vanuatu-based respondents demonstrated a greater knowledge of traditional cyclone signs than those in the USP-based sample. Thus 54% of the Vanuatu group stated one or more atmospheric signs, compared to 46% of the USP group. The contrast was particularly marked for observed changes in flora, with 29% of the Vanuatu group identifying an abnormally high output on fruit trees and 24% noting other changes in crops and plants, as compared with 3% and 0% respectively for the USP group. For fauna, 15% of the Vanuatu sample knew that cyclones are likely when hornets and birds build their hives/nests close to the ground, compared with 9% of the USP group, but a higher proportion of the latter (18% compared to 12%) mentioned the arrival of frigate birds or unusual bird movement. The proportion of USP respondents who could not state any traditional cyclone signs (35%) was almost double that of the Vanuatu-based group (18%). Other cyclone signs, principally those indicated in traditional calendars, were mentioned by 25% of the Vanuatu group and 12% of the USP group.

Differences in responses by gender were more marked for the Vanuatu group than the USP group, although the small size of the Vanuatu female sample may have led to some distortion of data. For the Vanuatu group, proportions of males were markedly higher for atmospheric signs and other changes in flora, while females had higher proportions than males for changes in bird movement, and for no traditional signs at all. For the USP group, however, males and females had similar proportions in all categories except for other environmental signs, in which females had higher percentages. Overall, Table 7.3 and Figure 7.3 suggest that the different responses for the two groups were due to age and experience.

Table 7.3 Traditional cyclone signs by number of respondents

Traditional cyclone sign	Vanuatu-based group			USP-based group		
	M (37)	F (11)	T (48)	M (35)	F (39)	T (74)
A. Atmospheric signs: unusual cloud formations, increasing wind speed, heavy rainfall, unusually hot days and nights, halo around moon, etc.	24 65%	2 18%	26 54%	17 48%	17 44%	34 46%
B. Changes in flora: abnormally high production of flowers and fruit on fruit trees – breadfruit, *nakatambol*, *navele*, mango	11 30%	3 27%	14 29%	0 0%	2 5%	2 3%
C. Other changes in flora: yam vines coil back down the yam stake; new banana shoots remain closed but leaves fall to ground; withering of *windiwindi* grass; red yam grows under *nabanga* tree; *nalumlum* (algal bloom) on sea surface, etc.	9 24%	0 0%	9 24%	0 0%	0 0%	0 0%
D. Changes in fauna: hornets /birds build nests close to the ground; fowl roost under houses; turtles lay eggs in bush; mangrove crabs leave habitat; unusual movements of animals/insects.	6 16%	1 9%	7 15%	4 11%	3 8%	7 9%
E. Changes in fauna: bird flight: frigate birds fly in from the sea; birds fly in unusual patterns/movements	3 8%	3 27%	6 12%	6 17%	7 18%	13 18%
F. Other environmental signs - rough seas, dirty seas, use of traditional calendar, etc.	10 27%	2 18%	12 25%	2 6%	7 18%	9 12%
G. No traditional signs stated	4 11%	5 45%	9 19%	13 37%	13 33%	26 35%

Figure 7.3 Percentage of total respondents identifying each category of cyclone signs



Similarly, a greater proportion of the Vanuatu-based group could demonstrate knowledge of traditional cyclone resilience strategies, particularly those of long-term duration. For example, 54% of the Vanuatu group stated traditional house construction and maintenance (A) as a key factor in resilience, compared with just 20% of the USP group: common features of such traditional homes include low or no walls, a triangular or semi-circular profile, and use of *natangura* (sago palm) thatch (Figure 7.4). The Vanuatu group also had higher proportions stating the strengthening of community solidarity (8% as against 1%), long-term food security and traditional food preservation (52% against 30%) and short-term food security just before and just after the passage of a cyclone (35% against 22%). However, the USP group had higher percentages for short-term maintenance and preparation of houses (39% compared to 25%), and short-term improvement of water security (12% to 0%), possibly reflecting young people's awareness of advice from the National Disaster Management Office about last-minute provisions before a cyclone arrives. Traditional short-term ways of calling upon the spirits or using special leaves or sacred stones in order to divert a cyclone away from an island or reducing damage to the home were mentioned by 8% of the Vanuatu group and 9% of the USP group. Percentages indicating no knowledge of traditional cyclone resilience strategies were very similar (17% for the Vanuatu group and 16% for the USP group), with males and females almost equally represented among the students. Differences in responses by gender were generally greater among Vanuatu respondents than with the USP students. For the Vanuatu group, females had higher proportions than males for short-term house preparation, strengthening of community solidarity, and long-term and especially short-term improvement of food security, while males had higher percentages for traditional house construction and maintenance, long-term improvement of water security and traditional ways of diverting or stopping a cyclone. The USP group replicated this pattern, except for long-term improvement of food security, in which males had a higher proportion, and with traditional ways of diverting/stopping a cyclone, where the percentage score was greater for females.

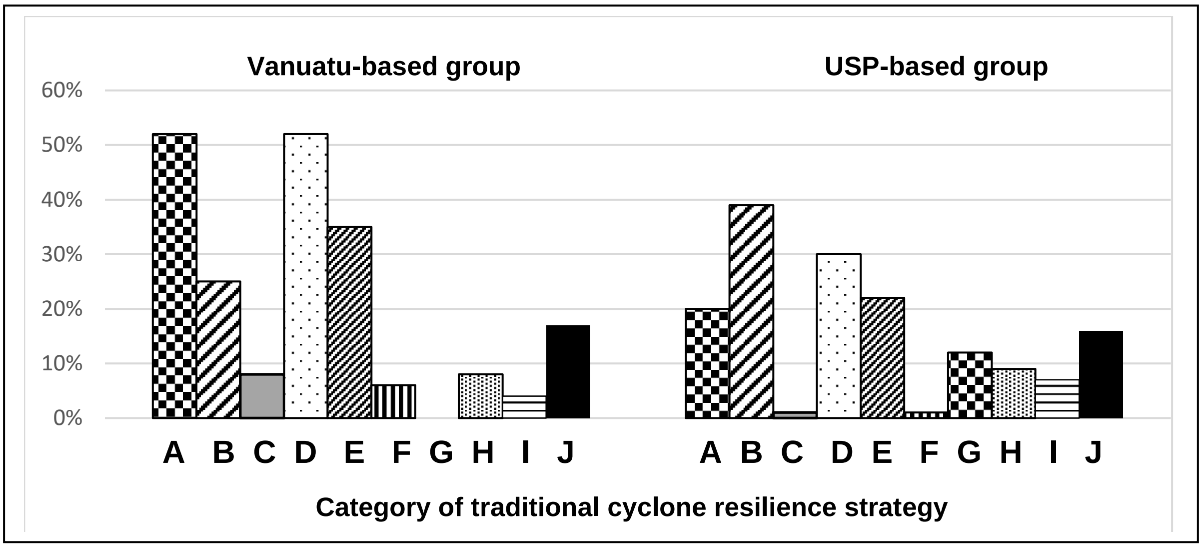
Figure 7.4 Traditional cyclone-resilient house in Forchenale village, Santo Bush

Author, 1987

Table 7.4 Traditional cyclone resilience strategies by number of respondents

Traditional cyclone strategy	Vanuatu-based group			USP-based group		
	M (37)	F (11)	T (48)	M (35)	F (39)	T (74)
A. Traditional house construction and maintenance (long-term) - style, shape, site. Construction of permanent houses	21 57%	4 36%	25 52%	11 31%	4 10%	15 20%
B. House maintenance and preparation (short-term), just before arrival of cyclone: ensuring roof is properly tied down, tying extra coconut leaves to roof, cutting branches of trees close to house, etc.	8 22%	4 36%	12 25%	10 28%	19 49%	29 39%
C. Strengthening of community solidarity / unity (long-term). Maintenance of *kastom* networks and reciprocal relationships. Obedience to chief.	2 5%	2 18%	4 8%	0 0%	1 3%	1 1%
D. Improving food security (long-term) – planting and storing long-life tubers, clearing and planting traditional food gardens, following seasonal planting calendar, traditional food preservation techniques, including burial of crops	19 51%	6 54%	25 52%	12 34%	10 26%	22 30%
E. Improving food security (short-term) – harvesting of manioc, bananas and other vulnerable crops before cyclone arrives, using wild crops as emergency foods after cyclone passes, storing food in home, etc.	11 30%	6 54%	17 35%	6 17%	10 26%	16 22%
F. Improving water security (long-term), e.g. by finding new sources, cleaning springs	3 8%	0 0%	3 6%	1 3%	0 0%	1 1%
G. Improving water security (short-term), e.g. by covering water sources /collecting water just before cyclone arrives.	0 0%	0 0%	0 0%	4 11%	5 13%	9 12%
H. Traditional ways of diverting or stopping a cyclone or reducing destruction of home (short-term), e.g. by using special leaves / magic	4 11%	0 0%	4 8%	2 6%	5 13%	7 9%
I. Other strategies, e.g. trapping crabs and fish, sheltering in caves, clearing path to caves, planting trees on slopes, planting windbreaks.	1 3%	1 9%	2 4%	1 3%	4 10%	5 7%
J. No traditional cyclone strategies stated	7 19%	1 9%	8 17%	6 17%	6 15%	12 16%

Figure 7.5 Percentage of total respondents identifying each category of cyclone resilience strategies



7.5.2 Droughts

Knowledge of traditional signs of impending drought are shown in Table 7.5 and Figure 7.6, and traditional resilience strategies for drought in Table 7.6 and Figure 7.7.

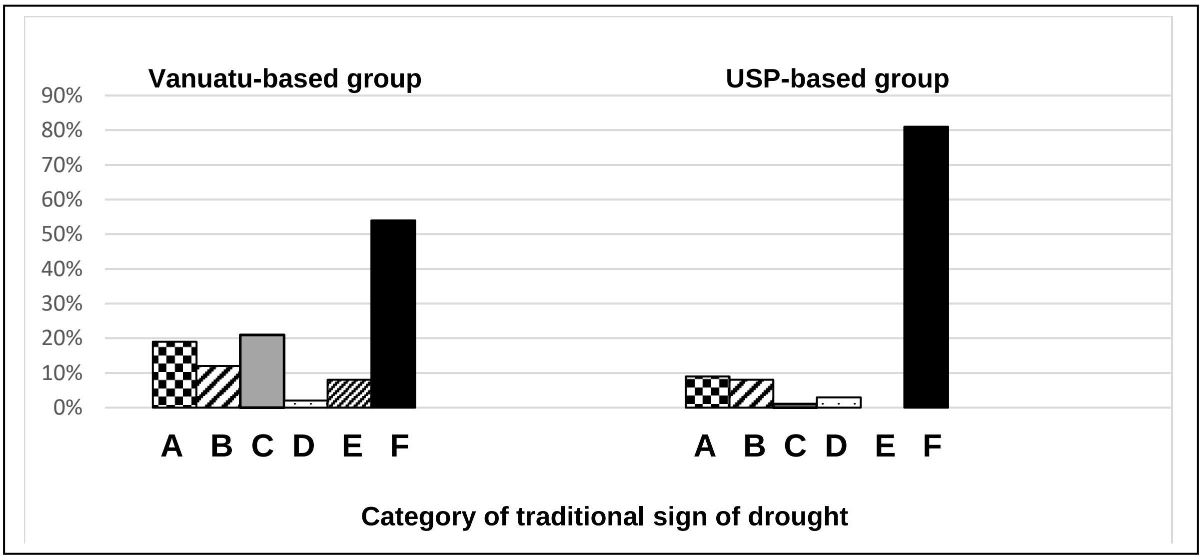
Unlike cyclones, droughts are slow-onset hazards that may take weeks or months to take effect. The intention was to find out traditional ways of forecasting droughts through observations of atmospheric phenomena, biota and soil. Yet the signs collected comprised not only such predictions, but also indicators that a drought is actually in progress.

Respondents knew less about traditional signs of impending drought than they did of cyclones, with 54% of the Vanuatu group and 81% of the USP group unable to state any such signs, compared with 19% and 35% respectively for cyclones. As for cyclones, the Vanuatu group had higher proportions of respondents than the USP group in identifying almost all categories of drought sign, with 19% compared to 9% for atmospheric signs, 12% to 8% for changes in flora, 21% to 1% for changes in fauna and 8% to 0% for other environmental signs. In the Vanuatu-based group, male respondents from West and South Santo accounted for most of those able to identify changes in flora, fauna and the atmosphere (Table 7.7). Among the Vanuatu group, males were more knowledgeable than females in all categories, while for the USP students, there was a more even gender balance, with female proportions higher in three of the five categories. Overall, the relatively small numbers in both cohorts imply that too much reliance should not be placed on the percentages given in Table 7.5, apart from the significant proportions stating "no traditional signs".

Table 7.5 Traditional signs of drought by number of respondents

Traditional sign of drought	Vanuatu-based group			USP-based group		
	M (37)	F (11)	T (48)	M (35)	F (39)	T (74)
A. Atmospheric signs relating to: clear skies, hot temperatures over long period, halo around sun, halo around moon, red sunset, red cloud along the horizon, "long" rainbow on the horizon, lack of wind, dust in the air.	8 22%	1 9%	9 19%	2 6%	5 13%	7 9%
B. Changes in flora: Leaves turn white or yellow, *ajaja* tree bears flowers without leaves, shedding of leaves during cool season, grass turns brown/dies, *navara* trees flower	6 16%	0 0%	6 12%	4 11%	2 5%	6 8%
C. Changes in fauna: Rats eat leaves and young shoots of pawpaw and bamboo; rats eat leaves, vines and branches of *jejea* and other trees; fowl cry out during heavy rain; *narua kara* birds cry out at high altitudes; frogs cry out; palolo worms appear; blow from whales reaches high in the sky	9 24%	1 9%	10 21%	0 0%	1 3%	1 1%
D. Lithospheric signs: weak earthquake, soil breaking up	1 3%	0 0%	1 2%	0 0%	2 5%	2 3%
E. Other environmental signs, e.g. use of traditional calendar, etc.	4 11%	0 0%	4 8%	0 0%	0 0%	0 0%
F. No traditional signs stated	16 43%	10 91%	26 54%	29 83%	31 79%	60 81%

Figure 7.6 Traditional signs of drought by number of respondents



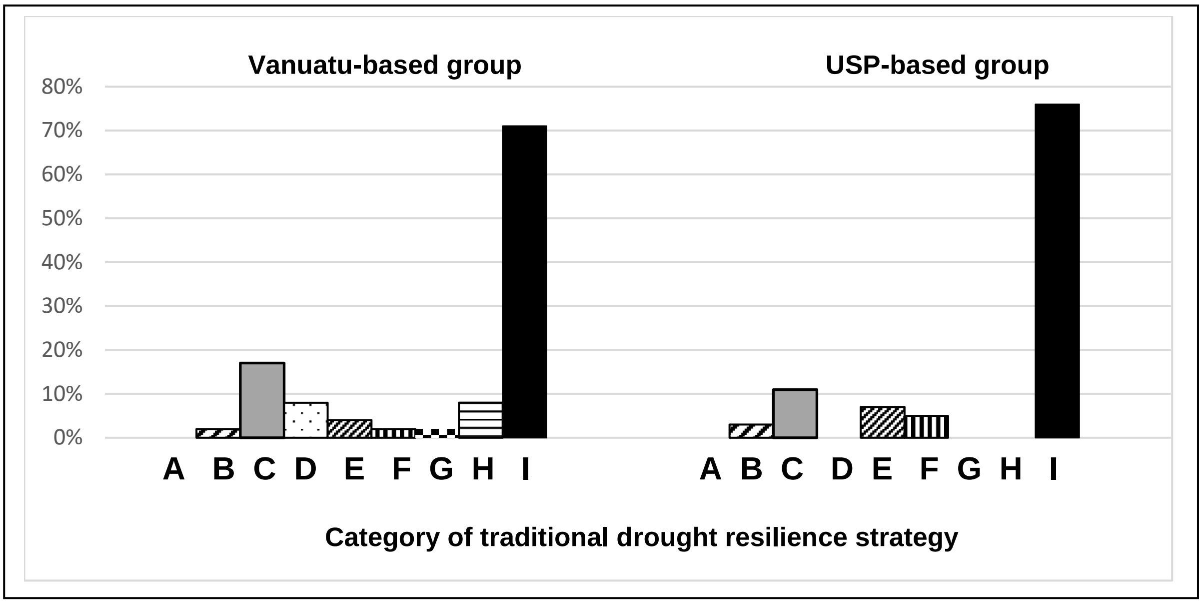
Likewise, there was less awareness of traditional resilience strategies for droughts (Table 7.6) than there was for cyclones (Table 7.4): approximately three-quarters of both cohorts professed no knowledge of drought strategies, whereas for cyclone strategies the comparable fraction was less than one fifth.

Table 7.6 Traditional resilience strategies for drought by number of respondents

Traditional resilience strategy for drought	Vanuatu-based group			USP-based group		
	M (37)	F (11)	T (48)	M (35)	F (39)	T (74)
A. House construction	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
B. Strengthening of community solidarity / unity (long-term). Maintenance of *kastom* networks and reciprocal relationships. Respect for chief.	0 0%	1 9%	1 2%	0 0%	2 5%	2 3%
C. Improving food security (long-term) – planting and storing long-life tubers, especially Fiji taro; clearing and planting traditional food gardens; following seasonal planting calendar; traditional food preservation techniques; setting traps for crabs and fish; storing small yams in bamboo ready for planting in drought.	6 16%	2 18%	8 17%	3 9%	5 13%	8 11%
D. Improving food security (short-term) –using wild crops as emergency foods during drought, not weeding taro or kava gardens	3 8%	1 9%	4 8%	0 0%	0 0%	0 0%
E. Improving water security (long-term) – hanging water containers over the roof, digging wells, using traditional methods to locate new water sources, preparing water supplies in advance.	2 5%	0 0%	2 4%	3 9%	2 5%	5 7%
F. Improving water security (short-term) – taking fresh water from springs along high water mark, using water from bamboo stems, storing water in bamboo	1 3%	0 0%	1 2%	4 11%	0 0%	4 5%
G. Traditional ways of bring rain during times of drought	1 3%	0 0%	1 2%	0 0%	0 0%	0 0%
H. Other strategies, e.g. use of traditional calendar, invoking the powers of *Tagaro.*	4 11%	0 0%	4 8%	0 0%	0 0%	0 0%
I. Not stated/ None	26 70%	8 73%	34 71%	26 74%	30 77%	56 76%

The most important strategy for both groups was the improvement of long-term food security (category C in Figure 7.7), stated by 17% of the Vanuatu group and 11% of the USP group, with the most common method being the use of similar traditional techniques of food preservation to those practiced for cyclones. Numbers of respondents able to identify resilience techniques were even smaller than those stating drought signs, and there was a more even balance between males and females in the responses, both for Vanuatu residents and the USP group.

Figure 7.7 Percentage of total respondents identifying each category of drought resilience strategies



7.5.3 All Hazards

Among all traditional signs and strategies for disasters identified by the 122 respondents, the greatest proportion related to tropical cyclones, with those for droughts, earthquakes and tsunamis mentioned less frequently, and those for volcanic eruptions least of all. It must be remembered there was no attempt to ask a interviewee to differentiate between those for each type of hazard; instead, the respondent was free to talk about the hazard(s) of his/her choice.

Table 7.7 attempts to assess the relative importance of signs and strategies for cyclones, droughts and earthquakes/tsunamis as perceived by respondents from various islands. Three types of symbol are used to differentiate between cases where more than half of respondents from an island could identify a relevant sign or strategy, those with less than half, and those where nobody in the sample provided a response. This crude method has obvious limitations, for example in exaggerating the significance of a response when the sample comprised just one person. However, it does give an insight into broad patterns. In order to determine whether geographic location within the archipelago has an influence on results, islands are listed from north to south, extending from the Banks group to Aneityum. A distinction is also made between the Vanuatu-based and USP-based groups.

Table 7.7 Traditional resilience signs and strategies by island and proportion of respondents

Home island of respondent	Vanuatu-based group							USP-based group						
	n	Cyclones		Droughts		Earthquakes/ Tsunamis		n	Cyclones		Droughts		Earthquakes/ Tsunamis	
		Signs	Strat-egies	Signs	Strat-egies	Signs	Strat-egies		Signs	Strat-egies	Signs	Strat-egies	Signs	Strat-egies
Banks	1	●	●	●	●	x	x	1	●	●	●	●	●	x
Santo (west coast)	12	●	●	●	•	•	x	1	●	●	x	x	•	x
Santo (other)	5	●	●	●	•	●	•	14	•	●	•	•	•	•
Malo	-							4	•	●	x	x	x	x
Maewo	-							4	●	●	•	•	•	x
Ambae	2	●	●	x	x	x	x	15	•	●	•	•	•	•
Pentecost	8	●	•	•	•	•	x	6	●	●	•	•	x	x
Malekula + offshore	-							16	●	●	•	•	•	•
Ambrym	-							2	•	●	x	x	•	•
Paama	-							1	x	x	x	x	x	●
Epi	8	●	●	x	•	x	•	-						
Shepherds	-							1	x	●	x	x	x	x
Efate + offshore	6	●	●	•	x	x	x	4	●	●	x	x	x	x
Erromango	-							1	●	●	x	x	x	x
Tanna	5	●	●	•	x	x	x	2	●	●	x	x	x	x
Aniwa	-							-						
Futuna	-							1	●	●	x	x	x	x
Aneityum	1	x	●	x	x	x	x	-						
Not stated	-							1	●	●	x	•	x	x
TOTAL	48							74						

●	More than half of respondents from this island identified these signs or strategies
•	Half or less of respondents from this island identified these signs or strategies
x	No respondent from this island identified these signs or strategies

The table confirms the dominance of cyclones as the principal hazard for which signs and strategies are available across the length and breadth of the archipelago. Cyclones are ubiquitous, and no part of any island is safe. A high proportion of respondents from almost all interview sites in Vanuatu stated detailed traditional signs and resilience strategies, with the lower proportion from Pentecost for strategies reflecting reluctance to reveal them rather than a lack of knowledge. On the other hand, the USP-group showed greater awareness of cyclone strategies than of signs, with their responses probably influenced by hazard messages from government bodies diffused through the media.

For droughts, notable reports of signs came from Santo, in particular from the rain-shadow zone along its west and south-west coast (Figure 7.2). Other sites where respondents gave signs for droughts were from rain-shadow areas of north-west Efate, north-west Malekula and west Tanna; from Mota island in the Banks, where despite high annual rainfall totals, villages are located on well-drained raised coral reefs and suffer severe drought during periods of El Niño; and from high, wet islands such as Ambae, Maewo and Pentecost. A few strategies for dealing with drought were mentioned by respondents from the northern and central islands of Vanuatu coming from both Vanuatu- and USP-based groups

Signs and strategies for earthquakes and tsunamis figured more prominently among responses from the USP-based group, although Vanuatu-based respondents from Santo also made a significant contribution. Only a few participants offered responses: among the Vanuatu group, just 6 for signs and 4 for strategies; among the USP group, 13 for signs and 13 for strategies. The limited evidence suggests that people living in northern and central islands have greater awareness of earthquake and tsunami signs and strategies than those in the south of Vanuatu. The most commonly mentioned sign was erratic behaviour of birds and animals, and for tsunami, an abnormally low tide and sudden drop in the water level of a well. For strategies, besides the need to seek higher ground, one traditional method stated was to seek the shelter of a *navele* tree, whose roots are longer and more robust.

Surprisingly, only three respondents mentioned any sign or strategy for volcanic activity: the stated sign was frequent small earthquakes, while a strategy from a respondent from Ambrym was to enhance food security by digging up yams previously buried behind the family house.

If we now examine participants' responses to traditional environmental signs and resilience strategies for <u>all</u> hazards together (cyclones, droughts, earthquakes, tsunamis, volcanic eruptions), differences between the Vanuatu-based and USP-based groups are amplified (Figures 7.8 and 7.9). Thus the Vanuatu group displayed much more detailed knowledge of traditional signs of imminent hazards or changes in weather than did the younger USP cohort of students who have spent much of their lives in educational institutions where observations of changes in the natural environment are more restricted.

Figure 7.8 Knowledge of traditional environmental signs (all hazards)

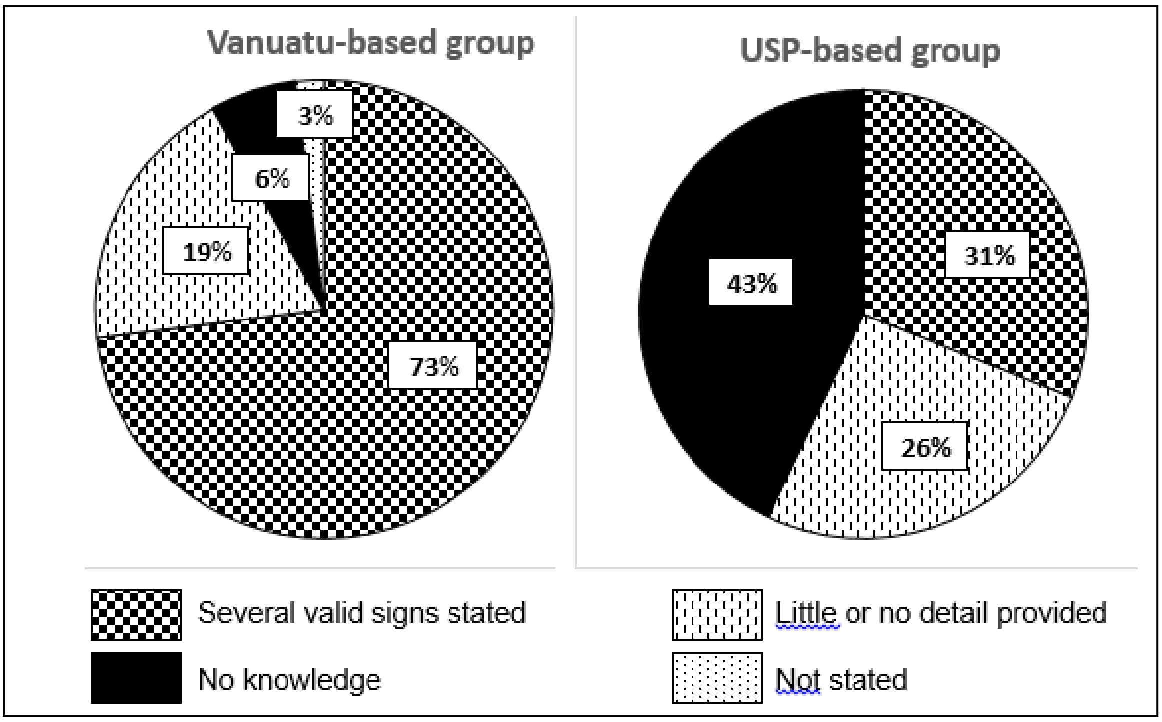
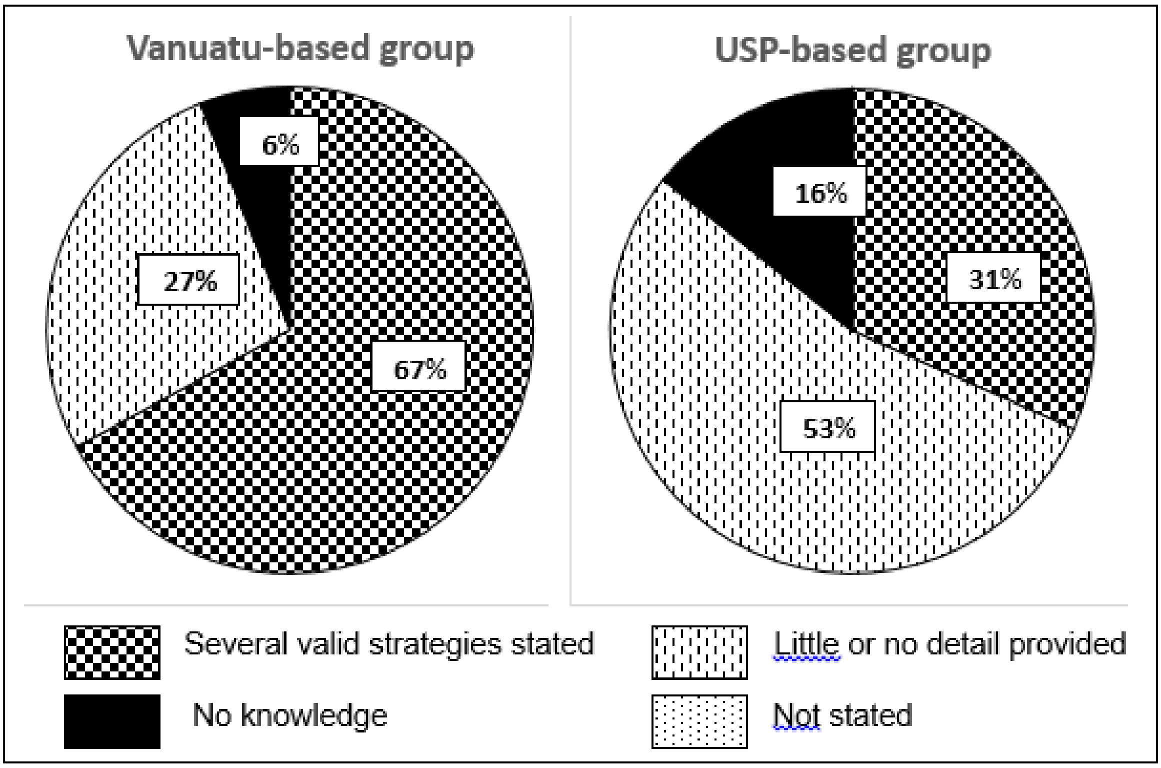


Figure 7.8 shows that 73% of the Vanuatu group had detailed knowledge of several traditional signs, while another 19% made generalised statements and 6% had no knowledge. On the other hand, only 31% of the USP cohort had detailed information, 26% gave generalised statements and 43% either had no knowledge or instead quoted modern warning systems such as sms messages and weather forecasting maps.

For traditional resilience strategies (Figure 7.9), 67% of the Vanuatu group gave detailed descriptions, 27% had generalised knowledge and 6% had no knowledge, as compared with 31%, 53% and 16% respectively for the USP cohort. As already noted from Table 7.7, the younger USP cohort displayed a better knowledge of traditional strategies for disaster resilience than they had for traditional signs of impending disasters, with responses suggesting that they had more faith in modern alerts available through mobile phones, the internet, radio and television.

Figure 7.9 Knowledge of traditional environmental strategies (all hazards)



7.5.4 Use of Traditional Signs and Strategies in Respondents' Own Lives

Respondents were asked to state whether they had used any of their received traditional knowledge of resilience in their own lives, and to provide a specific example of when or where this had happened (Table 7.8).

Table 7.8 Extent to which respondents have used TK of resilience in their own lives

Category	Vanuatu-based group		USP-based group		Total	
Yes, with a specific example	18	38%	37	50%	55	45%
Yes, but no example	30	62%	23	31%	53	43%
Not used	-	-	13	18%	13	11%
Not stated	-	-	1	1%	1	1%
TOTAL	48	100%	74	100%	122	100%

All Vanuatu respondents confirmed that they have used their received TK in their own lives, but only 38% could provide a specific example of this. For the USP group, half (50%) could provide a specific example, but 18% said that they had not used any of the TK received – which resonates with the large proportion of USP respondents (69%) who could demonstrate little or no knowledge of traditional hazard signs or of traditional resilience strategies (Figures 7.8 and 7.9).

7.6 Survey Results: Values

When asked to list one or more traditional values and attitudes that build resilience, responses from the older cohort interviewed in Vanuatu differed from those of the USP cohort (Table 7.9).

Table 7.9 Knowledge of traditional values and attitudes that build resilience

Category	Vanuatu-based group		USP-based group		Total	
	n	%n/T	n	%n/T	n	%n/T
A. Social capital: unity and solidarity, cooperation, working together, showing respect and obedience to leaders, strong leadership and governance, reciprocity, family bonds, trusted social networks, togetherness	26	54%	64	86%	90	74%
B. Personal qualities: integrity, strong work ethic, caring, friendship, love, kindness, hospitality, orderliness	5	10%	6	8%	11	9%
C. Traditional resilience strategies: traditional disaster mitigation unspecified; using/passing traditional knowledge, values and advice; ensuring food supplies through traditional farming, food storage and food preservation; traditional housing; conserving trees and using traditional ways of promoting crop growth; traditional hazard signs and warnings, including cyclone signs and observation of animal behaviour; sharing food, knowledge and communications; preparation and planning; valuing caves.	36	75%	37	50%	73	60%
D. Environmental attitudes: benefits of cyclones, pleasing the spirits	4	8%	-	-	4	3%
E. Not stated	4	8%	8	11%	12	10%
TOTAL number of values mentioned	75		115		190	
TOTAL persons completing survey (T)	48	100%	74	100%	122	100%

n = number of respondents stating this category of values
% n/T = percentage of respondents stating this category of values out of all respondents completing the survey

Overall, the 122 respondents mentioned a total of 190 values. For both groups, the two most frequently mentioned categories were social capital (A) and traditional resilience strategies (C), with the latter more important for the Vanuatu-based group and the former more important for the younger USP cohort. Regarding specific values, the most common for Vanuatu respondents was identified as “following traditional weather signs”, mentioned by 12 out of 48 respondents (25%), while the most common for USP respondents was “working together”, mentioned by 23 out of 74 respondents (31%), and “obedience to /respect for leaders”, stated by 17 respondents (23%). The responses for specific values stated by the two cohorts were significantly different, with greater proportions of the younger cohort of USP respondents stressing working together, obedience/respect, use of TK knowledge and values, cooperation and preparation. A possible reason for this difference might be that the older, village-based cohort took these social values for granted and did not feel the need to mention them.

The importance of traditional resilience strategies and social capital demonstrated by these findings supports earlier research in Vanuatu and/or Fiji by Campbell (1990), Granderson (2017), Le Dé et al (2018), McNamara & Prasad (2014) and Nakamura & Kanemasu (2019).

Responses to this question imply that despite a period of estrangement from their cultural roots, the majority of USP respondents still recognise the importance of social capital, and to a lesser extent, of traditional resilience strategies. However, a different picture emerges when we look at responses to another question that was only asked of receivers, who had to recall any basic attitudes or beliefs that the transmitter of TK had passed to them. Of the 71 USP respondents identifying themselves as TK receivers, 45 (63%) remembered traditional resilience strategies but only 2 (3%) could recall attitudes relating to social capital, or social aspects of community life; a further 18 (25%) couldn’t remember any basic attitudes at all.

7.7 Survey Results: Transmission of Traditional Knowledge

Both samples were asked to state the person(s) from whom they had received their TK on weather, climate and environmental change (Table 7.10). Of all 122 respondents, 34 (28%) said that they had received their TK from their fathers, 16 (13%) from their grandfathers, and the remaining 72 (59%) from a variety of family members or other adults. A much larger percentage of the Vanuatu adults said that they had received TK from their fathers (42%) than did the USP respondents (19%). Grandparents seemed to be more significant for the younger cohort of USP respondents than they were for the Vanuatu adults, with 22 out of 74 (30%) as compared with 10%. Another significant difference was that while just one of the Vanuatu adults received their TK from outside their extended families, 15% of USP respondents did so through the internet or teachers.

Table 7.10 Person from whom traditional knowledge was received

Category	Vanuatu-based group	USP-based group	Total
Father	20	14	34
Parents	1	6	7
Grandfather	4	12	16
Grandmother	-	3	3
Grandparents	1	7	8
Elders	1	-	1
Multiple relatives	1	4	5
Other relative – uncle, brother	-	3	3
Relative unspecified	1	8	9
Other person unspecified	-	2	2
Internet, VRAO*	1	5	6
Teacher	-	2	2
NDMO	-	1	1
Other	-	1	2
NS	18	6	24
TOTAL	48	74	122

* VRAO: Vanuatu Rainfall and Agro-Meteorology Outlook (Facebook group)

Respondents were also asked to indicate the person(s) to whom they would, or have already, transmitted their TK (Table 7.11). Only one response out of several alternatives was acceptable, and double counting was not a possibility. One third of the USP respondents (34%) said that their TK should be passed to their children, with the next highest response (12%) being for transmission to the first born son.

Table 7.11 Person to whom traditional knowledge should be transmitted

Category	Vanuatu-based group	USP-based group	Total
First born son	5	9	14
First born son, children, grandchildren	2	-	2
First born son and grandchildren		2	2
First born child	-	2	2
First born son and then other ch.	1	1	2
Boys	-	2	2
Children	6	25	31
Children with willing heart	1	-	1
Children and grandchildren	2	7	9
Children and siblings	-	3	3
Siblings	-	3	3
Nephews, nieces or cousins	1	2	3
All family / relatives	3	3	6
Next generation	-	5	5
Friends	-	1	1
Everyone	2	3	5
Those who show interest	2	-	2
Not passed	4	-	4
Other	-	1	1
Not stated	19	5	24
TOTAL	48	74	122

For Vanuatu adults, on the other hand, the highest response (40%) was for "not stated", followed by 12% each for transmission to children and the first born son. Another 6% only transmitted to those who showed interest or had a "willing heart", while 8% did not transmit at all because of a lack of interest.

A distinction was made between transmission of knowledge and the transmission of skills: TK receivers were asked how much they remembered of each on a scale of 1-4, with 4 being everything, and 1 very little. The majority of recipients in both cohorts said that they recalled "a lot" or "a little" knowledge and skills – the middle values in the scale. Average scores for memories of knowledge were higher for the USP group than for the Vanuatu group (2.9 compared to 2.6), but slightly lower for memories of skills (2.7 compared to 2.8). A surprising 25% of the USP receivers claimed that they remembered all the traditional knowledge transmitted – though they could have been thinking of modern knowledge about weather and climate rather than traditional environmental knowledge.

Finally, in response to the question on frequency of TK transmission, a majority of Vanuatu adults and USP respondents stated that the person transmitting TK to them did so repeatedly. Among the USP respondents, however, 16 (22%) said that this person transmitted their knowledge only once, possibly because they have had limited contact with that person since leaving their village to pursue secondary and tertiary education.

7.8 Survey Results: Declining Transmission of Traditional Knowledge

Providers were asked to discuss whether the transmission of TK is changing, and why. Most respondents felt that there is less transmission today than in the past, and hence there is a general decline in the amount of TK currently available. Among reasons for this decrease offered by the older cohort were that their children were no longer with them, are no longer interested in TK or that young people have lost respect for their elders. Other, more specific, reasons were that knowledge of traditional house design is perceived as no longer relevant because permanent building materials offer better protection from cyclones; that urban living precludes the demonstration of many traditional environmental signs to others; and that when children go away for education they are removed from home influences and gain preferences for processed rather than traditional foods. Among the younger cohort, however, 28 out of 74 (38%) stated that the decline in TK is because of their use of modern technology, citing the internet, social media, cell phones, and hazard warnings transmitted through the media. Other factors mentioned were the influence of urbanisation, education and Western culture and lifestyle, and the fact that young people are no longer spending time with their elders.

Results from the survey indicated that older people in rural areas of Vanuatu hold considerable knowledge of traditional weather signs and resilience strategies that they wish to transmit to younger generations, but that the out-migration of their descendants to schools and urban areas means that much of this wisdom is not being transferred. The majority of the USP students interviewed (69%) confirmed that they had little or no knowledge of traditional environmental signs or resilience strategies, but 86% had nevertheless retained awareness of key traditional values relating to social capital – working together, sharing, respect and preparation – that are important for community well-being and disaster risk reduction. Both survey groups also pointed out that TK is now being submerged under a tide of digital technology, with young people preferring to acquire knowledge through the internet, social media and cell phones – a trend that can only increase.

7.9 Role of Traditional Knowledge, Skills and Values in Resilience

We have seen that during TC Harold, greater responsibility for recovery was assumed by national and sub-national institutions. The *Malvatumauri* (National Council of Chiefs) mobilised communities to raise funds and collect relief items. Little external food aid was received, but during the months after TC Harold and under the coordination of the NDMO's Food Security and Agriculture Cluster, communities in central and southern islands donated boatloads of root and fruit crops to affected populations on Pentecost and in SANMA Province (Figure 7.10). For example, villages from Tongariki and Buninga contributed 2.3 tonnes of yams, 142 farmers from Emae supplied 11 tonnes of quality yams, while root and fruit crops have also been shipped from Erromango, Malakula, Paama and Tanna (VRAO, 2020). Such contributions testify to the importance of social capital – traditional values of sharing, cooperation, togetherness and mutual assistance – together with traditional leadership structures at national, island and community level. They also confirm the significance of traditional subsistence agriculture, with its emphasis on root crops, bananas and fruit trees grown through a bush-fallow system.

A major advantage of this sharing of locally grown food is that cyclone victims receive much healthier and more diverse food than would otherwise come through donations of rice, noodles, tinned meat and fish in food packages from overseas (Kenni & Wijewickrama, 2020). Another benefit is that a proportion of the root crops can be used for replanting in damaged food gardens, so strengthening future food security. These initiatives confirm that traditional knowledge and values give Vanuatu the potential to contribute to its own food security during future disasters, so reducing its need for overseas aid.   Indeed, the role of overseas aid must be re-assessed.

Figure 7.10 Root crops and fruit supplied from the central islands of Vanuatu arrive in Pentecost, 31st May 2020

Source: Siméon, A. 2020

In its latest report, the IPCC predicts that

> The proportion of intense tropical cyclones (categories 4-5) and peak wind speeds of the most intense tropical cyclones are projected to increase at the global scale with increasing global warming.
>
> (IPCC AR6 WGI, 2021, p.21, B.2.4)

From this perspective, aid agencies world-wide are going to be increasingly hard-pressed to fund reconstruction after cyclone-induced disasters. The reaction to TC Harold and the findings from my survey suggest that effective responses to, and recovery from, disasters lie in building greater capacity for preparedness at household, community, area council and provincial levels – processes that benefit from the use of traditional resilience strategies combined with on-going education and training on modern coping mechanisms. Building such local capacity can reduce the high cost of physical access to outer islands of Vanuatu, which regularly drains the already stretched annual budget of the NDMO and enables humanitarian aid to reach affected areas more rapidly (Ober & Bakumenko, 2020).

The role of TK in this development is stressed by a senior research officer in Vanuatu's National Disaster Management Office:

> Traditional knowledge definitely needs to be emphasised. Our forefathers have well survived the past disasters and we are proof of that. Traditional knowledge saves lives when modern knowledge is slow or lacking. Studies have shown that Vanuatu will experience more frequent and intense natural disasters. While waiting for modern knowledge to save us from a certain death, let's make use of our traditional knowledge. It is not a simple task, because traditional knowledge is slowly disappearing in the face of rising technology and change of focus from our youths.
>
> (NDMO research officer, personal communication, 7 September 2020)

7.10 Traditional Knowledge in Formal Educational Curricula

I have demonstrated that traditional knowledge, skills and values are relevant to building resilience in Vanuatu, especially for tropical cyclones, but that the intergenerational transmission of such knowledge is being eroded. Let us now consider the extent to which traditional knowledge and wisdom is being promoted in formal educational curricula. If young people are no longer gaining traditional education on resilience at the feet of their elders, can they receive it at school?

Primary and secondary educational curricula have been in process of major revision since 2010. The revised curriculum for primary schools includes aspects of resilience in Environmental Studies and Basic Science, with acknowledgement of the role of TK. Revised curricula for the junior cycle of secondary education (Years 7 to 10) are still being developed, so that in 2022, schools are reliant upon pre-2010 content in which limited coverage to climate change and disasters is provided, with no inclusion of TK. In the senior cycle, resilience issues feature in three optional subjects, but TK is only briefly mentioned in Development Studies. Furthermore, by the time students reach Year 11, 79% of those who began in Year 1 have dropped out (MOET, 2021, p.17). Thus, as demonstrated in Chapters 4 and 5, the majority of young people in Vanuatu are not benefiting from formal school exposure to resilience education, and are certainly not learning about traditional resilience strategies. This contrasts with the VCCDRRP's statement that TK should be included in formal and informal school curricula (Government of Vanuatu, 2015, p.14).

At post-secondary level, accredited courses on resilience have been offered through Certificates I & III TVET programmes at the Vanuatu Institute of Technology since 2017, but the total number of graduates to complete both courses to date is less than 50. Unlike most other programmes, these two courses do contain explicit content on traditional environmental signs of approaching hazards and traditional coping strategies. The University of the South Pacific offers on-line courses that cover climate change and disasters and make reference to TK, but again, the number of participants is limited.

TVET Certificate I at VIT has a whole unit devoted to traditional knowledge, skills and values - *CGCR0216: Use traditional knowledge to build community resilience to disasters and climate change*. Table 7.12 indicates the desired competencies to be developed, which include the demonstration of traditional techniques and field interactions with owners of TK in real communities.

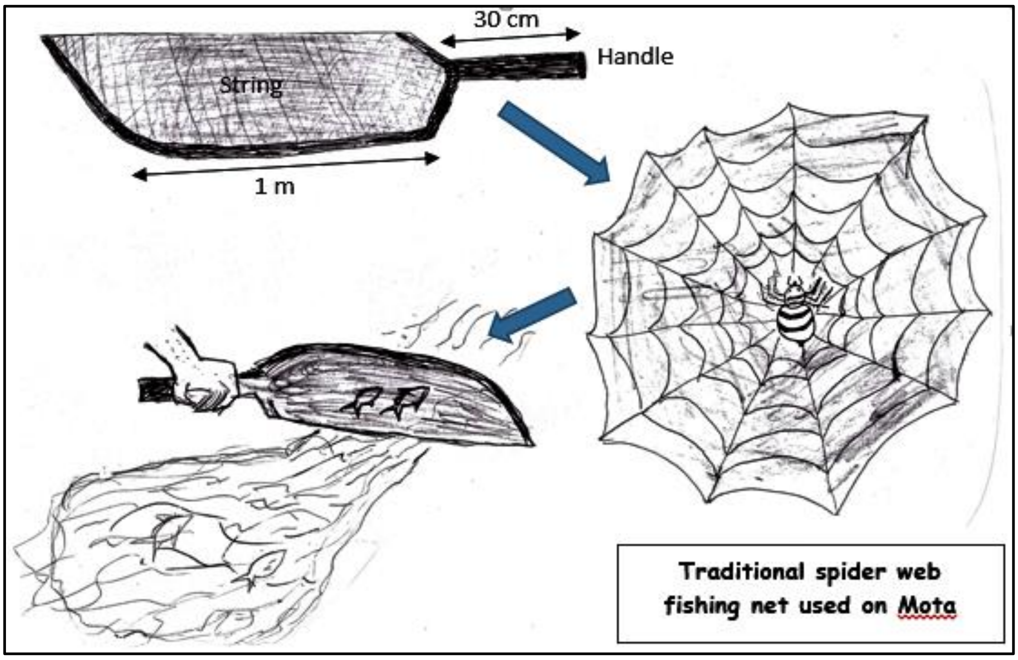
Among the pedagogical strategies used in this unit is the cross-cultural sharing of traditional resilience techniques, which vary from island to island and within islands. Learners work in island groups to research and share traditional methods of fishing (Figure 7.11), cultivation (Figure 7.12), food preservation, agro-forestry and house construction that enable a community to survive after storms, floods, droughts, volcanic eruptions and tsunamis.

Table 7.12 Desired competencies to be developed in Unit CGCR0216

ELEMENT	PERFORMANCE CRITERIA
1. Demonstrate awareness of the terms traditional knowledge and resilience.	1.1 The term traditional knowledge is used in the context of Vanuatu. 1.2 The term resilience is used in relation to hazards and climate change.
2. Examine the challenges in gaining access to traditional knowledge.	2.1 Reasons are suggested as to why traditional knowledge (TK) is disappearing in Vanuatu. 2.2 Issues relating to the ownership and sharing of TK are examined. 2.3 The types of traditional knowledge held by men and by women are differentiated. 2.4 Possible ways are suggested for overcoming the challenges associated with TK.
3. Examine ways in which traditional knowledge builds resilience to hazards and climate change	3.1 Examples of TK that help communities in Vanuatu to become more resilient to geological and hydro-meteorological hazards are provided. 3.2 A traditional calendar for a local community is produced.
4. Demonstrate traditional techniques that foster resilience.	4.1 Traditional techniques that build resilience to risks from hazards and climate change are demonstrated.
5. Promote the use of traditional knowledge in a local community.	5.1 Investigations are made into TK about hazards and climate change that already exists in a community. 5.2 Owners of TK are consulted in order to find ways in which it can be used to promote greater resilience in the whole community.

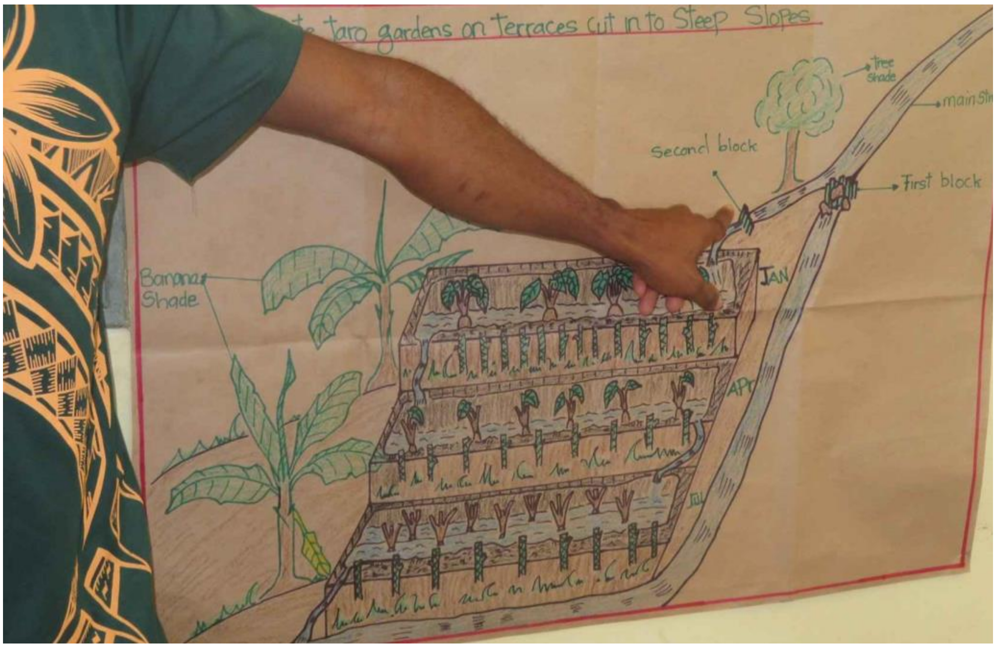
Source: Competency outline for Unit CGCR0216, Certificate I in CCDRR, VQA, 2017

Figure 7.11 A traditional fishing technique from the Banks Islands



Wogaley, E., 2016

Figure 7.12 A traditional technique of water taro cultivation from the island of Santo



Mele, F. & Author, 2017

During 2017, I observed that these student-centred activities were a source of great excitement for learners, who talked about their cultural traits with considerable pride. Equally effective was the one-on-one sharing that took place between students from different islands (Figure 7.13), often informally. These interpersonal exchanges also helped prepare learners for interviews with holders of traditional knowledge at community level during this and a subsequent unit of their course (Figure 7.14).

Figure 7.13 Exchanging traditional techniques of adaptation used on Futuna island and along the west coast of Santo

Author, 2017

Figure 7.14 Investigating traditional knowledge of disaster risk reduction in Wiana village, Emau island, North Efate

Author, 2017

Three years after completing their Certificates I and III in Resilience at VIT course, eight of these same learners who had researched, shared and demonstrated their traditional coping strategies for hazards agreed to comment on the role of such knowledge in building resilience to climate change and extreme weather events at the present time. The two relevant questions asked in the email interview, Q5 and Q6, are stated in Figure 6.12 of Chapter 6.

Table 7.13 summarizes responses to question 5, on whether and why TK is important in helping people become more resilient to climate change and disasters.

Table 7.13 Responses to the question on traditional knowledge and resilience

Why traditional knowledge build greater resilience to climate change	Number of responses
It gives us effective adaptation measures that have been developed by our ancestors to cope with disasters throughout our history	**3**
Because traditional weather indicators, e.g. cloud type, help us prepare for upcoming disasters	**3**
Because traditional techniques of food preservation, house design and building materials help us to cope with disasters	**2**
In remote parts of Vanuatu, where access to modern communication networks may be unstable or lacking, TK enables people to survive until external help arrives.	**2**
Because traditional calendars guide the timing of our agricultural activities	**1**
Because the use of traditional knowledge reduces our CO_2 emissions	**1**

For question 6, respondents were asked whether traditional knowledge should be taught in primary and secondary schools in Vanuatu, and if so, why and how. All eight agreed that it should be taught in schools. Why and how are covered in Tables 7.14 and 7.15.

Table 7.14 Responses to the question on why TK should be taught in schools

Why traditional knowledge should be taught in primary and secondary schools in Vanuatu	Number of responses
Because schoolchildren are tomorrow's leaders, so must know more about traditional knowledge and values	**2**
Because if they learn about TK and practice it at an early age, they will retain the knowledge and skills when they are adults	**2**
Because TK about the environment is getting lost in many islands as children and youth move away from home and spend less time with old people in the village	**2**
So that children can be equipped with knowledge and skills to address the impacts of CC and prepare for disasters without relying on modern technology	**2**
Children are the most vulnerable to disasters, so should be taught appropriate traditional knowledge and skills in order to adapt and survive	**2**
Because climate change is a cross-cutting issue and is inevitable	**1**

Table 7.15 Responses to the question on how TK should be taught in schools

How traditional knowledge should be taught in schools	Number of responses
Make it compulsory in primary schools	**3**
Make it compulsory for all students in secondary schools	**1**
Make it an elective subject in secondary schools	**2**
Introduce simple versions of TK into all school syllabi	**1**
Include it in syllabi for Basic Science or Social Science at junior secondary level	**2**
The person teaching TK should be a TK keeper/holder, even if on a voluntary basis	**2**
Teachers should receive appropriate training before teaching TK	**1**

In summary, official syllabi for primary and secondary education make virtually no mention of traditional knowledge, skills or values in building resilience to disasters and climate change. The only formal programmes to include traditional knowledge are Certificates I/III at the Vanuatu Institute of Technology: here, learners gain experience of traditional knowledge, skills and values from each other and through field interactions with older people in the community. Opinions expressed by a sample of these learners suggest that traditional adaptation methods, especially in food preservation, cultivation, fishing and house design, are ecologically sound and relevant to recovery after extreme hazard events, especially in remote areas. For this reason, and because the intergenerational informal transmission of traditional knowledge is declining, there must be renewed efforts to ensure that TK has a place in school curricula, perhaps using the VIT experience as a model.

7.11 The Way Forward

Evidence from a survey of older individuals in rural areas of Vanuatu demonstrates that traditional knowledge, skills and values help to equip people with the means of reading natural warning signs that prepare them for cyclones and other hazards, with strategies for mitigating the negative effects of disasters, and with attitudes that enable survival and recovery. Reports from West Coast Santo, a remote area severely affected by Tropical Cyclone Harold in April 2020, show how such traditional strategies and attitudes, together with skills learned through modern courses and awareness programmes on resilience, helped inhabitants support themselves through their own resources, not reliant on external aid. Further verification is provided by the forced localisation of responses to TC Harold throughout Vanuatu, with traditional leadership, sharing and mutual assistance able to mobilise movements of root and fruit crops to stricken populations in the northern islands.

On the other hand, a survey of ni-Vanuatu studying at the University of the South Pacific in Fiji, young people who have spent a significant portion of their lives isolated from their cultural roots and sources of traditional wisdom, indicates that although they still acknowledged many of their traditional social values, 69% of them had little or no knowledge of traditional environmental signs or traditional resilience strategies.

Generally the decline in TK is acknowledged by both survey groups as being due to reduced transmission from older to younger generations and by younger people's preference for the acquisition of knowledge through the internet, social media and cell phones. Further contributing to the decline in the use of traditional knowledge for building adaptive capacity is its near-absence from school curricula, despite this being advocated in the National Climate Change and Disaster Reduction Policy.

Yet the experience of Cyclone Harold shows that traditional knowledge, skills and values have a clear role to play in building resilience in Vanuatu, especially when used in conjunction with modern channels of communication and locally-owned institutions such as Community Climate Change and Disaster Committees.

Due acknowledgement must be accorded to the non-formal public education on resilience being fostered by the NDMO and the Vanuatu Meteorological and Geo-Hazards Department, but largely carried out by non-government and civil society organisations such as Red Cross, Care International, Save the Children, World Vision, Oxfam, Live and Learn Environmental Education, Wan Smolbag Theatre and the Vanuatu Christian Council. These organisations conduct awareness programmes for village communities and sub-national bodies such as Area Councils and CDCCCs, largely focusing on disaster preparedness and response, but recognising the importance of traditional knowledge, values and resilience strategies. This is in accord with the implementation of the VCCDRRP, which stresses that adaptation and disaster risk reduction should be 'owned and driven by communities through working within traditional and local knowledge and values so that these systems become more resilient' (Government of Vanuatu, 2015, p.18).

Despite this non-formal public education, however, there remains a gap. In mid-2021, Vanuatu had an estimated total population of 307,202 (VNSO, 2022), of whom 99,363 were enrolled in pre-primary, primary and secondary schools, ranging in official age from 4 to 19 years (MOET, 2021). The 32% of the population attending school represent a highly accessible market for resilience education – one which is presently largely untapped. Experiences in TVET courses at VIT suggest that students are readily and eagerly engaged when involved in the exploration of traditional signs and strategies for coping with environmental change, and that similar content and approaches can be employed for younger cohorts at primary and junior secondary school levels, most probably during Social Science lessons. The obvious enjoyment experienced by junior secondary students when carrying out the Climate Change Toolkit activity (Chapter 4) is further evidence that a similar student-centred approach to learning about traditional strategies for mitigation and adaptation could be viable. Teachers can draw upon their own and their students' reservoirs of traditional knowledge, but also provide opportunities for older custodians of knowledge from the local community to actively engage and share their specialised skills and wisdom with schoolchildren. At the same time, students must be empowered to hone their technological skills in accessing and interpreting meteorological and geological warnings and coping strategies through the media. Perhaps in these two ways young people will gain a more nuanced understanding of their integral relationship with the environment – one that balances scientific reason with first-hand observation and an appreciation of traditional Pacific values of respect, cooperation, humility and sustainability.

This thesis supports the recommendations of other authors (e.g. Granderson, 2017; Nakamura & Kanemasu, 2019; McCarter & Gavin, 2011) that renewed efforts must be made to document, store and promote the use of traditional knowledge and social capital. Centuries-old informal transmission pathways for building adaptive capacity for hazards and climate change must be revived and supplemented through formal and non-formal education, while at the same time recognising that resilience is at its most effective when both modern and traditional strategies are allowed to complement each other.

In relation to Research Question 2, therefore, I have demonstrated that although traditional knowledge, skills and values are very relevant to climate and disaster resilience in Vanuatu, they are in process of disappearing. Determined attempts must be made to ensure their revival and use.

CHAPTER 8: CONCLUSION

8.1 Summary and General Discussion of Results

This thesis has attempted to address two questions relating to the effectiveness of resilience education in Vanuatu, one of the planet's most at-risk countries to natural hazards. The first question (RQ1) asks whether formal school and post-school educational systems are effective in helping students to learn about climate and disaster resilience, as judged by changes in their knowledge, skills, attitudes and pro-environmental behaviours, as well as through impacts on their communities. The second question (RQ2) investigates the extent to which informal education of young people about climate and disaster resilience through the intergenerational transmission of traditional knowledge, skills and values is taking place at the present time, and whether it is of relevance to the nation's future. For RQ1, I have investigated the reality of resilience education in junior and secondary school classrooms, as well as in post-secondary settings. For RQ2, I have examined the importance of traditional knowledge, skills and values to the survival and recovery of individuals and communities in Vanuatu, documenting their declining transmission. For both questions, I have sought to compare national, regional and international policies on climate change and disaster risk reduction with the situation in Vanuatu's educational institutions and at grassroots community level.

In this Section, I will summarize the main findings obtained, relating them to RQ1 and RQ2 and to literature from other researchers.

8.1.1 RQ1: Formal Education Courses in Resilience – Overall Coverage

Learning about climate change and disasters is taking place at four stages of formal education in Vanuatu – primary (Years 1-6), junior secondary (Years 7-10), senior secondary (Years 11-13) and post-secondary. The latter includes dedicated Certificate courses in Resilience at Technical and Vocational Education and Training (TVET) level and the Post-Graduate Diploma in Climate Change (PGDCC) through the University of the South Pacific.

In addressing the research question on formal education, it has not been possible to adopt a uniform approach in collecting representative data for each of these four stages. This is partly because appropriate curricula for that level may not yet have been developed and partly due to constraints imposed by the current COVID-19 pandemic on my ability to access information. Hence the data presented for primary and junior secondary school students is not strictly comparable with that for senior secondary and post-secondary learners, and even within these last two groups, there are variations in the depth of data acquired. Further, comparisons between courses at senior secondary level, TVET Certificates through the Vanuatu Institute of Technology, TVET Certificate IV through USP and the PGDCC offered by USP must be treated with caution, since sample sizes for the latter two are very small.

8.1.2 RQ1: Formal Education Courses in Resilience – Primary Level

At primary level, where resilience issues are covered during Years 4-6 in Science and Social Science, I focused on curricular content and suggested activities. There is emphasis on interactions between humans and the natural environment, with students asked to draw upon their own experience of disasters and participate in field excursions, tree planting, interviewing people in their local community about traditional disaster signs, and discussing ways of adapting to climate change. This is coherent with the aims of climate change education advocated by Stevenson et al (2017) – requiring learning that is 'reflexive, creative and participatory', includes 'learning by doing', and sees disaster risk as an aspect of adaptation. Such a practical approach to learning is effective for children ranging in age from 8 to 16 (MOET, 2021, Table 18), and also prepares them for further exploration of resilience issues as they proceed through secondary school. The problem is that over this three-year period at primary level, learning about resilience takes up just 0.8% of class time for the whole curriculum. Such a small proportion of teaching time suggests a wasted opportunity, since students at primary level are so enthusiastic to learn about the world around them; also, there is a drop-out rate of 21.4% from Years 6 to 7 (ibid, 2021).

8.1.3 RQ1: Formal Education Courses in Resilience – Junior Secondary Level

At junior secondary level, the intended new curricula have only been introduced at Year 7 level, and students in Years 8 to 10 are still exposed to outdated syllabi that do not adequately tackle climate change or disasters. For this reason, I focused on the effectiveness of an educational resource designed to fill the gap in learning materials that address climate change adaptation measures for Pacific islands. The bilingual resource, *Learning About Climate Change the Pacific Way*, also known as the *CC Toolkit*, comprises a set of 16 wall pictures and a comprehensive Teacher's Guide useful at all levels of secondary education. I designed a diagnostic questionnaire for completion by students before and after they undertook a classroom intervention that involved discovery learning from the pictures, and facilitated several training sessions with teachers of Science and Social Science before the COVID-19 pandemic took effect. Quantitative data was obtained from 363 students in 19 classes in nine Vanuatu schools on five different islands, supported by qualitative data collected remotely from their teachers.

In terms of baseline knowledge, average scores for the 363 students showed that even before the intervention they already had a reasonable understanding of weather, human and natural factors as causes of climate change, El Niño as a cause of drought, cyclones and droughts as Vanuatu's greatest climatic hazards, compost as a sustainable form of gardening, and human activities responsible for GHG emissions. Their knowledge of the physical processes involved in global warming and ocean acidification was weak. Pro-environmental behaviours reflected students' experience of severe cyclones and strategies diffused by the National Disaster Management Office. Overall achievement was approximately 25% of the level that would indicate a high degree of resilience to disasters and climate change.

After participating in the CC Toolkit activity, students improved their average scores in 26 out of 27 items in the questionnaire, but were still confused between adaptation and mitigation, and their understanding of the physical processes of evaporation, ocean acidification and the enhanced greenhouse effect did not advance significantly. Students became more confident in their knowledge of the causes and impacts of climate change, and their marked increase in the score for intended behaviour showed that the Toolkit had exposed them to a much wider range of adaptation strategies that might otherwise be known. As illustrated in Figure 2.5 – the model of factors contributing to responsible environmental behaviour (Salter, 2013) – the Toolkit provided knowledge of climate change issues and possible action strategies, which in turn led to students' intentions to carry out these adaptation measures to help their family and community. Whether the intention was then translated into action was not measured. Overall, students' achievement was now approximately 44% of the level reflecting a high resilience to disasters and climate change. Factors that may have impacted negatively on results include the acquiescence response bias affecting three items in the Agree/Disagree section of the questionnaire, and inadequacies of language, which interfered with cognitive processes of interpretation and evaluation required in items like Qs 13, 15 and 25.

Interviews with teachers who had facilitated the activity revealed that they appreciated the manner in which its cooperative and discovery learning strategies engaged their students. This confirms Vygotsky's theory of social constructivism, whereby significant learning occurs when individuals are involved in social interaction and collaboration (Amineh & Asl, 2015). Teachers also valued how the Toolkit dealt with real-life situations in a Pacific island context and appeared to have an impact on attitudes and intended patterns of behaviour. Yet they made no comment on students' misunderstandings of mitigation and adaptation, scientific processes involved in the enhanced greenhouse effect or the absorption of carbon dioxide by forests and oceans.

Within the larger sample, a smaller cohort of 209 students was examined to see whether gender had played a role in responses. Results showed that the average overall scores for females and males, both before and after the intervention, were almost identical, as was the magnitude of improvement. Scores for knowledge items showed a similar pattern. For attitudes, boys showed a greater improvement than girls, while for intended behaviour, girls' scores improved more markedly than did those of boys.

Average scores for all items before the intervention were significantly higher in those classes taught by female teachers than those taught by males, but when students carried out the activity, those taught by male teachers then attained similar scores to those taught by females, possibly implying that male teachers were more effective overall in the activity's implementation. The same pattern was observed for knowledge and attitude items, but not for the short-answer question on behaviour, in which female teachers were more effective than males, perhaps because of their greater risk perception of environmental hazards and their innate tendency to stress the importance of caring for family and community – as suggested by Bord & O'Connor (1997), Tzelezny et al (2000) and Kiao & McCright (2012).

One of the most significant findings around gender was that in terms of performance, there was a close link between gender of student and gender of teacher: female students performed better when their teacher was female, and male students performed better when their teacher was male. In this sense, my research confirms the findings of Muralidharan & Sheth (2013) and is not in accord with those of Hadjar et al (2014). Another was the discovery that females had significantly higher scores than males when the CC Toolkit activity was conducted in urban schools, but not in rural schools. Among the reasons advanced by teachers for this pattern was that in an urban setting, Year 9/10 boys are more easily distracted from their studies than girls, mainly because of the influence of alcohol, cigarettes, kava, marijuana, peer pressure from those who have already left school, greater personal freedom and access to the internet. This finding resonates with contemporary research on Efate island by Nakaseko et al (2022), who found that underage drinking and smoking was more prevalent among urban than rural students, and among boys rather than girls.

Another comparison was the performance of English-and French-speaking students. The Toolkit benefited them in different ways, significantly improving the knowledge of the former and the intended behaviour of the latter, but maintaining similar scores for attitudes. Overall, English speakers performed better and showed greater improvement. I am not aware of any other comparable academic study in the context of Vanuatu that either confirms or negates this finding, although the National Examinations Office will hold confidential information on the relative performance of English- and French-speaking students in country-wide assessments.

A final comparison was made between students from urban and rural schools, which confirmed that there was no significant difference between average overall scores before and after participating in the intervention. Urban students performed better than rural students in short-answer questions testing knowledge and behaviour, but this was balanced by rural students outperforming urban students in the agree/disagree items on knowledge and attitudes.

Regarding the erosion of knowledge, attitudes and intended behaviour over time, results from a very small sample from just two schools show that the CC Toolkit is only effective in the short term and needs to be reinforced by follow-up activities.

In response to RQ1, there is quantitative evidence that the Toolkit activity is effective in increasing students' knowledge and in motivating their intention to carry out a range of adaptive measures to climate change. If it is delivered in a constructivist manner that combines discovery learning with discussion in small groups, its efficacy will be further heightened. There is still a role for the teacher, however. A committed, enthusiastic educator will also use the activity to foster student skills in observation, communication, literacy and numeracy; encourage attitudes that promote sustainable development; stimulate enquiry into the difference between adaptation and mitigation; and arouse interest in the physical processes underpinning climate change and hydro-meteorological disasters.

8.1.4 RQ1: Formal Education Courses in Resilience – Senior Secondary Level

Resilience education at senior secondary level is in its infancy, and as yet reaches a limited audience. Climate change and disasters are covered in depth in Years 11 to 13 in three optional subjects within the new common curriculum – Geography, Development Studies and Earth Science. However, the high rate of educational attrition – estimated at 82% between Year 1 and Year 13 – means that the vast majority of young people in Vanuatu do not in fact reach this level. The common curriculum, devised in 2011-2013, was only launched for Year 11 students in 2019. In 2021, the most effective in-depth study of CC and disasters occurs in all three years of Earth Science and in Year 13 of Development Studies by students who opted for these subjects, but this only applies to a minority of those in French-medium schools – schools that cater for just one third of all Year 11-13 students. In the larger cohort in English-medium schools, students are learning about resilience in Years 11 and 12 in the three optional subjects, but are missing out on the more meaningful aspects covered in Year 13. Even by the end of 2023, when the curriculum has been fully implemented in all schools, the subject that has the best treatment of resilience issues – Earth Science – will continue to have the least number of learners.

Views on the effectiveness of resilience education were obtained through a survey of 180 Year 11-13 students from 20 classes in the three optional subjects. As indicated in my Literature Review, ideas for these questions came from research in schools in Australia (Fletcher et al, 2014), India (Mishra & Suar, 2007), Philippines (Mamon et al, 2017), Sweden (Ojala, 2013) and world-wide (UNICEF & UNESCO, 2012), but were contextualized to Vanuatu. This thesis appears to be breaking new ground in that the questionnaires designed to measure the effectiveness of learning about climate and disaster resilience combined assessment of students' changes in knowledge, skills, attitudes and behaviour with evaluation of the relative importance of course delivery and course materials, analysis of pedagogy, and relevance to a model for resilience education (Figures 2.14 and 6.22) – all in a Pacific island context.

On a scale of -2 to +2, the overall average score for 30 pedagogical aspects of resilience education was 1.21, indicating students' moderate level of satisfaction with their experience. In all three subjects, aggregated scores for course delivery were higher than those for course materials, implying that the teacher has a greater influence on student performance than learning resources or other factors, as also demonstrated in different contexts by Polk (2006), Napoles & Macleod (2013) and Paolini (2015). The inadequacy of learning materials was exemplified by the low scores for statements on quality of resources and use of visual aids. In general, students rated teachers highly for their helpfulness, communication skills, use of questioning and promotion of cooperative learning, but were less impressed by their punctuality, degree of enthusiasm and respect for their pupils as individuals. In terms of course characteristics, the low scores for level of stimulation to know about resilience issues and preparation for disasters suggest that students may not be sufficiently motivated to further their learning and take action on climate change. Although sample size and language used in the questionnaire may have affected the results, evidence from student responses suggests that Earth Science is the subject with the greatest effectiveness in promoting resilience education.

The same survey disclosed that most students enjoyed learning about resilience because of the knowledge gained, not because of any new skills being learned. Similarly, most students identified items of knowledge as being the most important aspects of resilience acquired, with skills of minor importance and no mention of attitudes or behaviour. For desired improvements to the course, three key themes emerged – expanding the reach of resilience education to others outside the classroom, a greater use of visual materials, and the involvement of students in field and practical experiences.

When senior secondary students assessed their progress in terms of knowledge, skills, attitudes and behaviour, average scores did not differ significantly between Geography (0.62), Development Studies (0.60) and Earth Science (0.61), and indicated that a low/moderate degree of effectiveness in resilience education had been achieved. Within knowledge items, the highest levels of awareness were for anthropogenic climate change as a contemporary global issue and ash falls as a source of food and water insecurity, while there was a lack of understanding about atmospheric CO_2 concentrations, the effectiveness of sea walls and the relationship between earthquakes and tsunami. For skills, students probably overstated their capacities to give awareness talks, implement vulnerability surveys and hazard risk maps at community level, or demonstrate an adaptation strategy. Most attitudes were positive, although there was low acceptance of personal responsibility for reducing one's own carbon footprint. Pro-environmental behaviours had the lowest scores of all, perhaps reflecting the lack of specific outcomes in the syllabi related to practical actions.   I am unable to compare these findings with literature on similar quantitative studies of the effectiveness of resilience education among secondary school students in other countries: other surveys have focused on one rather than all aspects of resilience – for example, awareness and perception of disasters (Mamon et al, 2017), perception of climate change and pro-environmental behaviour (Ojala, 2013).

Further insights into the effectiveness of resilience education at senior secondary level came from responses by a sample of teachers to questionnaires on course content, strategies for teaching, learning and evaluation, and on their subject-specific experiences. When assessing the importance of six categories of course characteristics, teachers gave higher scores for overall attitudes, pedagogy and knowledge and lower scores for behaviour, attitudes and skills. The much lower score for skills contrasted with the higher scores for skills given by the students themselves, but this difference probably arose because statements in the teacher survey were theoretical, while those in the student survey were practical. A concerning issue that emerged was the minimal importance placed by teachers on aspects such as avoiding consumerism, traditional knowledge and fieldwork, coherent with the findings of Kagawa & Selby (2009). Regarding teaching and learning techniques, the most widely practiced of the modalities suggested were teacher-directed, with student-centred strategies involving practical experiences inside and outside the classroom of lesser importance – a pattern found ten years ago by UNICEF & UNESCO (2012) through research into DRR education in 30 countries. These same findings were also independently identified by the students themselves. Similarly, the most popular evaluation techniques were recall and knowledge acquisition, with only infrequent use of output- and action-oriented strategies – echoing investigations in the same survey (ibid, p.35):

> Imaginative forms of assessment that match with active, action-oriented and competency-based learning are largely notable by their absence.

In terms of teacher experiences, almost half the teachers thought that students had no difficulty in understanding the causes and impacts of climate change, while an equal number perceived the opposite. None mentioned students' misunderstandings of adaptation, mitigation or the scientific processes involved, perhaps reflecting their own uncertainty of the complexities of climate science (Stevenson et al, 2017); neither did they comment on students' skills, attitudes or behaviour – as if these aspects were irrelevant. For educational resources, teachers said that they must use their own initiative to find suitable materials in line with official learning outcomes. A majority depend on the internet, but this can be challenging in rural schools because of intermittent receptivity, power failures and breakdown of hardware and equipment. Relevant bilingual educational resources exist in hard copy but are largely untapped. At this early stage in the unfoldment of resilience education at senior secondary level, much rests with the individual teacher. Yet from my own educational immersion in Vanuatu, I believe that a resourceful teacher would be able to access the information required and draw upon the considerable experience of disasters and community resilience that many young people already possess, especially if student-centred learning strategies are adopted.

In general, results from both student and teacher surveys suggest that greater depth, stimulation and creativity is needed in the teaching of resilience issues at senior secondary level. This is because syllabi focus on cognitive learning rather than on practical skills and action-oriented behaviours, also because of the inadequacy of teaching and learning materials in use. There is a need to foster approaches that awaken awareness of a planetary emergency and build greater capacity for critical thinking and empowerment to act (Stevenson et al, 2017). We can conclude that in answer to Research Question 1, resilience education for senior secondary students in Vanuatu is not yet fulfilling its potential and has limited effectiveness. In addition to the pedagogical deficiencies just mentioned, only a minority of students have reached this level, and of those, just one third are studying a subject that includes climate and disaster topics – estimated at 6% of the cohort who began in Year 1. These two factors lead to a third justification for my assessment – that the impact of these courses on the wider community remains low.

8.1.5 RQ1: Formal Education Courses in Resilience – TVET Courses at VIT

Technical and Vocational Education and Training (TVET) courses in resilience began in 2017 at the Vanuatu Institute of Technology (VIT), with financial and technical assistance provided by multilateral donor agencies, and were hailed as the first such courses to be offered in the Pacific region. Once the first Certificate I and III programmes had been delivered, VIT assumed full responsibility for their administration, with a substantial reduction in financial input. In 2021, the two courses were merged into one Certificate III curriculum, and by 2022, the fifth cohort of learners is taking this combined programme of 15 modules.

Both Certificates I and III are different from senior secondary courses in that they are competency-based, requiring learners to demonstrate concrete skills rather than abstract concepts. They also have learning materials specifically designed for Vanuatu that provide practical, hands-on training to enable participants become agents of change at community level. Pedagogical elements reflect a “communities of enquiry” approach (Lower, 2021), with an emphasis on collaborative enquiry, social constructivism, and empowerment of learners to interact with others in the creation and application of knowledge.

Research into three cohorts of learners who have taken these Certificate courses used the same questionnaires as those for senior secondary students and teachers, as well as additional instruments for assessing student characteristics and their perception of the relative importance of teacher, course and student. There were also two further surveys conducted with the first (2018) cohort of learners one year and three years after course completion. Because of difficulties imposed by the COVID-19 pandemic, most information was obtained remotely, with data drawn from samples rather than whole populations of learners.

For questionnaire QS1, learners from the first cohort to complete both courses in 2018 gave a higher score for overall course effectiveness (1.72 on a scale of +2 to -2) than that awarded by later cohorts or by any of the senior secondary classes surveyed – reflecting the advantages experienced by this particular group in terms of pedagogy and educational resources. Learner perceptions suggest that there has been a decline over time in the effectiveness of resilience courses at VIT, with the decline more marked in course delivery than in course materials. As for senior secondary classes, this suggests the pre-eminence of the facilitator/teacher in influencing student progress. Possible reasons for this decline in effectiveness are the severe reduction in funding – particularly affecting practical fieldwork at community level – and the replacement of the initial facilitator by local staff who faced unprecedented challenges arising from VIT's responsibility for delivery. Nevertheless, when aggregated scores from all three VIT learner cohorts were compared with those for all senior secondary students taking resilience courses, they were higher overall and in the vast majority of individual items assessed; facilitators at VIT were seen as using more visual materials and demonstrating more enthusiasm, compassion and willingness to treat students as individuals, and the course as having more exciting learning materials and fostering greater motivation to take action on climate change. Responses from open questions asked of VIT learners about aspects most enjoyed and considered most important confirmed that the acquisition of specific skills became less valuable for later VIT cohorts, but was still of greater significance than it was for senior secondary students. When suggesting how the course could be improved, the most recent VIT cohort expressed needs relating to pragmatic classroom realities, such as bilingual teachers and course books in colour.

Regarding learner perceptions of factors affecting their progress (QS2), it was only possible to obtain data from two VIT cohorts. Findings suggest that when VIT assumed full responsibility for course delivery in 2019, learners felt less confident and more prone to financial stress. In terms of which had the greatest influence on student progress – the course, the facilitator or the student (QS3) – data from these same two cohorts confirmed that by far the most influential was the facilitator. One other trend implied was that course materials and pedagogical strategies had declined in quality between 2018 and 2020, since fewer financial resources were available for study guides and fieldwork.

Learner views on changes in their knowledge, skills, attitudes and behaviour (QS4) were collected from three cohorts of learners, with the sample representing 69% of all students involved. Learners from the 2018 cohort had the highest scores for knowledge, skills and attitudes and the highest score for all aspects combined, as compared with the other cohorts, but this could only be measured at the conclusion of their entire programme of resilience education. Learners in the 2020 cohort gave their views at the outset and completion of their Certificate III course: while their average score for knowledge declined from start to end, they showed a significant improvement in skills, attitudes, behaviour and in all aspects together, with their scores for skills and behaviour matching those of the 2018 cohort. For the 2021 cohort of learners, there was a notable advance in knowledge, skills, attitudes and overall scores between start and end of the Certificate I course, although scores for behaviour declined. One notable feature of average scores awarded by all three cohorts was that skills achieved by far the highest score of all four aspects, partly explainable by the intrinsic nature of the TVET courses in requiring participants to develop specific skillsets, and partly by efforts of facilitators to give their students field experience in which such skills could be learnt and demonstrated to others.

Analysis of teacher/facilitator views on course characteristics and pedagogy (QC1 and QC2) also demonstrated the difference between the wider coverage of aspects of resilience education and greater emphasis on student-centred teaching, learning and evaluation techniques in the VIT courses as compared with the more traditional techniques used in senior secondary schools. Note, however, that questionnaires used to measure these features were based upon my proposed model for resilience education, which itself drew heavily on my own experiences during the creation and delivery of the VIT courses – leading to a possible bias in favour of those courses.

Finally, surveys conducted with the first (2018) cohort of graduates from the VIT resilience courses revealed that one year after course completion, the overwhelming majority were confident in their ability to make use of knowledge gained about climate change, including methods of adaptation and mitigation, as well as in public speaking, risk mapping and interacting with communities. Three years after course completion, most of the sample named the causes and impacts of climate change and adaptation/mitigation strategies as being the most important aspects of knowledge learned, could recall precise practical adaptation and mitigation skills they had gained, quoted community- and environmentally-oriented attitudes coherent with the objectives of resilience education, and identified pro-environmental behaviours to promote community awareness that they had continued to practice. The majority of the sample have clearly had some degree of impact on their local communities. An implication is that the practicalities of resilience education have been embedded in their words and deeds, so indicating the effectiveness of their training.

In relation to RQ1, positive changes in students' knowledge, skills, attitudes and behaviour suggest that this TVET course is effective in the way it motivates participants to be proactive in dealing with climate change and disasters. With a pedagogy that is 'dynamic, interactive, experiential and participatory' (Kagawa & Selby, 2012, p.214), it exemplifies an educational response to climate change characterized by 'active social learning that develops capacity for personal and societal transformative practice' (Stevenson et al, 2017, p.9), and provides evidence of real impact on community life in remote rural areas. It is less effective in terms of the limited number of participating students who can currently benefit from the programme.

8.1.6 RQ1: Formal Education Courses in Resilience – Other TVET Courses

The effectiveness of TVET Pacific Regional Certificates in Resilience has also been assessed, focussing on Certificate IV offered through the University of the South Pacific. This online course targets people already working or desiring to work in a resilience-related field. The same questionnaires used with TVET Certificate I & III courses at VIT were completed remotely by a small sample of six learners and two facilitators.

For learners' assessments of the effectiveness of materials and course delivery (QS1), the overall score was 1.37, similar to that for Certificates I & III (1.39). But in contrast to VIT learners and senior secondary students, their score for course materials (1.50) was significantly higher than that for facilitator effectiveness (1.30), suggesting that learning materials were much more important than course delivery – a feature confirmed by their responses to statement 30. For Certificate IV learners, nearly all characteristics of course materials gained much higher scores than those awarded by VIT learners and senior secondary students.

In explaining why they enjoyed the course, most Certificate IV learners appreciated the teaching and learning strategies used, especially the promotion of cooperative learning within country and flexibility in the submission of assessments. For improvements to the course, the most common response was to have face-to-face sessions to clarify understanding.

In their evaluation of knowledge, skills, attitudes and behaviour (QS4), Certificate IV learners gave much higher scores than Certificate I/III learners for skills and attitudes, slightly higher for behaviour and lower for knowledge. The high score for skills contrasted with that awarded by facilitators in QC1, perhaps because the learners were drawing upon skills obtained through their work experience or previous resilience education. Certificate IV learners performed better than other cohorts in behaviours such as advocacy for action on climate change, talking about climate change with the family and assisting the CDCCC in their community.

Regarding the course characteristics measured in QC1, average scores were higher for attitudes than those for TVET courses at VIT, were broadly similar for overall attitudes but much lower for pedagogy, knowledge, behaviour and especially skills. Within pedagogy, the score for fieldwork was significantly less. Results need to be treated with caution, however, in view of the small sample size of respondents in both Certificate IV and Certificates I & III. Also, the aspects listed in questionnaire

QC1 may not be appropriate for Certificate IV since its focus is not on basic skills but on risk assessment and the administration of projects to address adaptation in specialized fields.

For teaching, learning and evaluation techniques (QC2), Certificate IV respondents showed great diversity of views, with learners tending to be harsher in their judgements than the facilitators. Overall, the results had little correspondence to those for the VIT Certificates, although there was some similarity between scores for affective learning, knowledge acquisition and demonstration of skills and knowledge.

In relation to RQ1, Certificate IV is judged to be effective in terms of knowledge, attitudes and skills, and to a lesser extent in behaviours nurtured. Although it promotes independent learning, the range of pedagogical techniques is more limited than with face-to-face courses at VIT, with less emphasis on practical and field experience. Its impact on communities has not been measured: in terms of the low volume of participants, it will be minimal, but if it fulfils its potential to help project administrators improve adaptation measures in managing natural resources and human activities, its effectiveness will be heightened.

8.1.7 RQ1: Formal Education Courses in Resilience – PGDCC

Quantitative and qualitative data on the Post-Graduate Diploma in Climate Change offered through USP was collected from a very small sample of four ni-Vanuatu learners, all of whom work in a professional capacity or pursue academic research. Participants completed questionnaires QS1, QS4, QC1 and QC2.

For course delivery and materials, PGDCC learners gave an overall score of 1.73, the highest among all groups and classes who completed questionnaire QS1, with course materials seen as marginally more effective than the facilitator. Learners appreciated the teaching, learning and evaluation strategies used, particularly the freedom for independent learning associated with on-line education. Suggestions for course improvement included fieldwork as a core component, more emphasis on traditional knowledge, and opportunities for work experience factored into the programme.

In their assessments of knowledge, skills, attitudes and behaviours gained through the course, the overall score for all aspects was the highest for any cohort completing QS4 and was much higher than the others for behaviour.

The wide-ranging coverage of this course can be gauged by the high average score (1.87) for course characteristics (QC1) awarded by participants. Compared to TVET programmes, the PGDCC had higher scores than Certificate IV in all six categories of characteristics, and broadly similar scores to those for Certificates I & III. Detailed responses from one of the learners showed the impact that this course can have on participants' knowledge, skills, attitudes and especially behaviour.

Regarding perceptions of teaching and learning techniques (QC2), PGDCC learners scored six of the seven categories more highly than did Certificate IV learners, but agreed that field experiential and action-oriented strategies were least used. Neither course attempts to measure oral contributions by learners, as is done in the VIT TVET Certificates, and this may be considered as a deficiency, since a protagonist of climate change education needs to develop communication skills at community level as well as in policy-making and administrative circles.

In response to RQ1, this course appears to offer an effective form of resilience education, although my assessment is based on findings from a very small convenience sample. The course covers almost all aspects of the model for an educational programme on resilience and outperforms other TVET programmes and senior secondary courses in terms of course materials and delivery as well as impacts on participants' knowledge, skills, attitudes and behaviour. However, the potential number of beneficiaries from this course is limited, for financial and academic reasons, and direct face-to-face impact on grass-roots communities is likely to be minimal.

8.1.8 RQ1: Formal Education Courses in Resilience – A Mismatch with Policies

Vanuatu's two national policies on climate and disaster resilience – the Vanuatu Climate Change and Disaster Risk Reduction Policy (VCCDRRP) and the National

Sustainable Development Plan (NSDP) – set objectives for the period 2016-2030. Under the VCCDRRP, school curricula are to adopt an integrated approach to CC and DRR and to include traditional knowledge of early warning and coping strategies. The NSDP's objective 3.4 requires public schools to use CC and DRR modules in the national curriculum at all levels. Both policies have been developed within the context of international and regional frameworks of which Vanuatu is a signatory – all of which stress the role of formal curricula in building climate and disaster resilience.

Data from TVET and post-graduate courses in resilience has demonstrated that post-secondary programmes are fulfilling the above policy goals, even though the number of learners is minimal in relation to Vanuatu's total population. For school courses, however, the reality is different. Despite the emphasis of all policies on the education of students at all levels about resilience issues, evidence from my research at primary and secondary levels during 2020-2022, five to seven years into the life-span of those policies, reveals a mismatch between formal school education on resilience and the policies that advocate such education – a situation inconsistent with the nation's high level of vulnerability to disasters and the impacts of climate change.

The first reason for this disparity is that the VCCDRRP requires the mainstreaming of CCA and DRR into the National Curriculum Statement (NCS), but this statement was published in 2010, five years beforehand: there is no reference to DRR and CC has only a cursory mention. The NCS has not been updated, yet constitutes the basis for all curricula currently being developed, and there are minimal guidelines on resilience issues.

Secondly, implementation of new formal curricula that do contain resilience issues has been delayed. Vanuatu's first submission to the Paris Committee on Capacity-building (PCCB) in 2017 focused on the Certificate I course in CCDRR at VIT, but teaching school students about resilience was not mentioned. However, in its 2019 report to the United Nations on the implementation of SDGs, the Vanuatu Government pointed out that from 2017 onwards, the national curriculum at all levels now incorporates climate and disaster modules. The reality in 2022 is that such modules are only being taught in all schools at upper primary level (Years 5/6) and in French-medium schools at senior secondary level (Years 11-13). Students in Years

7-10 in all schools and in Year 13 in English-medium schools (two-thirds of all secondary schools) are still following out-of-date syllabi in which resilience issues have low importance.

Thirdly, the most effective education on CC and disasters takes place at Years 12 and 13 level, by which time the high rate of attrition means that more than four fifths of students who began in Year 7 are no longer in school. Moreover, such resilience education is confined to the optional subjects of Geography, Development Studies or Earth Science – each studied by one third or less of all who reach this level. The percentage of students receiving the most valuable resilience education is estimated at just 6% of those who began their education in Year 1. The most pertinent of the optional subjects, Earth Science, has the least number of students.

Lastly, the content of school curricula in resilience regarding knowledge, skills, attitudes and behaviours must be questioned. Upper primary curricula provide basic knowledge and foster skills and field experience, but teaching hours constitute 1% of total classroom time. At senior secondary level, syllabi in the three optional subjects lack practical training on strategies for mitigation and adaptation; avoid participatory, field and affective learning; and have little emphasis on avoiding consumerism, the role of traditional knowledge and environmental stewardship. Furthermore, building capacity for climate and disaster resilience does not only depend on the amount of time allotted in the curriculum. My research suggests that the most effective resilience education results from stimulating teaching and learning materials, student-centred pedagogy that involves experiential learning, enthusiastic and committed teachers and facilitators, and a high level of student motivation.

8.1.9 RQ2: Informal Education in Resilience – Transmission of Traditional Knowledge

A survey of 48 “providers” and “receivers” of traditional knowledge, skills and values from rural areas in eight islands of Vanuatu showed that resilience to cyclones and other hazards can be built through reading natural warning signs, implementing strategies for mitigating their negative effects and displaying attitudes that enable survival and recovery. Data collected through semi-structured interviews was complemented by reports on experiences during and after Category 5 Tropical Cyclone Harold in April 2020. In the remote area of West Coast Santo, for example, traditional strategies of food preservation and house design, supplemented by skills learned through modern awareness programmes on resilience, empowered inhabitants to support themselves through their own resources rather than waiting for the arrival of external aid. In other locations within Vanuatu, traditional values of leadership, sharing and mutual assistance enabled food crops to be transferred to afflicted populations in the northern islands in the absence of the normal inflow of overseas aid that was severely restricted by the COVID-19 pandemic.

The survey was extended to a younger cohort of 74 respondents from 15 islands who were studying at the University of the South Pacific in Fiji. They answered the same questions for "providers" or "receivers" as those in the Vanuatu-based group, but most did this in the form of self-completed questionnaires.

Key findings relate to the identification of traditional environmental signs of imminent hazards and traditional strategies for building resilience to such hazards, echoing research in Pacific islands by Campbell (1990), McMillen et al (2014), Lefale (2010), Percival (2008), McNamara & Prasad (2014). Data was differentiated by category of hazard – tropical cyclones, droughts and all hazards – with the greatest proportion of all signs and strategies being identified for cyclones. When participants' responses were considered for all traditional hazard signs and strategies (cyclones, droughts, earthquakes, tsunamis, volcanic eruptions), the Vanuatu-based group displayed much more detailed knowledge than did the younger USP cohort who have spent much of their lives at school away from a village environment. For example, 73% of the Vanuatu group had detailed knowledge of several traditional signs and 6% had no knowledge, compared to 31% and 43% respectively for the USP-based group. With traditional resilience strategies, 67% of the Vanuatu group gave detailed descriptions and 6% had no knowledge, while comparable figures for the USP-based group were 31% and 16%.

Regarding traditional values and attitudes that build resilience, the two most frequently mentioned categories by both groups were "social capital" (cooperation, unity, respect for leaders, reciprocity, family bonds, trusted social networks, etc.) and belief in traditional resilience strategies – a finding that confirms other research in Vanuatu mentioned in Chapter 2 (e.g. Campbell, 1990; Fletcher et al, 2013; Granderson, 2017; Westoby et al, 2020). The former were more important for the younger USP-based group and the latter for the older Vanuatu-based group.

Studies of the intergenerational transmission of traditional knowledge about weather, climate and environmental change in Pacific islands mention traditional pathways (e.g. Apis-Overhoff, 2017; Tuisavusavu, 2017) and stress its decline in the face of education, urban migration, a capitalist economy, globalization, and climate change (e.g. McNamara & Prasad, 2014; Granderson, 2017; Nakamura & Konemasu, 2019). Empirical evidence of the effectiveness of such transmission, measured by its use and relevance to young people and their communities today, has not been documented, constituting a gap that my research attempts to fill. .

For transmission of traditional environmental knowledge (TEK), 28% of all respondents said that they had received their TK from their fathers, 13% from their grandfathers, and the remaining 59% from a variety of family members or other adults. Fathers were more important for the Vanuatu adults, while grandparents were more significant for the USP respondents. Only one of the Vanuatu adults received their TK from outside their extended families, but 15% of USP respondents received theirs through the internet or teachers. In terms of frequency of TK transmission, a majority of both groups confirmed that the person transmitting TK to them did so repeatedly. Most respondents felt that there is less transmission of TK today than in the past. The older cohort suggested that this decline in the amount of TK available has occurred because young people in their village have moved away and are no longer spending time with their elders, are no longer interested in TK or have lost respect for their elders. Just over one third of the younger cohort surveyed attributed the decline to their use of modern technology, citing the internet, social media, cell phones and hazard warnings transmitted through the media.

In general, my survey attests to the declining intergenerational transmission of traditional knowledge, skills and values. Older people in rural areas hold considerable knowledge of traditional weather signs and resilience strategies that they want to transmit to younger generations, but the out-migration of their descendants precludes this transmission. Most of the younger USP-based group confirmed that they have little or no knowledge of traditional environmental signs or resilience strategies, although 86% have retained awareness of traditional values relating to social capital that are important for community well-being and disaster risk reduction. Both groups corroborated the manner in which digital technology is seen by younger generations as a replacement for traditional knowledge.

On the other hand, two developments suggest that traditional knowledge still has a role to play in building community resilience in Vanuatu.

Firstly, the experience of TC Harold showed that traditional warnings and resilience strategies enabled populations in remote areas of Vanuatu to survive and begin to recover in the absence of external assistance. Further, traditional values of leadership, mutual assistance and cooperation – social capital – contributed to the mobilization and distribution of food aid from less affected parts of the country, confirming the significance of traditional subsistence agriculture to food security and reducing the need for overseas aid. As our planetary climate warms and the incidence of extreme weather events increases, aid agencies may not have the capacity to meet the demands of relief work after intense cyclones, floods and prolonged droughts. But in countries such as Vanuatu, response and recovery can benefit from the empowerment of households and communities to build resilience through the use of traditional resilience strategies and values (Figure 7.1), as well as on-going training and education in modern coping mechanisms.

Secondly, the TVET Certificate courses at the Vanuatu Institute of Technology reveal that young people respond readily to learning about traditional resilience techniques in fishing, cultivation, food preservation, agro-forestry and house construction that enable a community to survive after severe hazards. If a learner-centred pedagogy is followed, students can share their own knowledge, learn from human resources in the local community, and acquire skills that can be demonstrated to others. Similar initiatives in primary and secondary classrooms, if well-resourced and delivered with enthusiasm, would produce generations of young people who could call upon these traditional techniques to help their communities.

8.1.10 RQ2: Informal Education in Resilience – Traditional Knowledge and Policies

The discrepancy between policies on learning traditional knowledge and the reality on the ground is similar to the mismatch observed in Section 8.1.8 between policies on resilience education and the current situation in schools.

Vanuatu's national policies on resilience emphasize the importance of traditional knowledge. The VCCDRRP points out that climate change adaptation and disaster risk reduction should be driven by communities through the use of their traditional and local knowledge, while the NSDP advocates drawing upon the nation's 'rich history of resilience and risk reduction that stems from traditional knowledge and practices' (DSPPAC, 2015, p.6). The FRDP urges the documentation of traditional, contemporary and scientific knowledge in order to develop educational materials for communities, schools, training providers, etc. (Pacific Community, 2016)

Despite a weakening in the informal intergenerational transmission of traditional knowledge, other agencies are at work in Vanuatu to promote its use at community level. Non-formal public education on resilience is being carried out by government and non-government agencies through awareness programmes for village communities and sub-national bodies: such efforts focus on disaster preparedness and response, acknowledging the importance of traditional knowledge, values and resilience strategies. Yet there remains a gap. One third of Vanuatu's total population is currently attending pre-primary, primary and secondary school, and yet traditional knowledge, skills and values hardly figure in any school curricula beyond primary level: TK is absent from junior secondary syllabi and has only brief coverage in Development Studies in the senior cycle. In contrast, the VCCDRRP states that TK should be included in formal and informal school curricula. But as far as formal education is concerned, the only courses that do help learners to gain traditional knowledge are the TVET courses at VIT.

Given the decline in the informal transmission of traditional knowledge, the resilience of Vanuatu's population to climate change and disasters would benefit if this absence of traditional knowledge in formal school education were addressed, perhaps using the VIT courses as a model. Students must be enabled to access the reservoir of traditional knowledge that exists within their communities, at the same time making use of modern meteorological and geological warnings available through the media and being exposed to modern scientific knowledge that underpins adaptation and mitigation. In this way, rationality can be combined with first-hand observation of environmental change and an appreciation of traditional social capital and values that reinforce our symbiotic relationship with natural ecosystems.

8.2 Acknowledging the Limitations of My Research

There are at least eight shortfalls in the implementation of my research into the effectiveness of formal and traditional learning about climate and disaster resilience in Vanuatu.

Firstly, the lack of a uniform instrument for collecting quantitative data. At junior secondary level, in the absence of viable courses on climate change and disasters, I focused on the effectiveness of one educational resource – the Climate Change Toolkit – and used a diagnostic questionnaire to measure student responses before and after the intervention. At senior secondary and post-secondary levels, I used another four questionnaires – two for students (QS1 and QS2) and two for teachers (QC1 and QC2). Two other questionnaires for students, QS2 and QS3, were only used with post-secondary TVET courses at the Vanuatu Institute of Technology. Questionnaires for providers and receivers of traditional knowledge were entirely different to those used in formal courses. In summary, there was no uniform questionnaire that was used across all investigations: thus while it is possible to make tentative comparisons between impacts of courses at senior secondary and post-secondary levels, this has limited value between all levels of formal education, and is unrealistic between formal and informal types of resilience education.

Secondly, as research unfolded, numerous deficiencies became apparent in the ten questionnaires initially developed. At first, no questionnaire asked for information on a respondent's gender, but when it became apparent that females might be answering differently to males, this feature was added. Questionnaires QC2, QS1, QS2 (in part), QS4 and QS6 relied heavily on five- or three-point Likert scales in which responses may have been influenced by the acquiescence factor.

Notable limitations affected the “before/after” questionnaire (QS6) used with the CC Toolkit, whose questions differed from those answered by students (QS8) as they examined each of the 16 pictures. The first was that questions in QS6 were not devised to refer to each specific picture, but rather to determine a student’s understanding of modifications in Pacific environments due to climate variability and climate change, and of how to adapt to these changes in a sustainable manner. Thus aspects of some pictures did not directly appear in the “before/after” questions – urban problems, for example – while other aspects only appeared indirectly in those questions, requiring careful thought and interpretation – future changes in Vanuatu’s climate, for example. Also, definitions of technical terms such as “climate change” (Q21) and “enhanced greenhouse effect” (Q22) were not given in the pictures nor their associated questions, although they did appear in the Teacher’s Guide: as a result, Q22 had the weakest response of all short answer questions. A second limitation of QS6 was that answers to the 20 A/D items may have been influenced by the acquiescence factor, causing students to tick the left-hand (“agree”) column for all questions, especially if they were in a hurry to finish: as a result, the three items with which a student was supposed to disagree – statements requiring higher levels of cognition – had the least successful student response. An additional drawback of the instrument was the unequal number of questions asked on knowledge (22), attitudes (4) and behaviour (1), so that a comparison of averages between these categories might not be statistically valid, particularly as the intervention resulted in a notable increase in scores for the one behaviour item. Despite these deficiencies, however, data from the survey suggests that the Toolkit did impact on participants’ knowledge, attitudes and behaviours, especially the latter – even though this impact may have been short-lived.

A third shortfall is the inadequacy of sample sizes for courses at post-secondary level. I was able to directly collect responses from most learners in the first cohort of VIT TVET learners during my last pre-COVID visit to Vanuatu. But once I had to rely on remote contact with successive cohorts at VIT and from Certificate IV and PGDCC learners, response rates fell dramatically and I had to manage with answers from the willing that were scanned and transmitted by email. As a result, sample sizes for Certificate IV and PGDCC learners were 6 and 4 respectively, compared with a total of 37 for all Certificates I/III learners.

A fourth limitation is a possible distortion in interpreting comparisons between average scores calculated from varying sample sizes. At senior secondary level, the sample size for students taking Development Studies (66) and Earth Science (74), drawn from four and five schools respectively, was greater than that for Geography students (40), all from just one school. When comparing average scores for senior secondary students with those at post-secondary level, sample sizes were 180 for senior secondary level, 37 for Certificate I/III, 6 for Cert IV and 4 for PGDCC. For course characteristics and teaching/learning/evaluation techniques, scores were compared for samples of 12 senior secondary teachers, 3 Certificate I/III facilitators, 4 Certificate IV learners/facilitators and 4 PGDCC learners.

These last two limitations resulted from a fifth drawback – difficulties imposed by the pandemic. I could not be in Vanuatu to follow up on questionnaire completion by students, teachers and facilitators/lecturers at senior secondary and post-secondary levels, nor continue with personal interviews with providers and receivers of traditional knowledge. Sample sizes suffered accordingly. At junior secondary level, the twin scourges of COVID-19 and Cyclone Harold resulted in school closures and disruptions to the implementation of the CC Toolkit activity, meaning that when classes eventually resumed, attendance was erratic and the activity often carried out in a hurry: I was not there to encourage teachers to foster the necessary discussion and exploration of concepts prior to students completing their "after" questionnaires.

A sixth limitation was that for most of the formal courses in resilience I was unable to fulfil my aim of collecting data at both start and end of such courses in order to evaluate changes occurring in students' knowledge, skills, attitudes and behaviour. Again, this was linked to challenges in obtaining data through remote means. It was certainly possible to measure this change through the use of the CC Toolkit, and this became the principal focus of my first full year of research, 2020. For TVET courses at VIT, I was able to obtain before/after scores for two of the four cohorts surveyed. For senior secondary students, I had to wait until 2021 until receiving confirmation that new Year 12 and 13 programmes containing elements of resilience education were actually being implemented in classrooms, and could only obtain data at the end of the year, when teachers' and students' priorities were on examinations and sample sizes were smaller than anticipated. For students in other programmes at post-secondary level, I had to accept whatever information could be obtained during or after course completion.

Another limitation in my research may have been an element of bias resulting from my positionality as researcher. This is particularly relevant to the TVET Resilience courses at VIT, firstly because it was my involvement in creating and delivering these courses that contributed to the design of my principal questionnaires for learners and teachers in the senior secondary cycle and other post-secondary courses – effectively evaluating those other courses against the VIT experience. Secondly, my former role as the facilitator of the first group of learners to take these courses could have influenced their freedom to respond objectively to my questionnaires as a researcher, so distorting results. Bias is also possible through my role as a co-developer of the CC Toolkit, since the sense of ownership generated could cloud my objectivity in assessing its overall value as an educational resource.

A final limitation on the viability of my research was in the collection of data on traditional knowledge, skills and values. Three shortcomings must be acknowledged. Firstly, for respondents in Vanuatu, questionnaires were completed through semi-structured interviews, while most respondents based at USP completed their questionnaires on their own. Secondly, because convenience sampling was used, the findings may not be generalizable to the wider population of Vanuatu. Thirdly, findings from the Vanuatu-based respondents were heavily weighted in favour of data from one specific region of the archipelago – West Coast, Santo.

8.3 Reflections and Recommendations

8.3.1 A Model for Formal Resilience Education

My original model for formal resilience education was conceived through a study of relevant literature and my own learning experiences in creating and delivering a pioneer course in this field. After investigations into my two research questions, I find that this model can undergo further modifications (red font in Figure 8.1).

For influencing factors, the principal change relates to pedagogy. As a consequence of my findings on the importance of dynamic teachers and learning materials in the promotion of effective resilience education, I have now placed greater emphasis on teacher qualities, teacher training, stimulating and contextual educational materials, and ‘authentic’ or ‘performance’ evaluation (Janisch et al, 2007). In terms of subject matter relating to resilience, additional aspects include traditional knowledge, skills and values; policies and frameworks on resilience at national and international level; and climate finance.

For changes in content (blue box), I feel that a clearer exposition of the scientific aspects of climate change is required, as well as a more nuanced understanding of mitigation and adaptation. There is also greater focus on traditional knowledge, skills, values and their transmission, acknowledging that resilience is best achieved through a combination of traditional and modern techniques. In terms of attitudes, I have replaced “climate injustice” with the more positive “climate and disaster justice” to reflect a proactive approach to ensuring equal treatment of the most vulnerable. Similarly, “dangers of consumerism” has been replaced by “avoidance of consumerism”. For behaviour, a more proactive approach is reflected by adding “change of” to “eating habits” and by specifying the three elements involved in disaster reduction – preparation, response and recovery.

I offer the model as one of the distinctive contributions to knowledge from this research. It proposes a global programme of resilience education for formal educational establishments.

In practical terms, a tentative outline of its scope and sequence in secondary schools is suggested in Table 8.1, assuming four teaching hours per week. In light of current rates of student attrition, content has been adjusted to ensure that key aspects are covered at all three levels. I submit this proposal for further consideration by policy makers, curriculum developers and practicing teachers, who can decide which of the various aspects could be handled by each school subject at each level. Alternatively, considering its holistic and integrative nature, the programme could be offered as a discrete but compulsory subject at all levels.

Figure 8.1 Revised model of a proposed educational programme on resilience

ROLE OF EDUCATIONAL THEORY

- Build on knowledge and capacities of the individual/ community
- Promote the motivation to learn
- Develop moral qualities
- Encourage service to others
- Foster an outward-looking orientation to others & the environment

ROLE OF EDUCATIONAL PRACTICE (PEDAGOGY)

- Participatory learning
- Experiential learning
- Constructivism
- Student-centred, cooperative learning
- Field work
- Teacher qualities (enthusiasm, organisation, knowledge, treating participants as individuals …)
- Stimulating, contextual teaching / learning materials
- In-service teacher training
- Authentic evaluation

ROLE OF ENVIRONMENTAL EDUCATION (INCLUDING ESD)

- Symbiotic relationship between humans and environment
- Socio-economic effects of inequitable resource consumption
- Dangers of consumerism
- Dimensions of eco-friendly sustainable living
- Conservation of biodiversity and resources
- Pro-environmental behaviours

ROLE OF SUBJECT MATTER (RESILIENCE)

- Resilience
- Nature /causes of climate change
- Nature /causes of disasters
- Vulnerability
- Impacts
- Mitigation of CC and disasters
- Adaptation to CC and disasters
- Field observation and surveys
- Strategies for community planning/action
- Food/water security
- Traditional knowledge, skills and values
- Policies/Frameworks
- Climate finance

KNOWLEDGE

- Climate change science
- Disaster risk reduction
- Mitigation and adaptation
- Sustainable development
- Traditional Knowledge

SKILLS

- Communication
- Literacy and numeracy
- Information technology
- Observation
- Risk mapping
- Vulnerability surveys
- Writing project proposals
- Community awareness talks
- Demonstrating adaptation techniques

ATTITUDES

- Service
- Cooperation
- Inclusiveness
- Gender equality
- Respect for the environment
- Climate and disaster justice
- Holistic/integ-rative approach
- Outward-looking orientation and openness
- Avoidance of consumerism
- Sustainable living

BEHAVIOUR

- Pro-environmental behaviours, e.g. recycling, tree planting, protection of endangered species
- Demonstrating empathy
- Sharing knowledge of CC and DRR
- CC advocacy
- Change of eating habits
- Preparedness, response and recovery for disasters

Table 8.1 Proposed aspects of resilience education to be covered at different academic levels in secondary schools

<table>
<tr><th>Level</th><th>Knowledge</th><th>Skills</th><th>Attitudes</th><th>Behaviour</th></tr>
<tr><td>Years 7 and 8</td><td>• Weather and climate
• World climatic regions
• Water cycle
• Causes and impacts of hazards and disasters
• Sustainable development
• Traditional knowledge and values</td><td>• Oral communication
• Literacy
• Numeracy
• Recording field observations
• Basic IT
• Drawing maps</td><td rowspan="2">• Service to others
• Cooperation
• Inclusiveness
• Gender equality
• Respect for environment
• Climate and disaster justice
• Avoidance of consumerism
• Sustainable living</td><td>• Pro-environmental behaviours in the local area
• Showing empathy
• Change of eating habits
• Preparedness for disasters</td></tr>
<tr><td>Years 9 and 10</td><td>• Weather elements
• Climate of Vanuatu
• Climate variability (El Nino, etc.)
• Climate change – causes and impacts
• Cyclones and droughts
• Mitigation of GHG emissions
• Adaptation to CC through agriculture, fishing and forestry)
• Vulnerability and resilience
• Role of TK in adaptation
• Moral and spiritual factors in building resilience</td><td>• Measuring daily temperature, rainfall and wind
• Oral communication
• Literacy and numeracy
• Graphs of weather and climate
• Mapping skills
• Risk mapping in a local context
• Demonstrating a simple technique of adaptation to CC
• Demonstrating a strategy for mitigation of GHG emissions</td><td>• Pro-environmental behaviours in the local area
• Showing empathy
• Sharing knowledge of CC and DRR
• CC advocacy
• Change of eating habits
• Preparedness, response and recovery for disasters</td></tr>
<tr><td>Years 11 to 13</td><td>• World-wide impacts of CC and disasters
• Vulnerability
• Nature and causes of CC
• Nature and causes of hazards
• Local impacts of CC and disasters
• International policies on CC and DRR
• Climate and disaster justice
• More advanced knowledge of adaptation and mitigation
• Conservation of biodiversity
• Food and water security</td><td>• Oral communication at community level, including awareness talks
• Field observations of CC and disaster impacts
• Demonstrating mitigation and adaptation techniques at community level
• Advanced risk mapping
• Vulnerability survey
• Demonstrating a traditional adaptation technique</td><td>• Service to others
• Cooperation
• Inclusiveness
• Gender equality
• Respect for environment
• Climate and disaster justice
• Holistic/integrat-ive approach
• Avoidance of consumerism
• Outward-looking orientation and openness
• Sustainable living</td><td>• Exemplifying pro-environmental behaviour
• Demonstrating care for the vulnerable and disadvantaged
• CC advocacy
• Change of eating habits
• Preparedness, response and recovery for disasters
• Demonstrating sustainable living
• Improving food and water security
• Assisting work of CDCCC</td></tr>
</table>

8.3.2 Effectiveness of the Climate Change Toolkit

Evidence from quantitative data collected before and after Year 9/10/11 students participated in this intervention suggests that it advanced their knowledge of the causes and impacts of climate change and in their intended behaviours in promoting adaptation measures to benefit families and communities. At the same time, understanding of physical processes such as evaporation, ocean acidification and the enhanced greenhouse effect did not increase significantly. Qualitative evidence from teachers indicated that the activity engaged the students, not only at the target level of Years 9 and 10, but also at higher levels, providing them with an opportunity to take ownership of their own learning. In an ongoing environment of distractions, especially in urban settings, such engagement is a justification for renewed promotion of this educational resource and the student-centred pedagogy involved.

In evaluating the overall effectiveness of the CC Toolkit in relation to Research Question 1, five further reflections are relevant.

Firstly, the resource was only designed to deal with climate change and hydro-meteorological hazards: resilience to geological and biological hazards is not covered.

Secondly, participation in the activity should advance students' knowledge, understanding, attitudes and intended behaviours, but practical skills such as the demonstration of adaptation techniques and communication with local communities may not be developed. Thus its use can only respond in part to RQ1.

Thirdly, the 16 pictures were designed for use in a student-centred, discovery learning environment in which participants would cooperate in small groups to learn from each other and internalize their findings. The activity is thus illustrative of the constructivist approach described in section 2.7.2 (e.g. Brooks & Brooks, 1993; McLeod, 2019; Johnson & Johnson, 2018; Pierce, 2019B). In terms of my survey, however, the classroom reality may have been different. If the teacher used the pictures in a more didactic, "sage on the stage" manner, this may not have engaged their students and the Toolkit's impact on active learning would have been reduced. In most classrooms, the activity was carried out during the period when Vanuatu had declared a state of emergency because of COVID-19 and Cyclone Harold: all schools were closed for 3 months, and when classes did resume, teachers reported irregular attendance and lack of time for executing the Toolkit activity because of other priorities, leading to some students doing the activity individually or in a teacher-directed manner. Ideally, the intervention should take place over a longer time span than that used in this survey, with teachers in possession of the Teacher Guide and more hours allowed for small-group discussion. Key concepts such as mitigation and adaptation and the absorption of carbon dioxide by forests and oceans should be reinforced through teacher guidance.

Fourthly, students' performance in the intervention cannot be explained by the pictures and activity alone. The teacher is significant, as demonstrated by variations in average scores between classes, by the link between gender of teacher and gender of student, and by the language of instruction. Focusing on gender may obscure the influence of other teacher attributes that are in fact far more important – qualities such as clarity of communication, enthusiasm, approachability, careful preparation and organisation. This reflection is supported by my findings from resilience courses at senior secondary level and beyond – that the most influential factor in students' progress is the teacher or facilitator. The school milieu may also play a role, for example its urban or rural location, the existence of policies on environmental care, and attitudes towards student health and well-being.

Fifthly, there is not enough emphasis on the role of traditional knowledge, skills and values in building resilience, especially in rural areas. Pictures 11, 12, 13 and 14 do provide illustrations of traditional Pacific methods of shoreline protection, agro-forestry, gardening techniques and fishing methods, but they were not sufficiently highlighted in the associated questions, and did not figure in the "before/after" questionnaires, except implicitly through behaviour question 27. In Chapter 7, I argued that it is essential for young people in Vanuatu to learn about these ancient traditional resilience techniques in view of their relevance to sustainability in rural locations and the fact that knowledge of them is disappearing. Future use of the CC Toolkit can be expanded to encourage greater exploration of such skills and knowledge.

8.3.3 Overall Effectiveness of Formal Education Courses in Resilience

My findings, albeit incomplete, suggest that in the formal school system in 2022, potential for the most effective education in resilience lies in courses in Earth Science, Development Studies and Geography at Year 12/13 level. However, by this stage the majority of students have already left school, and resilience issues are covered in optional, not compulsory, subjects. Earth Science is the most relevant of these, but is currently taken by the least number of students. Further, the senior secondary courses have been shown to be biased towards cognitive rather than practical learning, and for the most part lack stimulating materials and field experience – thereby lacking coherence with UNESCO's goal for resilience education as empowering learners to change their behaviour and take action for sustainable development. Another discrepancy is the mismatch between national policies and what is actually happening in classrooms.

At post-secondary level, the picture is more positive. Dedicated courses in climate and disaster resilience have been offered at the Vanuatu Institute of Technology since 2017, emphasizing practical training to empower participants as agents of change at community level, and using materials relevant to a Vanuatu context that include a substantial component of traditional knowledge. Other effective tertiary courses available to a minority of ni-Vanuatu are offered by USP through the Certificate IV in Resilience and the Post-Graduate Certificate in Climate Change.

When assessing the level of overall effectiveness achieved by these formal courses in relation to RQ1, it is not only changes in students' knowledge, skills, attitudes and behaviour that must be considered. In the Literature Review (2.6.1), I referred to UNESCO's methodology for measuring the quality of an educational system through four indicators – context, enabling inputs, social and institutional processes, and outputs, with the latter providing 'the most important data for understanding whether educational quality and learning outcomes are improving as intended' (IIEP, 2021A, webpage). Adapting this framework to formal education on resilience, and based on my research findings, I offer Figure 8.2 and Table 8.2.

Figure 8.2 shows five elements contributing to the effectiveness of a formal course in resilience in Vanuatu: extent to which it implements national, regional and international policies (context); quality of pedagogy and materials (inputs); permeation among the student population, or proportion of students at a given academic level who can benefit from the course (process); effects on participants' knowledge, skills, attitudes and behaviour (output); and impact on the resilience of local communities (output).

Figure 8.2 Elements of the effectiveness of a formal course in resilience in Vanuatu

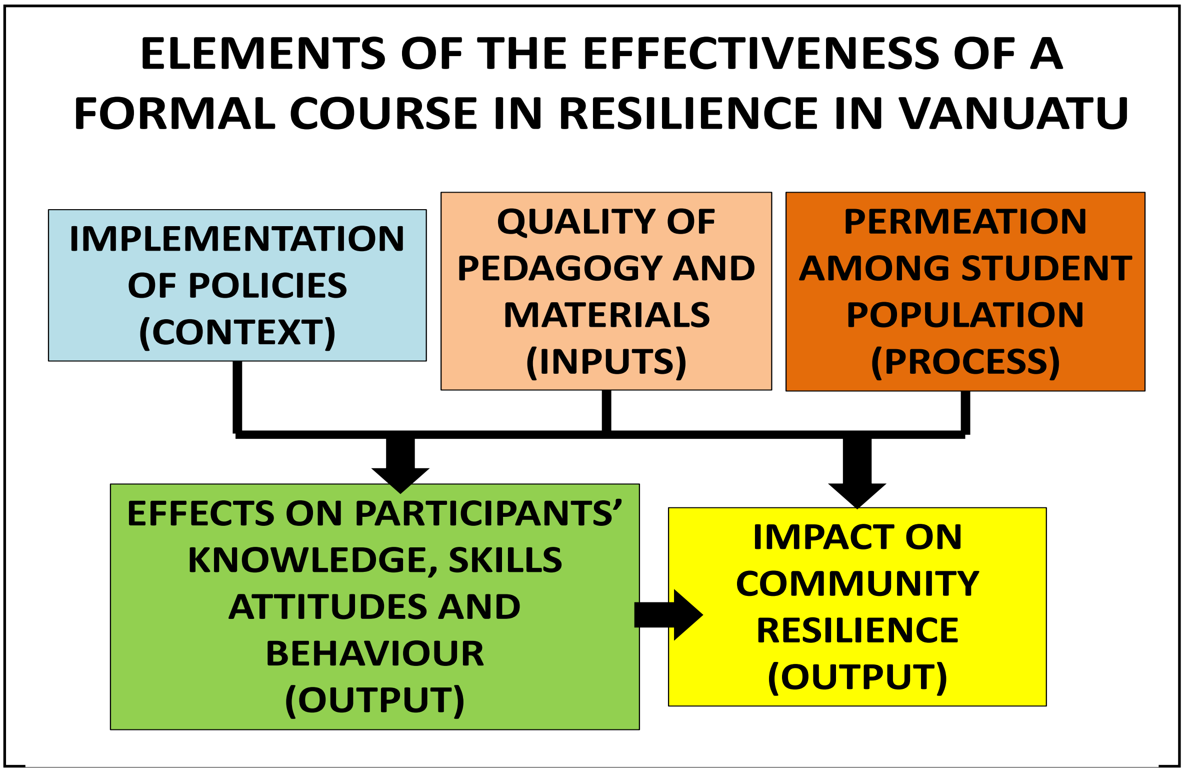


Table 8.2 attempts to measure each of the courses 8.1.2 to 8.1.7 against the above five criteria. Degrees of effectiveness are assessed on an arbitrary 1-4 rating scale, where 1 = limited, 2 = in process, 3 = moderate, 4 = high.

Table 8.2 Measures of effectiveness of courses in resilience

Course	Effectiveness rating (1-4) in 2022					
	Implement-ation of policies (context)	Quality of pedagogy & materials (inputs)	Permeation among student population (process)	Effects on participants' K,S,A & B (output)	Impact on local commun-ities (output)	Average rating
Primary	2	3	4	3	2	2.8
Junior secondary: use of CC Toolkit	2	3	1	3	1	2.0
Senior secondary	2	2	1	2	2	1.8
TVET at VIT	4	4	1	4	2	3.0
Other TVET	4	3	1	3	2	2.6
PGDCC	4	3	1	4	1	2.6

According to the average rating, the most effective course is the TVET Certificate I/III at VIT and the least are courses at senior secondary level. This assessment, however, is based on equal weighting for all five elements of effectiveness, while guidance from UNESCO (IIEP, 2021A) and the wording of RQ1 suggest that the data in the two output columns is more significant: TVET-VIT would still be the most effective, with junior and senior secondary as the least. Impact on local communities' resilience is a consequence of impact on course participants and the number of students benefiting from that course: in 2022, primary courses reach the entire school population at that level, while those at secondary and post-secondary level do not. However, as junior and senior secondary courses are implemented in full in 2023 and beyond, we can expect their rating for permeation, and hopefully for inputs and outputs, to rise.

8.3.4 Looking Ahead

The latest findings of the IPCC (2022, B.1.1., p.11) are that :

> widespread pervasive impacts to ecosystems, people, settlements and infrastructure have resulted from observed increases in the frequency and intensity of climate and weather extremes, including hot extremes on land and in the ocean, heavy precipitation events, drought and fire weather …

As our planet continues to warm, such impacts will only increase. In that light, two sub-questions arising from RQ1 beg further consideration. Firstly, is the existing provision of resilience education through formal means sufficient to empower our young people to be agents of change in their communities and help them become more resilient to the effects of a warming planet? Secondly, are we producing enough informed, qualified and motivated students who can satisfy the demands of the labour market in the field of resilience, considering that these demands will only grow as the impacts of climate change and disasters in Pacific islands increase in magnitude and frequency? From my research to date, I fear that the answer to both questions is in the negative.

In order to improve permeation (Figure 8.2) and reach the majority of school-age students, I recommend that more intensive learning about resilience takes place at upper primary and junior secondary school levels, with those currently writing junior secondary syllabi in Science and Social Science ensuring that greater weight is given to resilience issues. For extending the reach of senior secondary courses on resilience to a wider cohort, consideration can be given to greater promotion of Earth Science as an optional subject, or perhaps the introduction of a compulsory course on Resilience, following guidelines in Table 8.1.

For improving effectiveness in terms of quality, my findings suggest six factors that might better engage Vanuatu students in a formal learning environment, inspiring them to further their knowledge and skills and undertake actions that promote resilience to climate change and disasters.

Firstly, the teacher or facilitator needs to be approachable, knowledgeable, dynamic and well organized, full of enthusiasm, ready to treat students as individuals and motivated to help his/her students to learn. In terms of knowledge and pedagogy, there should be an expansion of pre-service teacher training in the field of Earth Science, both through NUV's School of Education and overseas universities. This implies that greater priority is placed on the allocation of scholarships for such specialisation. Tertiary institutions could also promote the development of dedicated degree courses in the fields of CC and DRR so as to expand the reservoir of professionals equipped to advance the frontiers of learning in adaptation and mitigation.

Secondly, course materials should be exciting, colourful, stimulating and set in the context of Vanuatu. At senior secondary level, teachers of Geography, Development Studies and Earth Science need to have appropriate teaching and learning materials for their students. The Vanuatu Institute of Technology is already teaching accredited certificate courses on CC and DRR at TVET level, and learner guides and workbooks from these courses can be adapted for use in Years 11-13. Specialist writers could be recruited to do this, and funding sought from donor partners for the production of resources. Staff from the Department of Climate Change, the National Disaster Management Office and non-government organisations can be approached to assist with running relevant in-service training for teachers.

Thirdly, fieldwork and practical activities are essential, exemplified by the VIT TVET courses and the PGDCC. Learners need to be immersed in community life in order to assess vulnerability and risks, interact with residents in promoting suitable adaptation and mitigation measures, and help others become more aware of climate and disaster issues. One solution is to ensure that funding is made available for them to experience reality outside the classroom. At senior secondary level, students are already assessed on the basis of 40% for performance in examinations and 60% for course work (CDU, 2018). Adjustments can be made to course outlines in Geography, Development Studies and Earth Science to ensure that at least half of all course work comprises mandatory field and practical elements. Such a move will have implications for teacher training and school finances.

Fourthly, teaching and learning techniques must focus on the student, not the teacher, acknowledging that each young person has innate capacities and talents that are there to be developed. Pedagogical strategies such as cooperative learning, discovery learning, role plays and mutual instruction are essential.

Fifthly, due weight must be accorded to the role of traditional knowledge, skills and values in relation to resilience (Kagawa & Selby, 2009; SPC, 2015). Like other Pacific islanders, generations of ni-Vanuatu have amassed a wealth of experience in the face of hydro-meteorological, geological and biological disasters, learning to live sustainably and share resources collectively. Yet traditional techniques of house-building, cultivation, fishing and food preservation, for example, are slowly disappearing as young people move away from rural settings and are influenced by negative economic and social forces operating in the towns. In view of this decline, we need to help our school students become more conscious of these strategies and values.

Lastly, there is a need to promote understanding among students that one of the root causes of anthropogenic climate change is consumerism, and that to combat this we need to adopt behaviours that promote eco-friendly, sustainable living – changing eating habits, recycling and re-using, tree planting, caring for others, acknowledging the oneness of humanity, focusing on “needs” rather than “wants”. This approach, must be reinforced at all levels. It is coherent with a well-rounded education that balances natural with social sciences (CEE, 2022) and science with religion and morality. In the words of the Bahá'i International Community (1998, V3):

> Sustainable environmental management must come to be seen … as a fundamental responsibility that must be shouldered – a pre-requisite for spiritual development as well as the individual's physical survival.

The above principles summarize an approach to resilience education offered by this thesis in a spirit of humility and learning.

APPENDIX A: Questionnaires and Instructions

1. QC1
2. QC2
3. QS1
4. QS2
5. QS3
6. QS4
7. QS5
8. QS6
9. QS7 & 8
10. QTK1
11. QTK2
12. Instructions TK provider p.1
13. Instructions TK provider p.2
14. Instructions TK receiver p.1
15. Instructions TK receiver p.2

1.

QC1 QUESTIONNAIRE ON COURSE CHARACTERISTICS

Name of course :.. Institution/Organisation:..

Length of course: 1 session ☐ 2-5 sessions ☐ 1 day ☐ 2-5 days ☐ 1-4 weeks ☐ 1-6 mths ☐ > 6 mths ☐

Location of course: .... Type of course: DRR/DRM ☐ CC/CCA ☐ CC/CCA + DRR ☐

Average no. of participants: ...... Name of respondent: .... Position/Responsibility:..........................

Does the course promote or teach these aspects of resilience education?		Importance of this aspect				Comment
		High ✓✓	Low ✓	None ✗	Don't know ?	
Overall attitudes	Moral qualities					
	Building on individual/ community capacities					
	Service to others					
	Outward orientation					
	Equal treatment for all					
	Gender equality/ empowerment of women					
	Motivation to learn					
Pedagogy	Cooperative learning					
	Participatory learning					
	Constructivism (see below under *)					
	Field work					
	Experiential learning (see below under **)					
Knowledge	Meaning of resilience					
	Nature and causes of climate change (CC)					
	Nature and causes of disasters					
	Vulnerability					
	Impacts					
	Mitigation					
	Adaptation					
	Strategies for disaster risk reduction (DRR)					
	Climate injustice					
	Food and water security					
	Traditional knowledge					
Skills	Communication skills					
	Risk mapping					
	Literacy/numeracy					
	IT skills					
	Writing project proposals					
	Vulnerability /SWOT surveys					
	Community awareness					
Attitudes	Sustainable living					
	Pro-environmental attitudes					
	Holistic approach					
	Outward-looking orientation and openness					
	Avoiding consumerism (see below under ***)					
Behaviour	Conservation of biodiversity					
	CC advocacy					
	Sharing knowledge of CC and/or DRR					
	Eating habits					
	Disaster preparedness					
	Other pro-environmental behaviours					
	Other					

* The student/participant is guided by the facilitator/expert to use his previous experience to construct new knowledge or concepts.

** The student/participant takes part in an activity and learns from the experience by reflecting on the results. This is like self-teaching.

*** Not following the constant desire to buy more and more material goods - clothes, phones, luxury food, vehicles, etc.

2.

QC2 TEACHING, LEARNING AND EVALUATION TECHNIQUES FOR RESILIENCE LESSONS

Name of course:.. Institution/Organisation:..
Length of course: 1 session ☐ 2-5 sessions ☐ 1 day ☐ 2-5 days ☐ 1-4 weeks ☐ 1-6 mths ☐ > 6 mths ☐
Location of course: .... Type of course: DRR/DRM ☐ CC/CCA ☐ CC/CCA + DRR ☐
Name of respondent: .... Position/Responsibility:..

Please tick one

	Aspect of resilience education	Never	Rarely	Sometimes	Often	Always
	TEACHING AND LEARNING TECHNIQUES BEING USED					
1.	Interactive - teacher engages students in brainstorming and discussion on a given topic					
2.	Surrogate experiential - use of simulations of real life events, e.g. role plays, photographs, films					
3.	Field experiential - undertaking practical activities outside the classroom, e.g. hazard risk mapping					
4.	Affective - students share their feelings and experiences of disaster events					
5.	Enquiry - students obtain information from outside the classroom, e.g. through interviews, internet sites					
6.	Action - active involvement of students in practical sessions					
7.	Lecture - teacher/facilitator provides information to the students in traditional teaching style					
	EVALUATION TECHNIQUES BEING USED					
8.	Recall - assessing students on their ability to remember and reproduce what they have been taught					
9.	Action-oriented - assessing students on how active they are in participating in the learning process, e.g. participating in a role play, demonstrating adaptation techniques					
10.	Output-oriented - assessing students on their production of tangible substances, e.g. plans, posters with DRR messages, risk maps					
11.	Knowledge acquisition - assessing students' ability to obtain information from other sources, e.g. internet, and to organise this information and present in a meaningful form					
12.	Application - assessing students' ability to use knowledge they obtain in class to solve community problems, e.g. interactions with community					
	APPROACHES TO EVALUATION					
13.	Class exercises / completion of workbooks					
14.	Written tests/exams					
15.	Demonstrations of skills and knowledge					
16.	Homework					
17.	Teacher follow-ups, e.g. asking questions in the next lesson					
18.	Reflections					
19.	Measuring oral contributions by students					

3.

QS1 QUESTIONS ON COURSE/SESSION/LESSON DELIVERY FOR CC & DRR

Name of course :.. Institution/Organisation:..

Length of course: 1 session☐ 2-5 sessions☐ 1 day☐ 2-5 days☐ 1-4 weeks☐ 1-6 mths☐ > 6 mths☐

Location of course: .... Type of course: DRR/DRM☐ CC/CCA☐ CC/CCA + DRR☐

Name of respondent: .... Age group: 10-15☐ 16-20☐ 21-30☐ over 30☐

Gender: M☐ F☐ Highest level of education reached: ....

Please tick one

	Question	Strongly disagree	Dis-agree	Neutral/ Don't know	Agree	Strongly agree
1.	The teacher/facilitator is knowledgeable					
2.	The teacher/facilitator is well prepared					
3.	The teacher/facilitator comes on time					
4.	The teacher/facilitator is enthusiastic					
5.	The teacher/facilitator is creative					
6.	The teacher/facilitator is well organised					
7.	The teacher/facilitator uses visual materials					
8.	The teacher/facilitator is approachable					
9.	The teacher/facilitator treats us as individuals					
10.	The teacher/facilitator values my contributions					
11.	The teacher/facilitator shows compassion					
12.	The teacher/facilitator is helpful					
13.	The teacher/facilitator communicates clearly					
14.	The teacher/facilitator explains new concepts					
15.	The teacher/facilitator makes me think					
16.	The teacher/facilitator asks us questions					
17.	The teacher/facilitator makes us participate					
18.	The teacher/facilitator participates in the activities					
19.	The teacher/facilitator promotes cooperative learning					
20.	The teacher/facilitator checks up on our progress					
21.	The course/lesson stimulates my interest in CC/ DRR					
22.	The learning materials are exciting and appropriate					
23.	I am encouraged to be responsible for my own learning					
24.	I know how to prepare for all kinds of disaster					
25.	I know ways to mitigate and adapt to climate change					
26.	I learn new skills through the course/lessons					
27.	I want to put my learning into action					
28.	I am ready to take action on climate change					
29.	I am ready to help others understand about disaster risk					
30.	The way that the teacher/facilitator delivers the lesson is more important than the learning materials used.					

PLEASE WRITE YOUR ANSWERS TO THESE THREE QUESTIONS ON THE BACK OF THIS SHEET

1. Give three reasons why you enjoy/enjoyed this course/session/these lessons
2. State the three most important things you have learnt from this course/session/these lessons
3. How could this course/session/these lessons be improved?

4.

QS2 QUESTIONS ON STUDENT/PARTICIPANT CHARACTERISTICS

Name of course:.. Institution/Organisation:..

Length of course: 1 session ☐ 2-5 sessions ☐ 1 day ☐ 2-5 days ☐ 1-4 weeks ☐ 1-6 mths ☐ > 6 mths ☐

Location of course: .... Type of course: DRR/DRM ☐ CC/CCA ☐ CC/CCA + DRR ☐

Name of respondent: .... Age group: 10-15 ☐ 16-20 ☐ 21-30 ☐ over 30 ☐

Gender: M ☐ F ☐ Highest level of education reached: ....

Please tick one

	Question	Strongly disagree	Dis-agree	Neutral/ Don't know	Agree	Strongly agree
	ACHIEVEMENT					
1.	I feel I am progressing well in this course					
2.	I am successful in tests					
3.	I am receiving feedback from the facilitator/teacher on my performance					
4.	I am learning new skills in this course					
	MOTIVATION					
5.	I really want/wanted to take and complete this course					
6.	I myself decided to take this course					

7. I am doing/I did this course because: (Tick ONE answer only)
   - a) It's part of my job/work ☐
   - b) It's part of the subject I'm taking at school ☐
   - c) I was asked to attend ☐
   - d) I really want to learn more about CC/DRR ☐
   - e) It will advance my career ☐
   - f) I want to help my community ☐
   - g) Other (please specify) ☐ ....

ACADEMIC LEVEL

	Question	Strongly disagree	Dis-agree	Neutral/ Don't know	Agree	Strongly agree
8.	A high level of education is needed in order to complete this course					
9.	This course is easy for me					

10. My highest level of education is: (Tick ONE answer only)
    - a) Primary (Year 6 or Year 8) ☐
    - b) Junior secondary (Years 7-10) ☐
    - c) Senior secondary (Years 11-13/14) ☐
    - d) Rural Training Centre ☐
    - e) Certificate ☐
    - f) Diploma ☐
    - g) University 100 level ☐
    - h) Bachelor degree or equivalent ☐
    - i) Post-graduate qualification, Master's, PhD ☐

COST/FEES

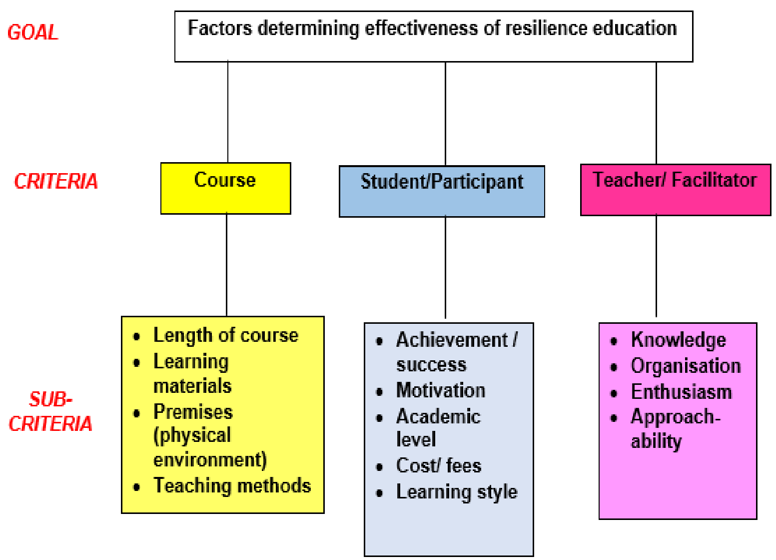
11. To meet the cost/fees for this course: (Tick ONE answer only)
    - a) I don't need to pay any fees ☐
    - b) My organisation/employer pays my fees ☐
    - c) I pay my own fees ☐
    - d) My family or friends pay my fees ☐
    - e) I have a scholarship ☐

LEARNING STYLES

12. Choose which of these describes the way that you learn best. Label them 1, 2 3 and 4 in order of preference:
    - a) Visual or spatial: I learn through pictures, images and spatial understanding ☐
    - b) Aural (auditory or musical): I learn through sound and music ☐
    - c) Verbal (linguistic): I learn through words, both in speech and writing ☐
    - d) Physical (kinaesthetic): I learn through my body, hands and sense of touch ☐

5.

FACTORS DETERMINING EFFECTIVENESS OF RESILIENCE EDUCATION



QS3

Instructions for pair-wise comparison of criteria

Course	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Teacher
Student	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Course
Teacher	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Student

From your own point of view, please compare the importance of each pair by circling the appropriate numbers on each line. If one is more important for you than the other, then you show the degree of its importance by encircling one of the numbers on the side corresponding to the element that is more important. Use these numbers :

9 absolute importance
7 very strong importance
5 strong importance
3 moderate importance
1 each element of the pair is of equal importance.

Example: John thinks that the qualities and characteristics of the teacher are very much more important to him than the course itself (materials, teaching methods, etc.). He also thinks that how he feels as a student is not as important as the quality of the course itself. He feels too that the effectiveness of the course is influenced a little bit more by how he feels as a student than by the qualities of the person who is teaching him. This is what his response would be:

Course	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Teacher
Student	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Course
Teacher	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Student

YOUR ANSWER

Name: **Course:**

Preferred learning style: (encircle one)

- **Visual (spatial):** You prefer using pictures, images, and spatial understanding.
- **Aural (auditory-musical):** You prefer using sound and music.
- **Verbal (linguistic):** You prefer using words, both in speech and writing.
- **Physical (kinesthetic):** You prefer using your body, hands and sense of touch.

Course	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Teacher
Student	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Course
Teacher	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Student

6.

QS4 CHANGES IN KNOWLEDGE, SKILLS, ATTITUDES AND BEHAVIOUR: CC+ DRR

Name of course :.. Institution/Organisation:..

Length of course: 1 session☐ 2-5 sessions☐ 1 day☐ 2-5 days☐ 1-4 weeks☐ 1-6 mths☐ > 6 mths☐

Location of course: .... Type of course: CC/CCA☐ CC/CCA + DRR☐

Name of respondent: .... Age group: 10-15☐ 16-20☐ 21-30☐ over 30☐

Gender: M☐ F☐ Highest level of education reached: ....

Please tick one

	Question	Strongly disagree	Dis-agree	Neutral/ Don't know	Agree	Strongly agree
	KNOWLEDGE					
1.	Climate change is happening now, caused mainly by human activities					
2.	Ocean temperatures will get warmer in the future					
3.	Atmospheric concentrations of CO_2 are now < 400 ppm					
4.	Temperatures are rising most rapidly in the Arctic					
5.	Future changes in seasonal rainfall patterns are likely					
6.	Tree planting is an effective mitigation measure for CC					
7.	The best protection against sea level rise is a sea wall					
8.	Ash falls affect food and water security					
9.	An earthquake is caused by a tsunami					
10.	Traditional knowledge helps us to adapt to CC					
11.	Climate change is really just a slow acting disaster					
12.	Children, women, elderly and handicapped people are the most vulnerable to disasters and climate change.					
	SKILLS					
13.	I can give an awareness talk on disaster risk reduction					
14.	I can give an awareness talk on climate change					
15.	I can go to a community and draw a hazard risk map					
16.	I can demonstrate one way of adapting to CC					
17.	I can carry out a vulnerability survey in a village					
	ATTITUDES					
18.	It is my responsibility to be prepared for disasters					
19.	It is the government's responsibility to reduce Vanuatu's carbon footprint					
20.	I must help my community to prepare for CC					
21.	I must help to conserve biodiversity					
22.	I must consume more vegetables and fruit and reduce my intake of meat and processed food					
	BEHAVIOUR					
	Question	Never	Rarely	Sometimes	Often	Always
23.	I plant tree seedlings					
24.	I talk about climate change with my family					
25.	I take part in demonstrations to support action on CC					
26.	I look after vulnerable people during cyclones					
27.	I assist the CDCCC in my community					

7.

QS5 CHANGES IN KNOWLEDGE, SKILLS, ATTITUDES AND BEHAVIOUR: DRR

Name of course :.. Institution/Organisation:..

Length of course: 1 day or less than one day ☐ 2-5 days ☐ 1-4 weeks ☐ 1-6 months ☐ > 6 months ☐

Location of course: ....

Name of respondent: .... Age group (years): 10-15 ☐ 16-20 ☐ 21-30 ☐ over 30 ☐

Gender: M ☐ F ☐ Highest level of education reached: ....

Please tick one

	Aspect of DRR education	Strongly disagree	Dis-agree	Neutral/ Don't know	Agree	Strongly agree
	THE COURSE PROVIDES ME WITH THE FOLLOWING KNOWLEDGE					
1.	Key DRR terms, concepts and practices, such as hazard, culture of safety, risk mapping					
2.	Awareness of 3 aspects of DRR - preparedness, response and recovery					
3.	Basic safety measures, including First Aid					
4.	Common hazards experienced in Vanuatu					
5.	Roles and responsibilities of national, provincial and community disaster committees and agencies					
6.	Different vulnerabilities of those affected by disasters and climate change					
7.	Relationship between climate change and disasters, with climate change seen as a slow acting disaster					
8.	Disasters as sources of both conflict and unity					
	THE COURSE IS TEACHING ME THE FOLLOWING SKILLS					
9.	Risk mapping					
10.	Communication through mobile phones and other IT					
11.	Critical thinking, e.g. ability to assess the level of danger of an impending hazard					
12.	Skills of coping, self-protection and self-management					
13.	Action skills - advocating for better DRR practices, assisting victims of disasters					
	THE COURSE IS TEACHING ME THE FOLLOWING ATTITUDES					
14.	Showing compassion, care and empathy for those involved in disasters					
15.	Willingness to help others during times of disaster					
16.	Willingness to assist with awareness talks on disasters					
17.	Being in harmony with the environment					
18.	Respecting the contribution that everyone can make to DRR					
	MY BEHAVIOUR					
	Question	Never	Rarely	Sometimes	Often	Always
19.	I help my family prepare the house for cyclones					
20.	I have a bag of valuables ready to carry to safety when sudden hazards arrive					
21.	I take part in earthquake drills					
22.	I look after vulnerable people during cyclones					
23.	I assist the CDCCC in my community					

8.

QS 6 CLIMATE CHANGE TOOLKIT: DIAGNOSTIC QUESTIONS TO BE ASKED BEFORE AND AFTER THE TOOLKIT IS USED

Name of school or training institution: .... Date: ....
Name of student/learner: .... Name of teacher/Facilitator: ....
Questions asked before or after use of toolkit pictures? (Encircle one): BEFORE AFTER

	Statement	My opinion		
		Agree	Disagree	Don't know
1.	Weather refers to the way that atmospheric conditions such as temperature, rainfall, pressure and wind are always changing.			
2.	Climate refers to average conditions of temperature, rainfall, etc. over a long period of time.			
3.	Our climate changes because of both natural and human factors			
4.	Evaporation occurs when water vapour in the air changes back to tiny droplets of water.			
5.	Climate variability means that the climate of a place may change from year to year.			
6.	During an El Niño period, Vanuatu experiences droughts.			
7.	The greenhouse effect means that certain gases in the atmosphere absorb the heat being radiated back from the Earth, so keeping the atmosphere warm.			
8.	Greenhouse gases include carbon dioxide, methane, nitrous oxide and water vapour.			
9.	For the past 200 years, human activities are putting extra greenhouse gases into the atmosphere.			
10.	Carbon dioxide is absorbed by forests and the oceans			
11.	Coral reefs are being damaged by warmer temperatures and ocean acidification.			
12.	Vanuatu's greatest climatic dangers are cyclones and droughts.			
13.	Adaptation refers to the actions we can take to reduce the levels of greenhouse gases in the atmosphere.			
14.	Using compost is a sustainable form of gardening.			
15.	Catching fish with nets that have very small holes is a sustainable form of fishing.			
16.	Vanuatu is one of the most vulnerable countries in the world to natural disasters.			
17.	I am worried that climate change will bring great dangers to the world in the future.			
18.	I want to join a student strike to show my concern about climate change.			
19.	I know a lot about the causes and impacts of climate change.			
20.	I want to help my community prepare for climate change and disasters.			

	Question	Answer
1.	What does "climate change" mean?	
2.	What is the enhanced greenhouse effect?	
3.	What are three human activities that are putting extra greenhouse gases into the atmosphere, so causing the enhanced greenhouse effect?	
4.	What causes ocean acidification?	
5.	Why is forestry (planting and caring for trees) important for mitigating climate change?	
6.	What are some of the main impacts of climate change in Vanuatu?	
7.	What kinds of actions can I take to help my family and community become better prepared for the impacts of climate change and more intense disasters? List three.	

9.

QS 8

Pic.	Questions
1	1. State 10 things that people are doing in this picture. 2. Can you see a town in the picture? What are three differences between the town and the village? 3. What can you see in the picture that reminds you of Vanuatu? 4. What do you think this village might be like in 10 years' time?
2	1. What does "evaporation" mean, and why does it happen? 2. What does "condensation" mean? 3. What are clouds made of? 4. What is "precipitation", and what happens when it reaches the ground? 5. What is the "water cycle"?
3	1. Name three things that "climate" measures. 2. What do the letters J,F,M,A,.... stand for? 3. Most islands in the South Pacific have two seasons - one that is hot and wet, and one that is cooler and drier. Which months have the hot,wet season? Which months have the cooler, drier season?
4	1. Place the zones in order of decreasing temperature, starting with the Tropical Zone. 2. What happens to temperature as you move away from the Equator? Why do you think this happens? 3. Name the climate zone in which these countries are found: a) VANUATU b) NEW ZEALAND c) RUSSIA
5	1. What do you think the word "variability" means? 2. Normally, which side of the Pacific Ocean is wetter - the west or the east? 3. During an "El Nino" period, what is the climate like in Vanuatu? 4. During a "La Nina" period, what is the climate like in Vanuatu?
6	1. What happens when the sun's rays reach the earth? 2. After the ground is heated, it sends this heat back into the atmosphere. But there are some gases in the atmosphere that absorb this heat, so keeping the atmosphere warm. These are called Greenhouse Gases (GHGs). Name five of them. 3. So what do you think will happen if extra GHGs are put into the atmosphere? 4. What activities are people doing that put extra amounts of GHGs into the atmosphere? State five of them.
7	1. If the temperature of the air is increasing, how will this affect the water in the seas and oceans? 2. As temperatures rise, will more CO_2 enter the sea? How will this affect coral reefs? 3. How will rising sea levels affect people living in coastal areas? 4. Name two human activities that put extra GHGs into the atmosphere.
8	1. Find the climate graph for Port Vila. State the average temperature in January and in July? 2. Look at the straight black line in the graph in the bottom right-hand corner. Are Vanuatu's temperatures increasing? 3. What two climatic dangers does Vanuatu face? Which of them may occur during an "El Nino" year
9	1. State five changes that have occurred in the village because of the cyclone. 2. How are old people, children and the disabled affected by a cyclone? 3. What steps can be taken to reduce risks of damage to food supplies and human lives during a cyclone? State five.
10	1. State five changes that have occurred in the village because of the drought. 2. How are old people, children and the disabled affected by a drought? 3. What steps can be taken to reduce the problems caused by a long period of drought? Suggest five.
11	1. What actions can we take to reduce the levels of GHGs in the atmosphere? (Called "mitigation") 2. What actions can be taken to change our way of life so that it fits a climate that is warmer, with stronger cyclones and more droughts? (Called "adaptation") 3. What are the actions shown in the middle of the diagram?
12	1. From this picture, describe five kinds of farming or gardening practices that we should use in order to adapt to future climate change. We can call these practices "sustainable", since they will give us sufficient healthy food. 2. Which of these could you do in your own village or in your school?
13	1. From the picture, describe some of the forestry practices that we should use in order to adapt to future climate change. 2. Could you do any of these actions in your village or your school? 3. Why is forestry (planting and caring for trees) important as a way of a) mitigating climate change and b) adapting to climate change?
14	1. From the picture, state three bad fishing practices that we should avoid. 2. From the picture, state three good fishing practices that will help us to adapt to climate change. 3. Could you carry out any sustainable fishing practices in your community? Which ones?
15	1. In the bottom part of the picture, find three ways in which people who live in a town produce extra greenhouse gases and so contribute towards climate change. 2. From the top part of the picture, explain three ways in which human actions are mitigating climate change. 3. Could any of these actions be done in your local town?
16	1. Compare Picture 16 with Picture 1. State five differences between the two pictures. 2. In which village would you prefer to live - the one in Picture 16 or the one in Picture 1? Why? 3. Which picture looks most like your own village? 4. How could you help to bring about these changes?

10.

QTK1 Questions to be asked of a provider of traditional knowledge

NAME: .... M☐ F☐ VILLAGE: .... ISLAND ....
AGE: 10-19☐ 20-29☐ 30-39☐ 40-49☐ 50-59☐ 60-69☐ 70-79☐ 80 +☐
INTERVIEWER: .... DATE: ....

1. **Wanem samfala saen we i soem se weta/klaemet i stap jenis o wan disasta i stap kam (saeklon, drae taem, etkwek, tsunami, volkeno...) ?**
   What are some signs that show that our weather or climate is changing or that a disaster is coming (cyclone, drought, earthquake, tsunami, volcanic eruption)

2. **Yu save eni kastom fasin blo stanap strong lo fes blo ol disasta we i kamaot (saeklon, drae taem, etkwek, tsunami) ? (Olsem fasin blo bildim haos, planem kakae mo nara samting olsem)**
   Do you know of any traditional ways of being resilient to disasters such as cyclones, droughts, earthquakes, tsunamis, volcanic eruptions? (House design, cultivating crops, finding fresh water, etc)

3. **Ol save ia yu holem yu wan o yu stap pasem? Mo yu pasem lo huia?**
   Do you hold on to your traditional knowledge about weather and climate, or do you pass it on to others? If so, to whom?

4. **Hao nao yu stap pasem?**
   How do you pass on such knowledge?

5. **Yu save givim wan eksampol blo las taem we yu bin pasem save ia, mo lo hu?**
   Can you give an example of the last time when you transmitted this traditional knowledge, and to whom?

6. **Long kastom blo yu, yu sud pasem ol tradisonal save blo yu lo huia? Fasbon boe blo yu, ol pikinini blo yu, bubu blo yu, o hu?**
   According to your custom, to whom should you transmit your traditional knowledge? Your first-born son, your children, your grandchildren or who?

7. **Tedei, fasin we yu pasem save blo yu lo narafala man i stap jenis, o no? From wanem?**
   These days, are there any changes in the way that you are transmitting your knowledge to others? Why?

8. **Wanem nao ol impotan valiu lo kastom we mekem se wan komuniti i save kam risilient (stanap strong) lo fes blo wan disasta?**
   What are some important traditional values that make a community more resilient in the face of a disaster

11.

QTK2 Questions to be asked of a recipient of traditional knowledge

NAME: .... M☐ F☐ VILLAGE: .... ISLAND ....
AGE: 10-19☐ 20-29☐ 30-39☐ 40-49☐ 50-59☐ 60-69☐ 70-79☐ 80 +☐
INTERVIEWER: .... DATE: ....

1. **Yu bin kasem eni save abaot ol disasta mo jenis lo weta mo klaemet tru lo .... (*nem blo man we hem i talem se hem i bin pasem*)?**

   Did you receive any knowledge about disasters and changes in weather and climate from .... *(person who says he/she passed it on to you)?*

2. **Aot lo man (woman) ia, yu bin kasem eni save abaot hao blo stanap strong lo fes blo ol disasta o jenis lo klaemet we i kam?**

   Did this person also pass on some knowledge about how to face and overcome the impacts of the disasters and changes in weather and climate?

3. **Talemaot sam samting we yu bin lanem aot lo hem. *(Yusum nara saed blo pepa ia)***

   Describe some of the things that you learnt from him/her *(You can write your answers overleaf)*

4. **Long saed blo ol save ia, hem i bin talem lo yu o hem i bin soemaot lo yu?**

   Was this knowledge just received just through talking, or through demonstrating how to do things?

5. **Yu bin yusum save ia lo laef blo yu? Givim sam eksampol**

   Have you used any of this knowledge in your own life? Give some examples.

6. **Yu rimemba hamas long ol <u>save</u> we man o woman ia i bin traem pasem lo yu?**
   - **Mi rimemba evri samting we hem i talem**
   - **Mi rimemba fulap samting we hem i talem**
   - **Mi rimemba smol lo wanem hem i talem**
   - **Mi fogetem fulap samting we hem i talem**

   Putum wan sekol raon long wiswan ansa we i stret lo yu

   How much do you remember of the knowledge that he/she tried to transmit to you?
   - I remember everything he/she told me.
   - I remember quite a lot of what he/she told me.
   - I remember a little of what he/she told me.
   - I've forgotten most of what he/she told me.

7. **Yu rimemba hamas long ol <u>skil</u> we man o woman ia i bin traem soem lo yu?**
   - **Mi rimemba evri samting we hem i soem**
   - **Mi rimemba fulap samting we hem i soem**
   - **Mi rimemba smol lo wanem hem i soem**
   - **Mi fogetem fulap samting we hem i soem**

   Putum wan sekol raon long wiswan ansa we i stret lo yu

   How much do you remember of the skills that he/she tried to demonstrate to you?
   - I remember everything he/she showed me.
   - I remember quite a lot of what he/she showed me.
   - I remember a little of what he/she showed me.
   - I've forgotten most of what he/she showed me.

8. **Yu rimemba eni stamba advaes, tingting o bilif we man o woman ia i bin traem serem wetem yu? Sipos yes, traem talemaot wanem yu rimemba**

   Do you remember any basic attitudes or beliefs that he/she shared with you? If so, can you tell me what they were?

9. **Taem we hem i talem o soem sam samting abaot weta o klaemet, o fasin blo stanap strong lo ol disasta, hem i talem wan taem nomo, o hem i stap ripitim plante taem ?**

   When he/she told or showed you something about weather, climate or being resilient, did he/she tell you just once, or did he/she repeat things over and over again?

12.

RESEARCH PROJECT: EFFECTIVENESS OF RESILIENCE EDUCATION IN VANUATU

INSTRUCTIONS FOR CARRYING OUT INTERVIEWS WITH PROVIDERS OF TRADITIONAL KNOWLEDGE

These instructions are designed for my research assistants who will be interviewing providers of traditional knowledge about resilience to changes in weather, climate and the environment.

1. Decide upon the village/villages and island where you would like to conduct interviews with providers and receivers of traditional knowledge.
2. Identify a few people (5-10 if possible) who are known to be holders of traditional knowledge about weather, climate and the environment, and of resilience to disasters and climate change.
3. Approach the first of these people and explain who you are and why you are coming to see them. Mention that you are helping Mr Charlie Pierce, who is a long-time educator in Vanuatu and is now working on a research project to find out how we are educating people about disasters and climate change. You must approach this person with the greatest respect, using appropriate customary protocols. Say that you would like to interview him/her and ask whether it is convenient to do this now, or whether you should come back later on.
4. If the person agrees to be interviewed now, then you should suggest that the two of you sit down in a quiet place, and ask whether you can record the interview on your mobile phone, or whether the person would prefer you to simply ask the questions and you write down the answers.
5. At the start of the interview, you can tell the person something about the research project and what you are going to do. You can do this in your own words, or you can read out the message from Charlie Pierce that is provided in the information sheet below:

Mi wantem faenemaot mo skelem ol fasin we yumi stap eduketem ol yangfala lo Vanuatu lo saed blo risiliens. Toktok ia i minim fasin blo stanap strong mo kam gud bakagen lo fes blo ol disasta mo ol jenis lo weta mo klaemet. Komiti blo Kaljaral Senta i agri finis blo mi mekem resej ia.

Yumi eduketem ol man lo skul. Be tu i gat ol grup blo gavman mo ol grup olsem Red Kros mo Oxfam mo Wan Smol Bag we oli go lo ol komuniti blo givim ol aweanes toktok.

Be wan narafala impotan wei i tru lo fasin we ol pipol long vilij we oli holem ol tradisonal save i stap pasem ol save blo olgeta lo ol narafala man. Hemia nao mifala i wantem toktok wetem yu. Mifala i wantem faenemaot wanem kaen save yu stap holem lo saed blo weta mo klaemet. Mifala i wantem faenemaot sipos yu gat save lo ol kastom fasin blo stanap strong lo fes blo olgeta disasta we i kamaot, olsem saeklon, drae taem, etkwek, sunami, mo hao nao yu stap pasem ol save ia lo ol pikinini blo yu o lo narafala man. Olsem, yu pasem save ia tru lo ol toktok, o yu stap yusum narafala wei?

Mo tu mifala i intres blo save sipos hem we i risivim save blo yu i yusum, o i fogetem kwik taem.

Mifala rili glad sipos yu agri blo helpem mifala. Vanuatu i wan lo ol kaontri lo wol we i safa bigwan tru lo ol disasta mo ol difikalti we i kam wetem ol jenis lo klaemet. Hem i impotan blo faenemaot ol bes rod blo helpem ol pipol blo ol redi blo fesem ol difikalti ia, mo oli save tekem ol step blo daonem damej o kil we i kam lo ol man mo lo envaeronmen (olsem ol plant mo animal, graon mo solwora we i stap raon lo yumi).

Ol infomesen we yu givim bae i kam lo han blo mi nomo, olsem mein man blo mekem resej. Mi hop se yu save agri blo tekpat mo yu save saenem fom blo talem se yu agri. Tangkyu tumas.

13.

6. If the person is happy to proceed, you can now ask the first question: **"Wanem samfala saen we i soem se weta/klaemet i stap jenis o wan disasta i stap kam (saeklon, drae taem, etkwek, tsunami, volkeno...)?"** You are asking this to find out the traditional signs of an approaching disaster, for example, unusual movements of animals, cloud formations, flowering and fruiting of plants, etc. Allow the respondent plenty of time to answer this question.

7. Now proceed to the second question: **"Yu save eni kastom fasin blo stanap strong lo fes blo ol disasta we i kamaot (saeklon, drae taem, etkwek, tsunami)?"** Here you are looking for traditional ways in which people have prepared for disasters in the past, for example, through food preservation, house design, specific methods of agriculture or fishing. The answer given may also refer to the way that the community meets together and makes plans. Accept any answer that is given.

8. You can move to the third question: **"Ol save ia yu holem yu wan o yu stap pasem? Mo yu pasem lo huia?"** Here, you want to know whether the respondent keeps this information to himself/herself, or whether he/she transmits it to anyone else. If it is passed to others, to whom is it passed and when?

9. The fourth question asks: **"Hao nao yu stap pasem?"** We want to know how exactly this traditional knowledge is passed to others. For example, is it just by talking? Or is it by demonstrating certain techniques, e.g. crop planting, house building, food preservation? One way, for example, is for a parent or grandparent to take children with him/her as he works in the garden or catches fish. Try to find out what he/she thinks is the best way of passing on this traditional knowledge.

10. Now ask the fifth question: **"Yu save givim wan eksampol blo las taem we yu bin pasem save ia, mo lo hu?"** We want to know exactly who are the persons who have received the traditional knowledge from the respondent and when. This question helps the respondent to be more accurate in his/her answers. From the responses to this and to question six we will be able to construct the transmission pathways of traditional knowledge.

11. The sixth question asks: **"Long kastom blo yu, yu sud pasem ol tradisonal save blo yu lo huia? Fasbon boe blo yu, ol pikinini blo yu, bubu blo yu, o hu"** This question is to check up whether the transmission is following the traditional or customary way, or whether it is just following the respondent's own preferences. We want to find out whether the most common pathway is from father to first born son, or mother to first born daughter, or another channel of communication.

12. The seventh question may produce many answers: **"Tedei, fasin we yu stap pasem save blo yu lo narafala man i stap jenis, o no?"** The purpose of asking this question is to find out all the factors that prevent traditional knowledge from being passed to others in the same way that it was in the past (e.g. children going away to school). The respondent will probably tell you that the transmission of TK has changed. Ask him/her to say <u>why</u>.

13. Now we come to the last question: **"Wanem nao ol impotan valiu lo kastom we mekem se wan komuniti i save kam risilient (stanap strong) lo fes blo wan disasta?"** You are asking this to find out whether there are any customary values that help people in the community to become more resilient to disasters. One might be the traditional value of maintaining unity. Another might be care/concern for every single person in the village.

14. You have reached the end of your interview. Ask the respondent to sign the "consent" form and thank him/her warmly for all the help given to you. But don't promise to give anything to him or her. Keep the documents that you have used in a safe place.

15. You can proceed to your next interview.

14.

RESEARCH PROJECT: EFFECTIVENESS OF RESILIENCE EDUCATION IN VANUATU

INSTRUCTIONS FOR CARRYING OUT INTERVIEWS WITH RECEIVERS OF TRADITIONAL KNOWLEDGE

These instructions are designed for my research assistants who will be interviewing recipients of traditional knowledge about resilience to changes in weather, climate and the environment.

1. After you have interviewed a provider of traditional knowledge, he/she will have given you names of persons to whom some TK knowledge, skills or attitudes were passed. You must try to find these persons and interview them. If you cannot find any of them named by the providers of TK, then just choose 5-10 people in the village at random and ask them if they have received any traditional knowledge or skills from an older person, and whether you can interview them about this. You are looking for people who may have received traditional knowledge about weather, climate and the environment, and of resilience to disasters and climate change.
2. Approach the first of these people and explain who you are and why you would like to interview them. Mention that you are helping Mr Charlie Pierce, who is a long-time educator in Vanuatu and is now working on a research project to find out how we are educating people about disasters and climate change. You must approach this person with the greatest respect, showing friendliness and confidence. Ask whether it is convenient to carry out the interview now, or whether you should come back later on.
3. If the person agrees to be interviewed now, then you should suggest that the two of you sit down in a quiet place, and ask whether you can record the interview on your mobile phone, or whether the person would prefer you to simply ask the questions and you write down the answers.
4. At the start of the interview, you can tell the person something about the research project and what you are going to do. You can do this in your own words, or you can read out the message from Charlie Pierce that is provided in the information sheet below:

Mi wantem faenemaot mo skelem ol fasin we yumi stap eduketem ol yangfala lo Vanuatu lo saed blo risiliens. Toktok ia i minim fasin blo stanap strong mo kam gud bakagen lo fes blo ol disasta mo ol jenis lo weta mo klaemet. Komiti blo Kaljaral Senta i agri finis blo mi mekem resej ia.

Yumi eduketem ol man lo skul. Be tu i gat ol grup blo gavman mo ol grup olsem Red Kros mo Oxfam mo Wan Smol Bag we oli go lo ol komuniti blo givim ol aweanes toktok.

Be wan narafala impotan wei i tru lo fasin we ol pipol long vilij we oli holem ol tradisonal save i stap pasem ol save blo olgeta lo ol narafala man. Hemia nao mifala i wantem tokbaot wetem yu.

Mifala i wantem faenemaot sipos yu bin kasem eni save o eni skil aot lo wan olfala man o woman long saed blo weta mo klaemet. Mifala i wantem faenemaot sipos yu bin kasem eni save o skil o tingting abaot ol kastom fasin blo stanap strong lo fes blo olgeta disasta we i kamaot, olsem saeklon, drae taem, ases blo volkeno, etkwek mo sunami. Mo tu mifala i intres blo save sipos yu rimemba gud lo ol save, skil mo tingting we yu bin kasem aot lo man o woman we i bin wantem givim lo yu.

Mifala rili glad sipos yu agri blo helpem mifala. Vanuatu i wan lo ol kaontri lo wol we i safa bigwan tru lo ol disasta mo ol difikalti we i kam wetem ol jenis lo klaemet. Hem i impotan blo faenemaot ol bes rod blo helpem ol pipol blo ol redi blo fesem ol difikalti ia, mo oli save tekem ol step blo daonem damej o kil we i kam lo ol man mo lo envaeronmen (olsem ol plant mo animal, graon mo solwora we i stap raon lo yumi).

Ol infomesen we yu givim bae i kam lo han blo mi nomo, olsem mein man blo mekem resej. Mi hop se yu save agri blo tekpat mo yu save saenem fom blo talem se yu agri. Tangkyu tumas.

15.

5. If the person is happy to proceed, you can now ask the first question: **"Yu bin kasem eni save abaot ol disasta mo jenis lo weta mo klaemet tru lo .... (*nem blo man we hem i talem se hem i bin pasem*)?** You are asking this to find whether the person who said that he/she had transmitted knowledge about climate change to the respondent actually did so. If you are dealing with a respondent who is not linked to the provider of TK that you have already interviewed, then just ask him/her to name the person who did share some knowledge or skills with him. Then he/she will simply answer YES to this question.
6. Now proceed to the second question: **"Aot lo man (woman) ia, yu bin kasem eni save abaot hao blo stanap strong lo fes blo ol disasta o jenis lo klaemet we i kam?** This is like the first question. It does not matter who was the provider of the TK about resilience. You just need to know whether the respondent actually received this kind of knowledge/skills.
7. You can move to the third question: **"Talemaot sam samting we yu bin lanem aot lo hem."** Here, you want to know all the things that the person learnt from the provider of traditional knowledge about weather, climate and resilience. List them all, but if possible, try to classify them into three groups - knowledge, skills and attitudes.
8. The fourth question asks: **"Long saed blo ol save ia, hem i bin talem lo yu o hem i bin soemaot lo yu?"** We want to know whether the traditional knowledge was transmitted orally, through talking, or by demonstration, through showing others what to do. Traditional skills are passed on through demonstration, while knowledge and attitudes are passed on by talking. In many cases, the respondent will say that both methods were used.
9. Now ask the fifth question: **"Yu bin yusum save ia lo laef blo yu? Givim sam eksampol."** Here, the respondent can say whether he/she actually made use of the TK that was received. Be sure to ask for specific examples of how he/she has used the TK.
10. The sixth and seventh questions are similar in that they are trying to find out how much the person remembers about the knowledge and skills that he/she received. Question 6 refers to knowledge, and question 7 to skills. Thus question 6 is **"Yu rimemba hamas long ol <u>save</u> we man o woman ia i bin traem pasem lo yu".** Ask how much traditional knowledge the person remembers - whether everything, quite a lot, a little, or it's all forgotten. Put a circle around the correct answer for question 6. You don't need to ask for details about the knowledge remembered - just how much.
11. The seventh question is: **"Yu rimemba hamas long ol <u>skil</u> we man o woman ia i bin traem soem lo yu?".** This question asks about traditional skills that the person remembers being shown to him/her - whether everything, quite a lot, a little, or it's all forgotten. Put a circle around the correct answer for question 7. You don't need to ask about the nature of these skills - just how many of them have been remembered.
12. Question 8 asks: **"Yu rimemba eni stamba advaes, tingting o bilif we man o woman ia i bin traem soem lo yu? Sipos yes, traem talemaot wanem yu rimemba"** The question aims to find out whether the person remembers any traditional attitudes or beliefs about the environment and resilience, and if so, which ones. Note all of them down.
13. Now we come to the last question: **"Taem we hem i talem o soem sam samting abaot weta o klaemet, o fasin blo stanap strong lo ol disasta, hem i talem wan taem nomo, o hem i stap ripitim plante taem?"** We are asking this question to see whether traditional advice, skills or knowledge are repeatedly transmitted to the same person, or just once. It is an attempt to measure the effectiveness of the transmission.
14. At the end of the interview, ask the respondent to sign the "consent" form. Thank him/her warmly for all the help given to you, but don't promise to give anything back. Keep the documents that you have used in a safe place.
15. Proceed to your next interview.

APPENDIX B: Authorisation Documents

1. **Endorsement NAB**
2. **Endorsement VCC**
3. **Extract from VCC regulations**
4. **Research agreement VCC p.1**
5. **Research agreement VCC p.2**
6. **Research agreement VCC p.3**
7. **Research agreement VCC p.4**
8. **Support letter VITE p.1**
9. **Support letter VITE p.2**
10. **Participant consent form for adults (in English only)**
11. **Participant consent form for secondary school students (in English only)**
12. **Participant consent form for parents/guardians/teachers of secondary school students (in English only)**
13. **Basic participant information sheet, signed (in English and French)**
14. **Participant information sheet for parents/guardians/teachers of school students, signed (in English and French).**
15. **Participant information sheet for school students, signed (in English and French)**
16. **Participant information sheet for providers and receivers of traditional knowledge, unsigned (in Bislama and English)**
17. **Participant information sheet for providers of traditional knowledge, unsigned (in Bislama only)**
18. **Participant information sheet for receivers of traditional knowledge, unsigned (in Bislama only)**
19. **Student photo consents Blackpalm**
20. **Student photo consents Pandanus**
21. **Student photo consents Acacia**

1.

REPUBLIC OF VANUATU

NATIONAL ADVISORY BOARD ON
CLIMATE CHANGE AND DISASTER
RISK REDUCTION

C/O Corporate Services Unit
Ministry of Climate Change and Natural Disasters

Private Mail Bag 9054, Port Vila
Telephone: (678) 22331; Fax: (678) 22310
Email: nab@meteo.gov.vu; Web: www.nab.vu

LONG GOD YUMI STANAP

August 31 2020 — Ref: PV/MCCA/NAB/AB

Mr. Charles Pierce
17 Fynd Street, Goode Beach
Western Australia 6330
Australia
Email: charliepierce19@gmail.com

Dear Mr Pierce

RE: Official NAB Endorsement Notice for the Research project "*The Effectiveness of Resilience Education in Vanuatu*"

This letter serves to inform you that the National Advisory Board on Climate Change and Disaster Risk Reduction (NAB) at its meeting of August 2020 has formally ***endorsed*** the research project "*The Effectiveness of Resilience Education in Vanuatu*".

The NAB appreciates the cooperation demonstrated thus far, and would like to encourage that the NAB be kept apprised of future developments in this research.

Should you seek further clarification or assistance on the recommendations, please contact the NAB Secretariat Manager Anna Bule at abule@vanuatu.gov.vu

Sincerely

REPUBLIC OF VANUATU
The Ministry of Climate Change Adaptation, Meteorolgy, Geohazards Environment, Energy & NDMO
Le Ministère Du Climat Change Adaptation, Météorologie Georiequs, Environnement Energie et NDMO
REPUBLIQUE DE VANUATU

Esline Garaebiti
Chairman National Advisory Board on Climate Change Disaster Risk Reduction
Director General, Ministry of Climate Change Adaptation

2.

VANUATU NATIONAL KALJORAL KAONSEL
Vanuatu National Cutural Council
Conseil National Culture du Vanuatu

VANUATU KALJORAL SENTA
Vanuatu Cutural Centre
Centre Cultural du Vanuatu

24th September 2019

Mr Charles Pierce
Port Vila
Efate

Dear Pierce,

Re: Approval letter of your research permit- Exempted

This is to officially confirm that your research permit has been approved and exempted by the Vanuatu National Cultural Council.

Your research Topic: **"The Effectiveness of Resilience Education in Vanuatu".**

Please comply with our Research Policy and Agreement which has been signed with the Vanuatu Cultural Centre.

Once again, thank you for choosing Vanuatu for this research and wish you all the best.

Yours faithfully,

Richard Shing
Director, Vanuatu Cultural Centre

CULTURAL CENTRE CULTUREL PORT-VILA-VANUATU

3.

(8) In undertaking research the Researcher will:

a) Recognize the rights of people being studied, including the right not to be studied, to privacy, to anonymity, and to confidentiality;

b) Recognize the primary right of informants and suppliers of data and materials to the knowledge and use of that information and material, and respect traditional copyrights, which always remain with the local community;

c) Assume a responsibility to make the subjects in research fully aware of their rights and the nature of the research and their involvement in it;

d) Respect local customs and values and carry out research in a manner consistent with these;

e) Contribute to the interests of the local community in whatever ways possible so as to maximize the return to the community for their cooperation in their research work;

f) Recognize their continuing obligations to the local community after the completion of field work, including returning materials as desired and providing support and continuing concern.

4.

Appendix 1 (Vanuatu Cultural Research Policy).

Research Agreement

AN AGREEMENT made the 18th day of September, 2019.

BETWEEN : THE NATIONAL CULTURAL COUNCIL, representing the Government of the Republic of Vanuatu and the local community, (hereinafter called "the Council") of the one part.

AND : Charles Andrew Pierce

of the Vanuatu Institute of Teacher Education

(hereinafter called "the Researcher") of the other part.

WHEREAS :

(1) The Researcher has applied to the Council to do research work in the Republic of Vanuatu, and agrees to the conditions placed upon her/him in this document and to compliance with the intent of the ethics described in the Vanuatu Cultural Research Policy.

(2) The Council has agreed to allow the Researcher to do such research, and has agreed to the obligations placed upon it by this document and by the Vanuatu Cultural Research Policy.

AND THEREFORE THE PARTIES AGREED AS FOLLOWS :

(1) The Council hereby authorises the Researcher to undertake research work in Vanuatu on the subject of
"The effectiveness of Resilience Education in Vanuatu"

with the communit(y/ies) of selected villages on the island/s of Mota, Santo, Malakula, Pentecost, Tongoa, Tanna and possibly others

in the capacity of the Researcher and up to 10 Research Assistants (depending on the availability of the Researcher's former students, all of whom are ni-Vanuatu living in Vanuatu)

for the period up until December 2022. During this period, the Researcher will be based in Albany, Western Australia, but will make frequent visits to Vanuatu, each of them for between 2-3 weeks. When in Vanuatu, the Researcher will live at the Vanuatu Institute of Teacher Education.

(2) The Researcher is applying to the Council to request that the authorisation fee of 100,000 vatu be waived.

CAPierce

5.

(3) The right to the products of research shall belong to the Researcher who shall be entitled to reproduce them for educational, academic or scientific purposes, provided that traditional copyrights are not compromised and the permission to use material has been obtained from copyright holders with their prior informed consent. The products of research shall not be reproduced or offered for sale or otherwise used for commercial purposes, unless specified under section 12 of this agreement.

(4) Copies of all non-artefact products of research are to be deposited without charge with the Cultural Centre and, where feasible, with the local community. Two copies of films and videos are to be provided, one for public screening and the other for deposit in the archives. In the case of films, a copy on video is also required. Any artefacts collected become the property of the Cultural Centre unless the traditional owners specify otherwise. The carrying of any artefacts or specimens outside the country is prohibited as stipulated under cap.39 of the Laws of Vanuatu. Artefacts and specimens may be taken out of the country for overseas study and analysis under cap.39(7). The conditions for the return of the following materials are:

(Specify artefacts/specimens/other materials and conditions for return)

No artefacts or specimens are required.

The Researcher has either
(a) provided a letter from the institution to which they are affiliated guaranteeing the researcher's compliance with the above conditions, or
(b) provided a retrievable deposit of 40 000 vatu to ensure their compliance with these conditions.

(5) The Researcher will be responsible for the translation of a publication in a language other than a vernacular language or one of the three national languages of Vanuatu into a vernacular or one of the national languages, preferably the one used in education in the local community. They will also make the information in all products of research, subject to copyright restrictions, accessible to the local community through such means as audio cassettes or copies of recorded information, preferably in the vernacular. The Researcher will also submit an interim report of not less than 2000 words no later than 6 months after the research period has ended giving a reasonable precis of their work. This will be in one of the national languages and in 'layman's terms' so as to be of general use to all citizens.

(6) There will be maximum involvement of indigenous scholars, students and members of the community in research, full recognition of their collaboration, and training to enable their further contribution to country and community. The Council nominates the following individuals to be involved in research and/or trained, in the following capacities:

(The Researcher's assistants have not yet been formally identified, but will comprise teachers in selected secondary schools in Vanuatu and former students of the Researcher who can investigate traditional methods of education on resilience as well as non-formal programmes being carried out by government agencies and non-government organisations.)

CAPierce

6.

(7) A product of immediate benefit and use to the local community will be provided by the Researcher no later than 6 months after termination of the research period. This product is: The completed PhD thesis on the effectiveness of resilience education in Vanuatu.

(8) In addition to their research work, the Researcher will, as a service to the nation of Vanuatu, undertake to : (section 8.3 of the Cultural Research Policy suggests possible services of benefit to the nation) assist the Education Department, the Vanuatu Institute of Teacher Education, the Vanuatu Institute of Technology and Rural Training Centres throughout Vanuatu to work towards a more effective delivery of courses on climate change and disaster risk reduction.

(9) In undertaking research the Researcher will:

a) recognise the rights of people being studied, including the right not to be studied, to privacy, to anonymity, and to confidentiality;

b) recognise the primary right of informants and suppliers of data and materials to the knowledge and use of that information and material, and respect traditional copyrights, which always remain with the local community;

c) assume a responsibility to make the subjects in research fully aware of their rights and the nature of the research and their involvement in it;

d) respect local customs and values and carry out research in a manner consistent with these;

e) contribute to the interests of the local community in whatever ways possible so as to maximise the return to the community for their cooperation in the research work;

f) recognise their continuing obligations to the local community after the completion of field work, including returning materials as desired and providing support and continuing concern.

(10) In all cases where information or material data is obtained by the Researcher, the Researcher has the responsibility to make his/her informant(s) fully aware of their rights and obligations, and those of the Researcher, in the transmission of this information. In particular, it is the obligation of the Researcher to:
a) ensure the informant(s) have given their Prior Informed Consent to provide this information for the purposes of the research project ;
b) record full details as to the extent to which this information can be transmitted to other people and to publish or otherwise disseminate this information only in accordance with these disclosure details given by the informant(s) ;
c) properly acknowledge and attribute this information to the informant(s) in all cases where it is recorded, published and/or cited.

(11) A breach of any part of this agreement by the Researcher or a decision by the local community that it no longer wishes to be involved in the research venture will result in the termination of the research project.

CA Pierce

7.

(12) (Additional clauses/conditions) (This section will detail commercial ventures, extra costs incurred by the Cultural Centre, etc.)

No commercial ventures

The Cultural Centre is not liable for any costs.

Signed :

Charles Pierre (C Pierre)
....
The Researcher

....
On behalf of the National Cultural Council.

8.

VANUATU INSTITUTE OF TEACHER EDUCATION
Private Mail Bag 9076,
Port Vila, Vanuatu
Tel: (678) 23099
Fax: (678) 27530

INSTITUT DE FORMATION DES ENSEIGNANTS DU VANUATU
Sac Postal Réservé 9076,
Port Vila, Vanuatu
Tel: (678) 23099
Fax: (678) 27530

To the Attention of:
Mr. Richard Shing.
Director
The Vanuatu Cultural Centre and the Vanuatu National Cultural Council,
Port Vila, Vanuatu

18th September 2019

Dear Sir,

RE: Research project to be undertaken by Mr. Charles Pierce, MBE

As the institution with which Mr. Pierce will be affiliated when carrying out research leading to his PhD, we are herewith providing a letter of guarantee in accordance with the requirements of the National Cultural Council.

The Vanuatu Institute of Teacher Education knows Mr. Pierce well, because he was a lecturer here in Social Science and Earth Science from 1999 to 2013, and was heavily involved in the project to harmonize curriculum development in English and French. He is a dedicated teacher and will be a thorough researcher. We stand to benefit considerably from the proposed project. Some of the trainee teachers and staff may be used as research assistants and will benefit from the rigour and exactitude of research procedures that will be required. The findings should also provide insights to staff in the Science and Social Science Departments in the use of materials and teaching strategies that make the teaching of climate change issues more effective. Furthermore VITE's status as a research institution will be enhanced, hopefully leading to the development of other research projects in the field of education.

The Vanuatu Institute of Teacher Education will support Mr. Pierce by allowing him to interact with staff and trainee teachers in order to do the research. We will also provide Mr. Pierce with basic accommodation. But the institution will not provide any allowance or salary for Mr. Pierce.

As required by the National Cultural Council, we guarantee Mr. Pierce's compliance with the following conditions:

1. The subject of research is "The effectiveness of resilience education in Vanuatu". This covers an analysis and evaluation of the various ways in which young people are being educated about resilience to climate change and disasters, including informal and formal methods. Research will be conducted in selected schools, tertiary institutions and civil society organisations in

9.

Vanuatu, as well as with holders of traditional knowledge in selected villages on islands such as Santo, Malakula, Pentecost, Tanna, Tongoa and Mota. Such villages have yet to be selected and will depend on those persons who wish to serve as research assistants. Research will be conducted over a three year period, beginning in October 2019. Mr. Pierce will be based at his home in Western Australia, but will make frequent visits to Vanuatu to organise the research, and will be based in accommodation that we will provide at the Vanuatu Institute of Teacher Education

2. Mr. Pierce is applying for a waiver of the authorisation fee of 100,000 vatu normally required by the National Cultural Council.

3. The right to the products of research shall belong to Mr Pierce as Researcher, who shall be entitled to reproduce them for educational, academic or scientific purposes, provided that traditional copyrights are not compromised and the permission to use material has been obtained from copyright holders with their prior informed consent. The products of research shall not be reproduced or offered for sale or otherwise used for commercial purposes, unless specified under section 12 of the Research Agreement.

4. Copies of all non-artefact products of research are to be deposited without charge with the Cultural Centre and, where feasible, with the local community. Two copies of films and videos are to be provided, one for public screening and the other for deposit in the archives. In the case of films, a copy on video is also required. Any artefacts collected become the property of the Cultural Centre unless the traditional owners specify otherwise. The carrying of any artefacts or specimens outside the country is prohibited as stipulated under cap.39 of the Laws of Vanuatu. Artefacts and specimens may be taken out of the country for overseas study and analysis under cap.39 (7).

We again wish to point out that this research project has the full support of the Vanuatu Institute of Teacher Education, since it will benefit the entire nation of Vanuatu as it struggles to become more resilient in the face of disasters and ongoing climate change.

Yours sincerely,

Ben Boulekouran
Acting Principal
Vanuatu Institute of Teacher Education

10.

Written consent form (adult interviews):

CONSENT FORM

Project: ***Effectiveness of resilience education in Vanuatu***

I have understood the information that has been given to me about this project. I agree to help with this research. I consent to publication of the results of the project as described in the information given to me on the understanding that my anonymity is preserved (my name or other identifying information about me will not be used).

I understand that at any time up to one month after the date of my signature below I may withdraw from the project, as well as withdraw any information that I have provided.

I note that this project has been reviewed and approved by the University Research Ethics Committee at Bishop Grosseteste University.

Name (please print)

Signature

Date

Researcher: Charles Pierce (PhD candidate)

Supervisor:

DR SARAH L HEMSTOCK
Programme Leader Geography

Bishop Grosseteste University
Longdales Road
Lincoln
LN1 3DY

Phone: +44 (0)7534668818 | **Website** http://www.bishopg.ac.uk/study/ug/geography/#1478643211865-60929a5d-30c4
Email: sarah.hemstock@bishopg.ac.uk | **Orcid** https://orcid.org/0000-0003-3407-2267
Twitter www.twitter.com/BGULincoln | **Facebook** www.facebook.com/BGULincoln | **Website** www.bishopg.ac.uk

11.

Written consent form (secondary school student):

CONSENT FORM TO BE COMPLETED BY PARTICIPATING STUDENT

The question this research is addressing: ***The effectiveness of resilience education in Vanuatu.***

I have understood the information that has been given to me about this project. I agree to help with this research. I consent to publication of the results of the project as described in the information given to me on the understanding that my anonymity is preserved (my name or other identifying information about me will not be used).

I understand that at any time up to one month after the date of my signature below I may withdraw from the project, as well as withdraw any information that I have provided.

I note that this project has been reviewed and approved by the University Research Ethics Committee at Bishop Grosseteste University.

Name of student (please print) *Institution/Course*

Signature *Date*

Researcher: Charles Pierce (PhD candidate)

Supervisor:

DR SARAH L HEMSTOCK
Programme Leader Geography

Bishop Grosseteste University
Longdales Road
Lincoln
LN1 3DY

BISHOP GROSSETESTE UNIVERSITY

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Email: sarah.hemstock@bishopg.ac.uk | Orcid https://orcid.org/0000-0003-3407-2267
Twitter www.twitter.com/BGULincoln | Facebook www.facebook.com/BGULincoln | Website www.bishopg.ac.uk

12.

Written consent form (parents/guardians/teachers of secondary school students):

CONSENT FORM TO BE COMPLETED BY PARENT/GUARDIAN/TEACHER OF PARTICIPATING STUDENT

The question this research is addressing: **The effectiveness of resilience education in Vanuatu.**

I have understood the information that has been given to me about this project. I agree that my son/daughter/student can participate in this research and consent to publication of the results of the project on the understanding that anonymity is preserved (my name or other identifying information about me or my son/daughter will not be used).

I understand that at any time up to one month after the date of my signature below we may withdraw from the project, as well as withdraw any information that we have provided.

I note that this project has been reviewed and approved by the University Research Ethics Committee at Bishop Grosseteste University.

Name (please print) *Parent/ Guardian/Teacher of (please print)*

Signature *Date*

Researcher: Charles Pierce (PhD candidate)

Supervisor:

DR SARAH L HEMSTOCK
Programme Leader Geography

BISHOP GROSSETESTE UNIVERSITY

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Twitter www.twitter.com/BGULincoln | Facebook www.facebook.com/BGULincoln | Website www.bishopg.ac.uk

13.

PARTICIPANT INFORMATION SHEET

RESEARCH PROJECT: EFFECTIVENESS OF RESILIENCE EDUCATION IN VANUATU

This research is being carried out to find out how young people in Vanuatu are being educated about resilience to climate change and disasters. "Resilience" means our ability to cope with, and recover from, injury, stress or damage. Education to become more resilient to climate change and disasters is taking place in schools and tertiary institutions such as the Vanuatu Institute of Technology and USP. It is taking place in communities through the efforts of non-government organisations and government agencies. Traditional knowledge about resilience to disasters is also being transmitted in an informal way at village level.

I would like to ask questions to youth and adults to measure how their knowledge, skills, attitudes and behaviour change as a result of taking such educational programmes. I wish to research how a participant's progress in these courses depends upon the materials and teaching methods used, the qualities of the teacher or facilitator, and the attitude of the participant.

Your help in this research is greatly appreciated. Vanuatu is one of the most vulnerable countries in the world to disasters and the impacts of climate change, and it is important that we find out the best ways of educating people to prepare for these difficulties and take steps to reduce loss and damage to humans and the environment.

By completing the questionnaires or by agreeing to be interviewed, you will be contributing to this research. All data collected will be used, stored and held only by myself as the principal researcher. I hope you will agree to take part and sign the required "consent" form. Thank you for your help.

Charles Pierce

(Charles Pierce, PhD candidate and former teacher at Malapoa College, the Vanuatu Institute of Teacher Education, Emalus Campus and the Vanuatu Institute of Technology)

INFORMATION POUR LES PARTICIPANTS : PROJET DE RECHERCHE: L'EFFICACITÉ DE L'ÉDUCATION SUR LA RÉSILIENCE AU VANUATU

Cette recherche est menée pour découvrir les différentes façons dont les jeunes de Vanuatu reçoivent une éducation sur la résilience aux catastrophes et au changement climatique. Le terme « résilience » signifie notre capacité de s'ajuster et de se remettre des blessures, du stress ou des dégâts. L'éducation sur la résilience au changement climatique et aux catastrophes se déroule aux écoles et aux institutions tertiaires telles que l'Institut de Technologie de Vanuatu et l'Université du Pacifique Sud. Elle se déroule au sein des communautés grâce aux efforts des organisations non gouvernementales et des organismes gouvernementaux. De plus, les connaissances traditionnelles sur la résilience aux catastrophes sont transmises de manière informelle au niveau du village.

Je voudrais poser des questions aux jeunes et aux adultes pour mesurer les changements dans leurs connaissances, leurs compétences, leurs attitudes et leurs comportements à la suite de leur participation dans ces programmes éducatifs. Je veux rechercher comment les progrès d'un participant dans ces cours dépendent du matériel et des méthodes d'enseignement utilisés, ainsi que des qualités de l'enseignant/ le facilitateur et de l'attitude du participant.

Votre aide dans cette recherche est fortement appréciée. Vanuatu est l'un des pays les plus vulnérables au monde aux catastrophes et aux impacts du changement climatique, et il est important de trouver les meilleures façons d'éduquer les gens à se préparer à ces difficultés et à prendre des mesures pour réduire les pertes et les dommages aux humains et à l'environnement.

En complétant les questionnaires et en acceptant d'être interviewé, vous contribuez à cette recherche. Toutes les données recueillies ne seront utilisées, stockées ou retenues que par moi-même, en tant que chercheur principal. J'espère que vous accepterez de participer et de signer le formulaire de consentement requis. Merci de votre aide.

Charles Pierce

(Charles Pierce, candidat au doctorat et ancien professeur à Malapoa College, à l'Institut de Formation des Enseignants du Vanuatu, au Campus Emalus et à l'Institut de Technologie du Vanuatu.)

14.

INFORMATION SHEET FOR PARENTS AND GUARDIANS OF SCHOOL STUDENTS
RESEARCH PROJECT: EFFECTIVENESS OF RESILIENCE EDUCATION IN VANUATU

This research is being carried out to find out how young people in Vanuatu are being educated about resilience to climate change and disasters. "Resilience" means our ability to cope with, and recover from, injury, stress or damage. Education to become more resilient to climate change and disasters is taking place in schools and tertiary institutions such as the Vanuatu Institute of Technology and USP. It is taking place in communities through the efforts of non-government organisations and government agencies. Traditional knowledge about resilience to disasters is also being transmitted in an informal way at village level.

I would like to ask students in a number of secondary schools to complete questionnaires for this research. Your son/daughter is one of those students. I want to know how his/her knowledge, skills, attitudes and behaviour may change as a result of taking lessons or courses on climate change and disasters. The teacher will hand out questionnaires to the students before they take the course and again after the course is completed. The student may also be asked to give his/her opinion about the learning materials and methods of teaching that are used. All information provided by students is confidential, and each student is asked to sign a consent form showing that he/she agrees to answer the questions. When the data is compiled, no names will be used.

I hope you will allow your son/daughter to help in this research. Vanuatu is one of the most vulnerable countries in the world to disasters and the impacts of climate change, and it is important that we find out the best ways of educating people to prepare for these difficulties and take steps to reduce loss and damage to humans and the environment.

By allowing your son/daughter to complete the questionnaires or to be interviewed, you will be contributing to this research. All data collected will be used, stored and held only by myself as the principal researcher. Thank you for your help.

Charles Pierce (Charles Pierce, PhD candidate and former teacher at Malapoa College, the Vanuatu Institute of Teacher Education, Emalus Campus and the Vanuatu Institute of Technology)

INFORMATION POUR LES PARENTS/GARDIENS DES JEUNES SCOLARISÉS
PROJET DE RECHERCHE: L'EFFICACITÉ DE L'ÉDUCATION SUR LA RÉSILIENCE

Cette recherche est menée pour découvrir les différentes façons dont les jeunes de Vanuatu reçoivent une éducation sur la résilience aux catastrophes et au changement climatique. Le terme « résilience » signifie notre capacité de s'ajuster et de se remettre des blessures, du stress ou des dégâts. L'éducation sur la résilience au changement climatique et aux catastrophes se déroule aux écoles et aux institutions tertiaires telles que l'Institut de Technologie de Vanuatu et l'Université du Pacifique Sud. Elle se déroule au sein des communautés grâce aux efforts des organisations non gouvernementales et des organismes gouvernementaux. De plus, les connaissances traditionnelles sur la résilience aux catastrophes sont transmises de manière informelle au niveau du village.

Pour mes recherches, je voudrais demander aux étudiants de plusieurs écoles secondaires de bien vouloir compléter des questionnaires. Votre fils/fille est un(e) de ces étudiant(e)s. Je veux savoir les changements dans ses connaissances, ses compétences, ses attitudes et son comportement à la suite de leçons ou de cours sur le changement climatique et les catastrophes. Le professeur demandera aux étudiants de compléter un questionnaire avant et après qu'ils participent dans ce cours. On pourra leur demander de donner leur avis sur le matériel d'apprentissage et sur les méthodes d'enseignement utilisés. Tous les renseignements fournis par les étudiants sont confidentiels, et chaque étudiant est invité à signer un formulaire pour montrer qu'il/elle accepte de répondre aux questions. Lorsque les données dont compilées, aucun nom ne sera utilisé.

J'espère que vous permettrez à votre fils/fille de participer dans cette recherche. Vanuatu est l'un des pays les plus vulnérables au monde aux catastrophes et aux impacts du changement climatique, et il est important de trouver les meilleures façons d'éduquer les gens à se préparer à ces difficultés et à prendre des mesures pour réduire les pertes et les dommages aux humains et à l'environnement. En permettant à votre fils/fille de compléter les questionnaires ou en acceptant d'être interviewé, vous contribuez à cette recherche. Toutes les données recueillies ne seront utilisées, stockées ou retenues que par moi-même, en tant que chercheur principal. Merci beaucoup.

Charles Pierce *(Charles Pierce, candidat au doctorat et ancien professeur à Malapoa College, à l'Institut de Formation des Enseignants du Vanuatu, au Campus Emalus et à l'Institut de Technologie du Vanuatu.)*

15.

PARTICIPANT INFORMATION SHEET FOR SCHOOL STUDENTS
RESEARCH PROJECT: EFFECTIVENESS OF RESILIENCE EDUCATION IN VANUATU

This research is being carried out to find out how young people in Vanuatu are being educated about resilience to climate change and disasters. "Resilience" means our ability to cope with, and recover from, injury, stress or damage. Education to become more resilient to climate change and disasters is taking place in schools and tertiary institutions such as the Vanuatu Institute of Technology and USP. It is taking place in communities through the efforts of non-government organisations and government agencies. Traditional knowledge about resilience to disasters is also being transmitted in an informal way at village level.

I would like to ask students in a number of secondary schools to complete questionnaires for this research. I want to know how your knowledge, skills, attitudes and behaviour may change as a result of taking lessons or courses on climate change and disasters. Your teacher will ask you to complete the questionnaire before you take the course and again after you have completed the course. You may be asked to give your opinion about the learning materials you are given and the methods of teaching that are used. All information that you provide is confidential, and you are asked to sign a form to show that you agree to answer the questions. When the data is compiled, no names will be used.

Your help in this research is greatly appreciated. Vanuatu is one of the most vulnerable countries in the world to disasters and the impacts of climate change, and it is important that we find out the best ways of educating people to prepare for these difficulties and take steps to reduce loss and damage to humans and the environment.

By completing the questionnaires or by agreeing to be interviewed, you will be contributing to this research. All data collected will be used, stored and held only by myself as the principal researcher. I hope you will agree to take part. Thank you for your help.

Charles Pierce (Charles Pierce, PhD candidate and former teacher at Malapoa College, the Vanuatu Institute of Teacher Education, Emalus Campus and the Vanuatu Institute of Technology)

INFORMATION POUR LES JEUNES SCOLARISÉS: PROJET DE RECHERCHE: L'EFFICACITÉ DE L'ÉDUCATION SUR LA RÉSILIENCE AU VANUATU

Cette recherche est menée pour découvrir les différentes façons dont les jeunes de Vanuatu reçoivent une éducation sur la résilience aux catastrophes et au changement climatique. Le terme « résilience » signifie notre capacité de s'ajuster et de se remettre des blessures, du stress ou des dégâts. L'éducation sur la résilience au changement climatique et aux catastrophes se déroule aux écoles et aux institutions tertiaires telles que l'Institut de Technologie de Vanuatu et l'Université du Pacifique Sud. Elle se déroule au sein des communautés grâce aux efforts des organisations non gouvernementales et des organismes gouvernementaux. De plus, les connaissances traditionnelles sur la résilience aux catastrophes sont transmises de manière informelle au niveau du village.

Pour mes recherches, je voudrais demander aux étudiants de plusieurs écoles secondaires de bien vouloir compléter des questionnaires. Je veux savoir les changements dans vos connaissances, vos compétences, vos attitudes et votre comportement à la suite de leçons ou de cours sur le changement climatique et les catastrophes. Votre professeur vous demandera de compléter un questionnaire avant et après que vous participiez dans ce cours. On pourra vous demander de donner votre avis sur le matériel d'apprentissage et sur les méthodes d'enseignement utilisés. Tous les renseignements que vous fournissez sont confidentiels, et je vous demande de signer un formulaire pour montrer que vous acceptez de répondre aux questions. Lorsque les données dont compilées, aucun nom ne sera utilisé.

Votre aide dans cette recherche est fortement appréciée. Vanuatu est l'un des pays les plus vulnérables au monde aux catastrophes et aux impacts du changement climatique, et il est important de trouver les meilleures façons d'éduquer les gens à se préparer à ces difficultés et à prendre des mesures pour réduire les pertes et les dommages aux humains et à l'environnement. En complétant les questionnaires et en acceptant d'être interviewé, vous contribuez à cette recherche. Toutes les données recueillies ne seront utilisées, stockées ou retenues que par moi-même, en tant que chercheur principal. J'espère que vous accepterez de participer et de signer le formulaire de consentement. Merci beaucoup.

Charles Pierce *(Charles Pierce, candidat au doctorat et ancien professeur à Malapoa College, à l'Institut de Formation des Enseignants du Vanuatu, au Campus Emalus et à l'Institut de Technologie du Vanuatu.)*

16.

INFOMESEN ABAOT TISFALA PROJEK BLO RESEJ (STADI)

FASIN WE YUMI STAP TIJIM OL YANGFALA ABAOT OL WEI BLO STANAP STRONG LO FES BLO OL DISASTA MO OL JENIS LO WETA MO KLAEMET

Mi wantem faenemaot mo skelem ol fasin we yumi stap eduketem ol yangfala lo Vanuatu lo saed blo risiliens. Toktok ia i minim fasin blo stanap strong mo kam gud bakagen lo fes blo ol disasta mo ol jenis lo weta mo klaemet. Komiti blo Kaljaral Senta i agri finis blo mi mekem resej ia.

Yumi eduketem ol man lo skul. Be tu i gat ol grup blo gavman mo ol grup olsem Red Kros mo Oxfam mo Wan Smol Bag we oli go lo ol komuniti blo givim ol aweanes toktok.

Be wan narafala impotan wei i tru lo fasin we ol pipol long vilij we oli holem ol tradisonal save i stap pasem ol save blo olgeta lo ol narafala man. Hemia nao mifala i wantem toktok wetem yu. Mifala i wantem faenemaot wanem kaen save yu stap holem lo saed blo weta mo klaemet. Mifala i wantem faenemaot sipos yu gat save lo ol kastom fasin blo stanap strong lo fes blo olgeta disasta we i kamaot, olsem saeklon, drae taem, etkwek, sunami, mo hao nao yu stap pasem ol save ia lo ol pikinini blo yu o lo narafala man. Olsem, yu pasem save ia tru lo ol toktok, o yu stap yusum narafala wei?

Mo tu mifala i intres blo save sipos hem we i risivim save blo yu i yusum, o i fogetem kwik taem.

Mifala rili glad sipos yu agri blo helpem mifala. Vanuatu i wan lo ol kaontri lo wol we i safa bigwan tru lo ol disasta mo ol difikalti we i kam wetem ol jenis lo klaemet. Hem i impotan blo faenemaot ol bes rod blo helpem ol pipol blo ol redi blo fesem ol difikalti ia, mo oli save tekem ol step blo daonem damej o kil we i kam lo ol man mo lo envaeronmen (olsem ol plant mo animal, graon mo solwora we i stap raon lo yumi).

Ol infomesen we yu givim bae i kam lo han blo mi nomo, olsem mein man blo mekem resej. Mi hop se yu save agri blo tekpat mo yu save saenem fom blo talem se yu agri. Tangkyu tumas.

. (Charles Pierce, tija lo Malapoa Kolej, Kolej blo ol Tija, INTV mo USP bifo)

RESEARCH PROJECT: EFFECTIVENESS OF RESILIENCE EDUCATION IN VANUATU

This research is being carried out to find out how young people in Vanuatu are being educated about resilience to climate change and disasters. "Resilience" means our ability to cope with, and recover from injury and damage. The research is approved by the Board of the Vanuatu Cultural Centre.

Education to become more resilient to climate change and disasters is taking place in schools. It is taking place in communities through awareness talks given by government agencies and groups such as Red Cross, Oxfam and Wan Smol Bag.

But another important way is through the traditional knowledge passed down from one person to another. This is why we would like to interview you. We want to find out the kinds of knowledge that you have about weather and climate and about traditional ways of being resilient to disasters and changes in the environment. We want to know how you pass this knowledge to your children or to others - through talking or in other ways. And we are interested to know whether the young people who receive this knowledge use it, or quickly forget it.

Your help in this research is greatly appreciated. Vanuatu is one of the most vulnerable countries in the world to disasters and the impacts of climate change, and it is important that we find out the best ways of educating people to prepare for these difficulties and take steps to reduce loss and damage to humans and the environment.

By agreeing to be interviewed, you will be contributing to this research. All data collected will be used, stored and held only by myself as the principal researcher. I hope you will agree to take part and sign the required "consent" form. Thank you for your help.

(Charles Pierce, PhD candidate and former teacher at Malapoa College, the Vanuatu Institute of Teacher Education, Emalus Campus and the Vanuatu Institute of Technology)

17.

INFOMESEN ABAOT TISFALA PROJEK BLO RESEJ (STADI)

FASIN WE YUMI STAP TIJIM OL YANGFALA ABAOT OL WEI BLO STANAP STRONG LO FES BLO OL DISASTA MO OL JENIS LO WETA MO KLAEMET

(Blong olgeta we oli holem mo pasem ol tradisonal save)

Mi wantem faenemaot mo skelem ol fasin we yumi stap eduketem ol yangfala lo Vanuatu lo saed blo risiliens. Toktok ia i minim fasin blo stanap strong mo kam gud bakagen lo fes blo ol disasta mo ol jenis lo weta mo klaemet. Komiti blo Kaljaral Senta i agri finis blo mi mekem resej ia.

Yumi eduketem ol man lo skul. Be tu i gat ol grup blo gavman mo ol grup olsem Red Kros mo Oxfam mo Wan Smol Bag we oli go lo ol komuniti blo givim ol aweanes toktok.

Be wan narafala impotan wei i tru lo fasin we ol pipol long vilij we oli holem ol tradisonal save i stap pasem ol save blo olgeta lo ol narafala man. Hemia nao mifala i wantem toktok wetem yu. Mifala i wantem faenemaot wanem kaen save yu stap holem lo saed blo weta mo klaemet. Mifala i wantem faenemaot sipos yu gat save lo ol kastom fasin blo stanap strong lo fes blo olgeta disasta we i kamaot, olsem saeklon, drae taem, etkwek, sunami, mo hao nao yu stap pasem ol save ia lo ol pikinini blo yu o lo narafala man. Olsem, yu pasem save ia tru lo ol toktok, o yu stap yusum narafala wei?

Mo tu mifala i intres blo save sipos hem we i risivim save blo yu i yusum, o i fogetem kwik taem.

Mifala rili glad sipos yu agri blo helpem mifala. Vanuatu i wan lo ol kaontri lo wol we i safa bigwan tru lo ol disasta mo ol difikalti we i kam wetem ol jenis lo klaemet. Hem i impotan blo faenemaot ol bes rod blo helpem ol pipol blo ol redi blo fesem ol difikalti ia, mo oli save tekem ol step blo daonem damej o kil we i kam lo ol man mo lo envaeronmen (olsem ol plant mo animal, graon mo solwora we i stap raon lo yumi).

Ol infomesen we yu givim bae i kam lo han blo mi nomo, olsem mein man blo mekem resej. Mi hop se yu save agri blo tekpat mo yu save saenem fom blo talem se yu agri. Tangkyu tumas.

.

(Charles Pierce, tija lo Malapoa Kolej, Kolej blo ol Tija, INTV mo USP bifo)

18.

INFOMESEN ABAOT TISFALA PROJEK BLO RESEJ (STADI)

FASIN WE YUMI STAP TIJIM OL YANGFALA ABAOT OL WEI BLO STANAP STRONG LO FES BLO OL DISASTA MO OL JENIS LO WETA MO KLAEMET

(Blong olgeta we oli bin risivim tradisonal save)

Mi wantem faenemaot mo skelem ol fasin we yumi stap eduketem ol yangfala lo Vanuatu lo saed blo risiliens. Toktok ia i minim fasin blo stanap strong mo kam gud bakagen lo fes blo ol disasta mo ol jenis lo weta mo klaemet. Komiti blo Kaljaral Senta i agri finis blo mi mekem resej ia.

Yumi eduketem ol man lo skul. Be tu i gat ol grup blo gavman mo ol grup olsem Red Kros mo Oxfam mo Wan Smol Bag we oli go lo ol komuniti blo givim ol aweanes toktok.

Be wan narafala impotan wei i tru lo fasin we ol pipol long vilij we oli holem ol tradisonal save i stap pasem ol save blo olgeta lo ol narafala man. Hemia nao mifala i wantem tokbaot wetem yu.

Mifala i wantem faenemaot sipos yu bin kasem eni save o eni skil aot lo wan olfala man o woman long saed blo weta mo klaemet. Mifala i wantem faenemaot sipos yu bin kasem eni save o skil o tingting abaot ol kastom fasin blo stanap strong lo fes blo olgeta disasta we i kamaot, olsem saeklon, drae taem, ases blo volkeno, etkwek mo sunami. Mo tu mifala i intres blo save sipos yu rimemba gud lo ol save, skil mo tingting we yu bin kasem aot lo man o woman we i bin wantem givim lo yu.

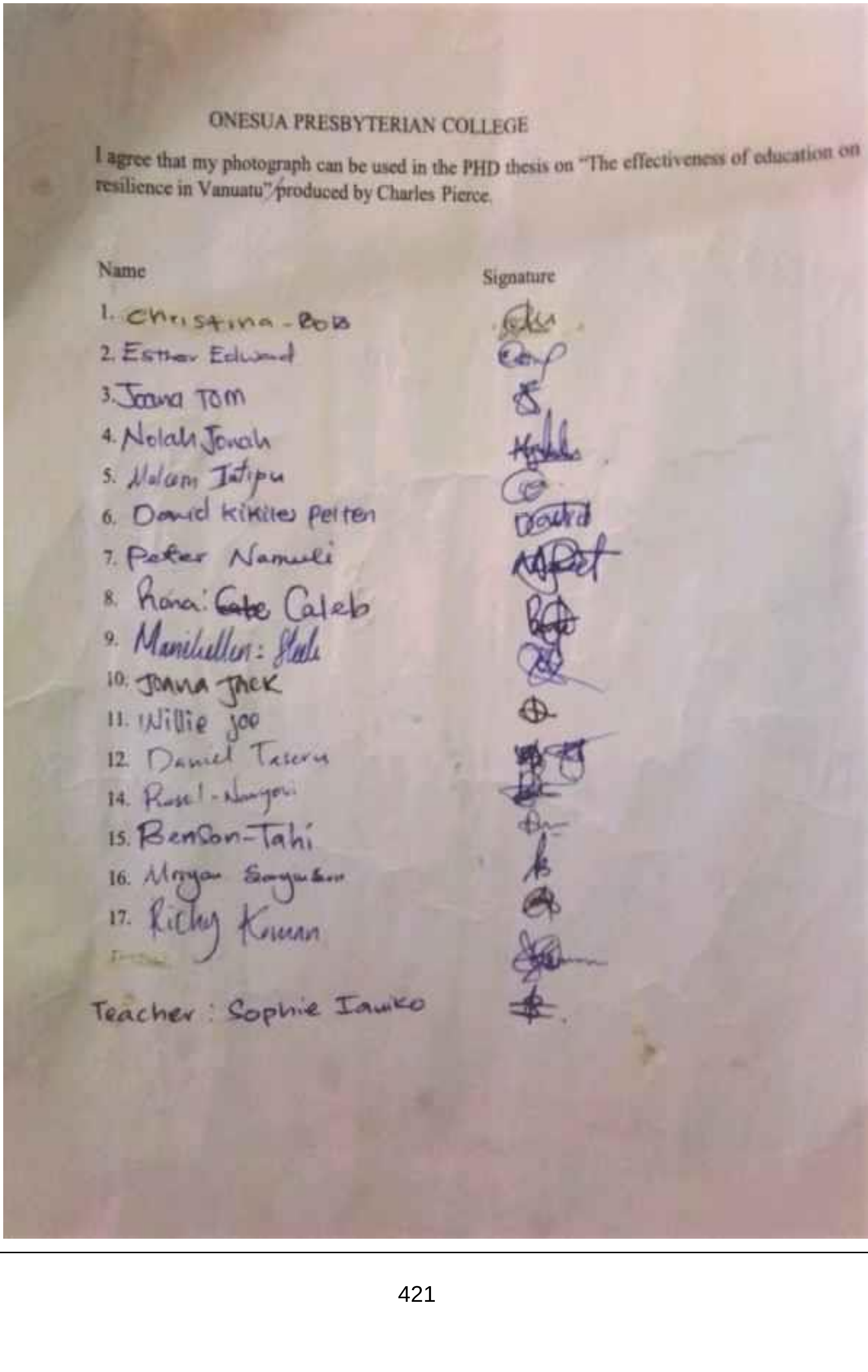
Mifala rili glad sipos yu agri blo helpem mifala. Vanuatu i wan lo ol kaontri lo wol we i safa bigwan tru lo ol disasta mo ol difikalti we i kam wetem ol jenis lo klaemet. Hem i impotan blo faenemaot ol bes rod blo helpem ol pipol blo ol redi blo fesem ol difikalti ia, mo oli save tekem ol step blo daonem damej o kil we i kam lo ol man mo lo envaeronmen (olsem ol plant mo animal, graon mo solwora we i stap raon lo yumi).

Ol infomesen we yu givim bae i kam lo han blo mi nomo, olsem mein man blo mekem resej. Mi hop se yu save agri blo tekpat mo yu save saenem fom blo talem se yu agri. Tangkyu tumas.

.

(Charles Pierce, tija lo Malapoa Kolej, Kolej blo ol Tija, INTV mo USP bifo)

19.



ONESUA PRESBYTERIAN COLLEGE

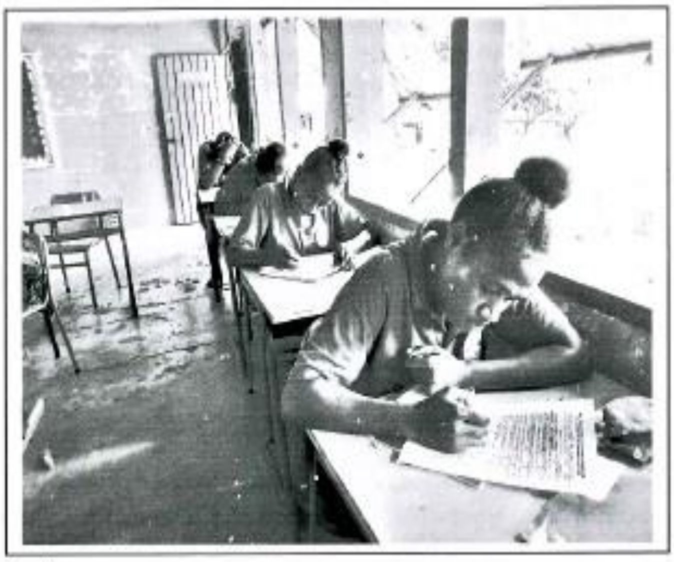
I agree that my photograph can be used in the PHD thesis on "The effectiveness of education on resilience in Vanuatu" produced by Charles Pierce.

Name	Signature
1. Christina - Bob	
2. Esther Edward	
3. Joana Tom	
4. Nolah Jonah	
5. Nelson Itipu	
6. David Kikilei Pelten	
7. Peter Namuli	
8. Rona: ~~Cabe~~ Caleb	
9. Manilullen: Stade	
10. Joana Jack	
11. Willie Joe	
12. Daniel Taseru	
14. Rosel - Nangoi	
15. Benson-Tahi	
16. Morgan Sanyakon	
17. Ricky Kuman	
Teacher : Sophie Iawko	

20.

PHOTOGRAPHS USED IN PhD RESEARCH THESIS: CHARLES PIERCE

"EFFECTIVENESS OF RESILIENCE EDUCATION IN VANUATU"



I agree that the above photograph, in which I appear, can be used in the thesis being submitted by Charles Pierce for his PhD research on the effectiveness of resilience education in Vanuatu

Name (please print) Naomi . Kappa *Signature* NK *Date:* 4/08/21

Name (please print) Talia . Ben *Signature* Ben *Date:* 4/08/21

Name (please print) Jefflyne . Kalmer *Signature* Kalmar *Date:* 4/08/21

Name (please print) .... *Signature* Acalsaufa *Date:* ....

Name of teacher/parent/guardian: Meriana . Tatangis Signature ....

Date: 4/08/21

21.

PHOTOGRAPHS USED IN PhD RESEARCH THESIS: CHARLES PIERCE

"EFFECTIVENESS OF RESILIENCE EDUCATION IN VANUATU"

I agree that the above photograph, in which I appear, can be used in the thesis being submitted by Charles Pierce for his PhD research on the effectiveness of resilience education in Vanuatu

Name (please print) Tyler Kovikalu *Signature* .... *Date:* 05/08/21

Name (please print) William. Williams *Signature* .... *Date:* 05/08/21

Name (please print) Setoki. Rantes *Signature* .... *Date:* 05/08/21

Name (please print) Augusta. Sero *Signature* .... *Date:* 05/08/21

Name of teacher/~~parent/guardian~~: Bryent Forau Signature ....

Date: 05/08/21

APPENDIX C: Policy Documents on Resilience

Documents relating to policies:

- ***Report of the Conference of the Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015: Addendum: Decisions adopted by the Conference of the Parties*** **(United Nations Framework Convention on Climate Change, 2015).**
- ***The Paris Committee on Capacity-building*** **(United Nations Framework Convention on Climate Change, 2020).**
- ***Sendai Framework for Disaster Risk Reduction 2015-2030.*** **(United Nations Office for Disaster Risk Reduction, 2015).**
- ***Capacity Development: Strategic Approach to Capacity Development for Implementation of the Sendai Framework: Section 3. Action Areas for Capacity Development for DRR: 6. 1 Education for Disaster Risk Reduction.*** **(United Nations Office for Disaster Risk Reduction, 2020).**
- ***Framework for Resilient Development in the Pacific (FRDP): An Integrated Approach to Address Climate Change and Disaster Risk Management 2017-2030.*** **(Pacific Community, Secretariat of the Pacific Regional Environment Programme, Pacific Islands Forum Secretariat, United Nations Development Programme, United Nations Office for Disaster Risk Reduction and University of the South Pacific, 2016).**
- ***Vanuatu Climate Change and Disaster Risk Reduction Policy 2016-2030*****. (Government of the Republic of Vanuatu and Secretariat of the Pacific Community, 2015).**
- ***Vanuatu 2030: The People's Plan: National Sustainable Development Plan 2016 to 2030*****. (Department of Strategic Policy, Planning and Aid Coordination, Republic of Vanuatu, 2016).**
- ***Submission to the Paris Committee on Capacity-Building.*** **(Republic of Vanuatu, 2017).**
- ***Voluntary National Review on the Implementation of the 2030 Agenda for Sustainable Development.*** **(Republic of Vanuatu, 2019).   .**
- ***The 2015 Annual Report of the Ministry of Climate Change Adaptation, Meteorology and Geo-Hazards, Energy,***

Environment and National Disaster Management Office. (Ministry of Climate Change, Government of Vanuatu, 2015)

- *Intended Nationally Determined Contribution.* (Government of the Republic of Vanuatu, 2016).
- *Transforming our world: the 2030 Agenda for Sustainable Development. A/RES/70/1.* (United Nations Department of Economic and Social Affairs (UNDESA, 2015).

Documents relating to formal educational curricula and student enrolment in Vanuatu:

- *Vanuatu National Curriculum Statement.* (Ministry of Education, Republic of Vanuatu, 2010)
- *Digest of Education Statistics, 2007.* (Ministry of Education, Youth Development and Training, Republic of Vanuatu, 2007).
- *Education Statistics: Basic Tables of 2019.* (Ministry of Education and Training, Government of Vanuatu, 2020).
- *Vanuatu National Syllabus Primary Years 4-6*. (Curriculum Development Unit, Ministry of Education and Training, Republic of Vanuatu, 2013).
- *Vanuatu National Timetabling Policy for Primary, Years 1 to 6*. (Ministry of Education and Training, Government of Vanuatu, 2015).
- *Teacher's Guide Social Science Year 5*. (Ministry of Education and Training, Government of Vanuatu, 2019).
- *Teacher's Guide Science Year 5.* (Ministry of Education and Training, Government of Vanuatu, 2019)
- *Vanuatu National Earth Science Syllabus, Senior Secondary Years 11-13*. (Curriculum Development Unit, Ministry of Education and Training, 2018).
- *Vanuatu National Geography Syllabus, Senior Secondary Years 11-13*. (Curriculum Development Unit, Ministry of Education and Training, 2018).
- *Vanuatu National Development Studies Syllabus, Senior Secondary Years 11-13*. (Curriculum Development Unit, Ministry of Education and Training, 2018).

APPENDIX D: Example of a Carousel Activity

EXAMPLE OF A "CAROUSEL ACTIVITY" TO BE USED IN COOPERATIVE / ENQUIRY-BASED LEARNING

INSTRUCTIONS TO LEARNERS

Researching examples of the impacts of hazards and climate change in Vanuatu

You are going to work in groups to find some examples of the impacts you have already studied. Each group will concentrate on just one or two of the different impacts, then present its findings to the whole class.

You can do your research in several ways. You can read the relevant section of your textbook again, and think of some examples of each kind of impact from your own island or from another island in Vanuatu. You can consult newspapers. You can go and interview people in your community about what they remember about various hazards that have affected them.

The class should divide into four groups, with four learners in each. Each group should select **one** of the following topics:

1. Examples of impacts of hazards and climate change on the natural landscape and on terrestrial and marine ecosystems.
2. Examples of impacts of hazards and climate change on livelihoods and economic activities.
3. Examples of impacts of hazards and climate change on fresh water resources, buildings and infrastructures
4. Examples of impacts of hazards and climate change on human life, health, education, and other human dimensions

After choosing the topic, the group should prepare a large poster with pictures and information about each topic, and each member of the group should practice talking about the poster. Remember that you must find actual examples from your own community, your own island or from other places in Vanuatu.

When groups are ready, they pin up their posters on the classroom wall and each group stands in front of its poster. The members of each group then give themselves a number from 1 to 4. The facilitator will now ask the number 1s from each group to leave their group and come and stand in front of the first poster, the number 2s from each group to stand in front of the second poster, all the number 3s to stand in front of the third poster and all the number 4s to stand in front of the fourth poster.

In each of the new groups, there will be one person who has prepared a talk on the poster that faces the group. He or she then talks about the poster. After 4-5 minutes, the facilitator will tell the groups to move to the next picture. Now another member of the new group will give the presentation. In this way, every person will have the chance to talk about his/her topic to a small group of fellow-trainees.

A carousel is something that goes round and round. This is a carousel activity because groups are moving around the classroom from one poster to another.

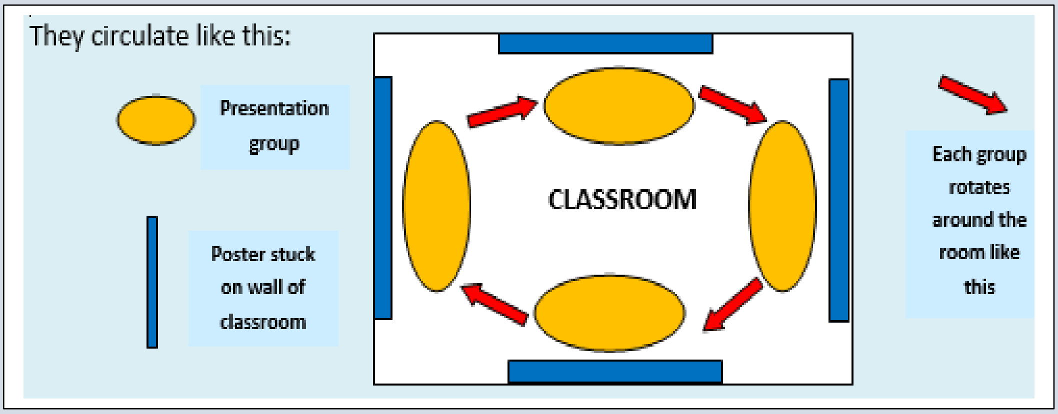
If by chance there are more than 16 persons in the class, then there can be five or more in each of the first groups that are formed. Then, instead of one person giving the talk, two people can share the presentation together. In other words, in each of the new groups that form, there might be two number 1s, two number 2s, but only one number 3 and one number 4.

When all the presentations are complete, you may wish to record some of the things you have learnt.

INSTRUCTIONS TO THE TEACHER/FACILITATOR

You should go through the instructions for this activity with the learners, carefully reading the details on pages 27-28 of the Learner Workbook. Because there are four topics, there should be exactly four learners in the first group that is formed for preparing the poster. Then when the new groups are formed for the presentation, there will be four persons in each, with one who is an "expert" on each poster. One group will contain all the number 1s from the first groups, another will contain all the number 2s, and so on. Each of the new groups stands in front of one of the posters, and the person who knows about the poster will make his/her presentation. After about 5 minutes, you give a signal, and all the groups move to the next poster. This process continues until all groups have visited all posters.

They circulate like this:



If you have between 17 and 19 learners in the class, you can put more than four in each of two groups, and then when they give themselves a number, two of them can have the same number and so share in the presentation of the topic. If you have 20 learners in the class, you can add an extra topic, so that you have five groups of four learners. One way you could do this is to separate Topic 3 into two, with one group doing "fresh water resources" and another group doing "buildings and infrastructures". If you have less than 16 learners, you can reduce the number of topics, and have three instead of four. One way of doing this is to remove Topic 3, giving "fresh water resources" to the group doing Topic 1, and "buildings and infrastructures" to the group doing Topic 2.

This is a very good method of helping your learners to speak about a topic. Everyone has to speak about his/her poster, but only to a small group.

You should encourage all the learners to actually leave the classroom and go and talk to people from the local community who might be able to provide information on the impacts of past hazards in your area - teachers, pastors, elderly people, men, women, youth.

LIST OF REFERENCES

Aghaei, N., Seyedin, H., & Sanaeinasab, H. (2018). Strategies for disaster risk reduction education: A systematic review. *Journal of Education and Health Promotion, 7*, 98-98. doi:10.4103/jehp.jehp_31_18

Ahmad, S. & Hussain, M. (2017) The analytic hierarchy process of the decision-making factors of African students in obtaining higher education in the United Arab Emirates.   *Compare: A Journal of Comparative and International Education, 47:2*, 163-176. doi: 10.1080/03057925.2016.1171703

Ahmed, S. (2017?). *Climate change impact on Pacific Islands.*   https://www.academia.edu/37762965/Climate_change_impact_on_pacific_Islands_pdf#

Amineh, R. & Asl, H. (2015). Review of Constructivism and Social Constructivism. *Journal of Social Sciences, Literature and Language, Vol 1(1),* pp. 9-16. jssll.blue-ap.org

Amjad, K. (2016). *Challenges of climate change: GO and NGO approaches in Bangladesh.* Thesis submitted to the Institute of Social Welfare and Research, University of Dhaka, for the requirements of the degree of Master of Philosophy, September 2016. Dhaka University Institutional Repository. https://www.academia.edu/40396940/Challenges_of_Climate_Change_GO_and_NGO_Approaches_in_Bangladesh

Ammons, M. (1961). Purpose and program: How does commitment today differ from that in other periods? *Educational Leadership, October 1964*. In: Association for Supervision and Curriculum Development (ASCD). (2012) What is the purpose of education? *ASCD Education Update volume 54 no. 7, July 2012*. http://www.ascd.org/publications/newsletters/education-update/jul12/vol54/num07/What-Is-the-Purpose-of-Education%C2%A2.aspx

Amri, A., Haynes, K., Bird, D. & Ronan, K. (2018). Bridging the divide between studies on disaster risk reduction education and child-centred disaster risk reduction: A critical review. *Children's Geographies, 16*(3), 239-251. doi:10.1080/14733285.2017.1358448

Andersen, H. & Hepburn, B. (2016). The Scientific Method, *The Stanford Encyclopedia of Philosophy (Summer 2016 Edition),* Edward N. Zalta (ed.). https://plato.stanford.edu/archives/sum2016/entries/scientific-method/.

Anderson, A. (2012). Climate Change Education for Mitigation and Adaptation. *Journal of Education for Sustainable Development 6:2* (2012), 191–206. https://doi.org/10.1177/0973408212475199. www.sagepublications.com.

Apis-Overhoff, L. (2017). *The role of Engin Kehlap, a heuristic model for addressing environment and climate change problems and issues: Case studies in the Federated States of Micronesia.* PhD thesis submitted to the Pacific Centre of Environment and Sustainable Development (PACE-SD), University of the South Pacific, Suva, Fiji.

Apronti, P., Osamu, S., Otsuki, K. & Kranjak-Berisavljevik, G. (2015). Education for disaster risk reduction (DRR): Linking theory with practice in Ghana’s basic schools. *Sustainability*, 7, 9160-9186. doi:10.3390/su7079160

Arbuthnott, K. & Krätzig, G. (2015). Effective Teaching: Sensory Learning Styles versus General Memory Processes. *Comprehensive Psychology, Volume 4, January-December 2015*. https://doi.org/10.2466/06.IT.4.2

Arnambath, J., Senior Education Officer, TVET Unit, Tertiary and Higher Education, Ministry of Education and Training, Republic of Vanuatu. (2019). Personal communication, 3rd September 2019.

Australia Pacific Climate Partnership (APCP) & the Vanuatu Institute of Technology (VIT). (2019). *Graduate tracer study, Certificate III in Resilience (Climate Change and Disaster Risk Reduction), September 2019*. Unpublished report commissioned by the Department of Foreign Affairs and Trade, Government of Australia.

Australian Bureau of Meteorology (ABM), Commonwealth Scientific and Industrial Research Organisation (CSIRO) & South Pacific Regional Environment Programme (SPREP). (2020). *Pacific Climate Change Science*. https://www.pacificclimatechangescience.org/

Australian National University (ANU). (2016). *Origins of Vanuatu and Tonga's first people revealed*. https://www.anu.edu.au/news/all-news/origins-of-vanuatu-and-tongas-first-people-revealed

Ayong, Z., Principal Research Officer, National Disaster Management Office, Government of Vanuatu. Personal communication on 07/09/2020

Badri, M., Al Qubaisi, A., Mohaidat, J., Al Dhaheri, H., Yang, G., Al Rashedi, A. & Greer, K. (2016). An analytic hierarchy process for school quality and inspection. *International Journal of Educational Management, Vol. 30 Issue 3*, 437 – 459 http://dx.doi.org/10.1108/IJEM-09-2014-0123

Bahá'í International Community. (1998) *Valuing Spirituality in Development: Initial Considerations Regarding the Creation of Spiritually Based Indicators for Development*. *Section V, no. 3: Environmental Stewardship.* A concept paper presented to the World Faiths and Development Dialogue hosted by the President of the World Bank and the Archbishop of Canterbury at Lambeth Palace, London, England. https://www.bic.org/statements/valuing-spirituality-development

Bahá'í International Community. (2021) *What Bahá'ís believe.* https://www.bahai.org/beliefs/

Bahá'u'lláh. (1882). *Lawh-i-Maqsud, Gleanings from the Writings of Bahá'u'lláh* CXXII, Bahá'í Reference Library, Bahá'í World Centre, Haifa, Israel. https://www.bahai.org/library/authoritative-texts/bahaullah/gleanings-writings-bahaullah/gleanings-writings-bahaullah.pdf?173da2ac

Ballantyne, R. & Packer, J. (2009). Introducing a fifth pedagogy: Experience-based strategies for facilitating learning in natural environments. *Environmental Education Research*, *15*(2), 243–262.

Ballew, M., Marlon, J., Leiserowitz, A. & Maiback, E. (2018). *Climate Note: Gender Differences in Public Understanding of Climate Change.* Yale Programme on Climate Change Communication. https://climatecommunication.yale.edu/ publications/gender-differences-in-public-understanding-of-climate-change/

Bani, W., PEBACC project manager, SPREP. (2020). Personal communication on 27th February 2020.

Bartlett, C. (2020). *Category 5 Cyclone Harold: West Coast Santo: Response update and early recovery priorities report.* Submitted to the Vanuatu National Disaster Management Office on 30 April 2020. PacificIslandClimateChange@gmail.com

Beeson, M. & McDonald, M. (2013) The politics of climate change in Australia. *Australian Journal of Politics and History, Volume 59, Issue 3, September 2013,* 331-338. doi: org/10.1111/ajph.12019

Benadusi, M. (2014). Pedagogies of the unknown: Unpacking 'culture' in disaster risk reduction education. *Journal of Contingencies and Crisis Management, 22*(3), 174-183. doi:10.1111/1468-5973.12050

Berkes, F., Colding, J. & Folke, C. (2000). Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications, Vol. 10, No. 5 (Oct., 2000)*, 1251-1262. http://www.jstor.org/stable/2641280

Bernhardsdottir, A., Musacchio, G., Ferreira, M. & Falsaperla, S. (2016). Informal education for disaster risk reduction. *Bulletin of Earthquake Engineering : Official Publication of the European Association for Earthquake Engineering, 14*(7), 2105-2116. doi:10.1007/s10518-015-9771-9

Bhushan, B. & Satsangee, N. (2021). Getting Sustainable Development through Climate Change Education. *Academia Letters*, Article 3479. https://doi.org/10.20935/AL3479.

Billiet, J. & McClendon, M. (2000). Modeling Acquiescence in Measurement Models for Two Balanced Sets of Items. *Structural Equation Modeling 7(4),* 608-628. Lawrence Erlbaum Associates, Inc., New Jersey, USA.

Bird, A. (2017). *Local Learnings from Local Voices: Exploring rural ni-Vanuatu perspectives of agricultural education and extension services in Santo, Vanuatu.* Thesis for the degree of Master of Development Studies submitted to the School of Geography, Environment and Earth Sciences, Victoria University of Wellington, March 2017. http://researcharchive.vuw.ac.nz/handle/10063/6468

Bodin, L. & Gass, S. (2004). Exercises for Teaching the Analytical Hierarchy Process. *INFORMS Transactions on Education Vol. 4, No. 2, January 2004*, 1–13 issn 1532-0545_ 04_0402_0001. doi 10.1287/ited.4.2.1

Bord, R. & O'Connor, R. (1997). The gender gap in environmental attitudes: The case of perceived vulnerability to risk. *Social Science Quarterly*, *78*, 830–840.

Borrevik, C., Crook, T., Hviding, E. & Lind, C. (2014). *European Union Development Strategy in the Pacific.* Directorate-General for External Policies of the European Union. https://protorp.org/european-union-development-strategy-in-the-pacific-european-parliament

Boyle, A., Maguire, S., Martin, A., Milsom, C., Nash, R., Rawlinson, S. & Conchie, S. (2007). Fieldwork is good: The student perception and the affective domain. *Journal of Geography in Higher Education*, *31*(2), 299-317. doi:10.1080/03098260601063628

Bräutigam, D. (2000). Aid Dependence and Governance. *Expert Group on Development Issues, 2000:1.* Almqvist & Wiksell International, Stockholm, Sweden https://pdfs.semanticscholar.org/cdae/b3e9d7faa67be3281ab14bfa21a8797ecf6b.pdf.

Brooks, J. & Brooks, M. (1993). *In search of understanding: the case for constructivist classrooms.* Association for Supervision and Curriculum Development (ASCD). Alexandria, VA, USA. Retrieved on 5 April 2021 from http://www.ascd.org/ publications/books/199234.aspx

Buggy, L. & McNamara, K. (2016). The need to reinterpret "community" for climate change adaptation: a case study of Pele Island, Vanuatu. *Climate and Development 8:3,* 270-280. https://doi.org/10.1080/17565529.2015.1041445

Bündnis Entwicklung Hilft & the Institute for Law of Peace and Armed Conflict (IFHV) of Ruhr University Bochum. (2021). *World Risk Report 2021.* https://www.preventionweb.net/publication/world-risk-report-2021-focus-social-protection

Bündnis Entwicklung Hilft & the Institute for Law of Peace and Armed Conflict (IFHV) of Ruhr University Bochum. (2022). *World Risk Report 2022.* https://reliefweb.int/report/world/worldriskreport-2022-focus-digitalization

Bune, R. (2020). Personal communications through Facebook Messenger with the author, July-September 2020.

Burušić, J., Babarović, T. & Velić, M. Š. (2016). School Effectiveness: An Overview of Conceptual, Methodological and Empirical Foundations. In *School Effectiveness and Educational Management* (pp. 5-26). Springer International Publishing. https://www.researchgate.net/publication/303361932_School_Effectiveness_An_Overview_of_Conceptual_Methodological_and_Empirical_Foundations.

Business Research Methodology (BRM). (2022). *Ontology*. https://research-methodology.net/research-philosophy/ontology/

Cambers, G., Carruthers, P., Rabuatoka, T., Tubuna, S. & Ungaro, J. Implementing climate change adaptation interventions in remote outer islands of the Pacific island region. In: Leal Filho, W. (Ed.). (2017). *Climate change adaptation in Pacific countries : Fostering resilience and improving the quality of life* (Climate change management). Cham, Switzerland: Springer. doi:10.1007/978-3-319-50094-2

Campbell, J. (1990). Disasters and Development in Historical Context: Tropical Cyclone Response in the Banks Islands, Northern Vanuatu, *International Journal of Mass Emergencies and Disasters*, 8(3), 401–424

Carbon Brief. (2015). *Storms: Cyclone Pam: Untangling the complex science on tropical storms and climate change, 16 March 2015*. https://www.carbonbrief.org/cyclone-pam-untangling-the-complex-science-on-tropical-storms-and-climate-change

Cassidy, S. (2004). Learning Styles: An overview of theories, models and measures. *Educational Psychology, 24:4*, 419-444. doi: 10.1080/0144341042000228834

Centre for Excellence in Education (CEE). (2022). *The Right Balance between the Sciences and the Humanities.* Centre for Excellence in Education, Mclean, VA, USA. https://www.cee.org/about-us/blog/right-balance-between-sciences-and-humanities

Chand, P., Manager, USP component of the Intra-ACP GCCA+Pacific Adaptation to Climate Change and Resilience Building (PACRES), Pacific Centre for

Environment and Sustainable Development (PaCE-SD), University of the South Pacific (USP), Suva, Fiji. (2020). Personal communication on 26th June 2020.

Chand, S., Chambers, L., Waiwai, M., Malsale, P. & Thompson, E. (2014). Indigenous Knowledge for Environmental Prediction in the Pacific Island Countries. *Weather, Climate and Society (2014) 6 (4),*445-450. American Meteorological Society. https://doi.org/10.1175/WCAS-D-13-00053.1

Chicago Manuel of Style (CMOS) Shop Talk. (2021). *Styling COVID-19 and Related Terms*. https://cmosshoptalk.com/2020/04/21/styling-covid-19-and-related-terms/

Clarke, T., McNamara, K., Clissold, R. & Nunn, P. Community-based adaptation to climate change: lessons from Tanna island, Vanuatu. *Island Studies Journal, 14(1), 2019*, 59-80. https://doi.org/10.24043/isj.80

Cohen, L., Manion, L. & Morrison, K. (2007). *Research Methods in Education (6th edition).* Routledge, Abingdon, UK. ISBN 0-203-02905-4 Master e-book ISBN.

Cole, J., *Climate Ready and Resilience Programme*. (2020). Personal communication, 11th September 2020.

Connell, J. (2015). *Islands at Risk? Environments, Economies and Contemporary Change*. Cheltenham, UK. Edward Elgar Publishing, 2013. ISBN 9781-78100-350-3.

Connor, B. (2005). Protecting traditional knowledge: An overview of a developing area of intellectual property law. *The Journal of World Intellectual Property 6(5),* 677-698. https://doi.org/10.1111/j.1747-1796.2003.tb00236.x

Conway, A. (2009). *Giving adult learners a voice after the inquest: A review of a mixed method approach to educational research.* Dublin Institute of Technology. http://arrow.dit.ie/tfschhmtcon?utm_source=arrow.dit.ie%2Ftfschhmtcon%2F2&utm_medium=PDF&utm_campaign=PDFCoverPages

Cresswell, J. (2007). *Qualitative inquiry and research Design: Choosing among five approaches (2nd edition).* Sage Publications, London, UK. ISBN 978-1-4129-1606-6 (cloth) ISBN 978-1-4129-1607-3 (pbk.)

Cresswell, J. & Plano Clark, V. (2007*). Designing and Conducting Mixed Methods Research*. Sage Publications, Thousand Oaks, California, USA. ISBN 1-4129-2791-9.

Cronin, S., Gaylord, D., Charley, D., Alloway, B., Wallez, S. & Esau, J. (2004). Participatory methods of incorporating scientific with traditional knowledge for volcanic hazard management on Ambae Island, Vanuatu. *Bulletin of Volcanology 66***,** 652–668. Springer-Verlag 2004. https://doi.org/10.1007/s00445-004-0347-9

Cruz, A., Selby, S. & Durham, W. (2018). Place-based education for environmental behavior: a ‘funds of knowledge’ and social capital approach. *Environmental Education Research, 24:5*, 627-647. doi:10.1080/13504622.2017.1311842

Curriculum Development Unit (CDU), Ministry of Education and Training, Republic of Vanuatu. (2013). *Vanuatu National Syllabus Primary Years 4-6*. Ministry of Education and Training, Republic of Vanuatu, PMB 9028, Port Vila, Vanuatu. ISBN 978-982-9126-09-2.

Curriculum Development Unit (CDU), Ministry of Education and Training, Republic of Vanuatu. (2018). *Vanuatu National Geography Syllabus, Senior Secondary Years 11-13*. Ministry of Education and Training, Republic of Vanuatu, PMB 9028, Port Vila, Vanuatu. ISBN 978-982-9126-17-7.

Curriculum Development Unit (CDU), Ministry of Education and Training, Republic of Vanuatu. (2018). *Vanuatu National Development Studies Syllabus, Senior Secondary Years 11-13*. Ministry of Education and Training, Republic of Vanuatu, PMB 9028, Port Vila, Vanuatu. ISBN 978-982-9126-18-4.

Curriculum Development Unit (CDU), Ministry of Education and Training, Republic of Vanuatu. (2018). *Vanuatu National Earth Science Syllabus, Senior Secondary Years 11-13*. Ministry of Education and Training, Republic of Vanuatu, PMB 9028, Port Vila, Vanuatu. ISBN 978-982-9126-26-9.

Cvetek., S. (2008). Applying chaos theory to lesson planning and delivery. *European Journal of Teacher Education, 31:3*, 247-256. doi: 10.1080/02619760802208320

Dantas, L. & Cunha, A. (2020). An integrative debate on learning styles and the learning process. *Social Sciences & Humanities Open, Volume 2, Issue 1, 2020, 100017.* https://doi.org/10.1016/j.ssaho.2020.100017.

De Souza, R., Henly-Shepard, S., McNamara, K. & Fernando, N. (2015). Re-framing island nations as champions of resilience in the face of climate change and disaster risk. *UNU-EHS Working Paper Series, No. 17.* Bonn: United Nations University Institute of Environment and Human Security. https://collections.unu.edu/eserv/UNU:2856/Reframing_island_nations_WP_No_17.pdf

DeCarlo, M. (2018). *10.2 Sampling in qualitative research*. In: Scientific Inquiry in Social Work. PressBooks. https://scientificinquiryinsocialwork.pressbooks.com/chapter/10-2-sampling-in-qualitative-research/

Department of Foreign Affairs and Trade (DFAT), Government of Australia & Government of the Republic of Vanuatu. (2016). *Australia-Vanuatu Aid Partnership Arrangement 2016-2019*. https://www.dfat.gov.au/sites/default/files/vanuatu-australia-aid-partnership-arrangement.pdf

Department of Foreign Affairs and Trade (DFAT), Australian Government. (2019). *Climate Change Action Strategy, November 2019: tackling climate change through Australia's development assistance programme 2020-2025*. Department of Foreign Affairs and Trade, ISBN - 978-1-74322-480-9 (Book), ISBN - 978-1-74322-479-3 (PDF), ISBN - 978-1-74322-481-6 (Word doc), ISBN - 978-1-74322-482-3 (Online). https://www.dfat.gov.au/about-us/publications/Pages/climate-change-action-strategy

Department of Foreign Affairs and Trade (DFAT), Australian Government. (2020). *Development cooperation fact sheet, February 2020*. https://www.dfat.gov.au/geo/vanuatu/Pages/vanuatu

Department of Foreign Affairs and Trade (DFAT), Government of Australia. (2020). *Crisis Hub: Tropical Cyclone Harold*. https://www.dfat.gov.au/crisis-hub/Pages/tropical-cyclone-harold

Department of Strategic Policy, Planning and Aid Coordination (DSPPAC), Republic of Vanuatu. (2016). *Vanuatu 2030: The People's Plan (National Sustainable Development Plan 2016 to 2030).* Government of the Republic of Vanuatu, Port Vila. https://www.gov.vu/images/publications/Vanuatu2030-EN-FINAL-sf.pdf

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Pacific Community (SPC), Pacific Islands Forum Secretariat (PIFS) & United Nations Development Programme (UNDP). (2018). *Vanuatu climate change and disaster risk finance assessment: final report*. Pacific Islands Forum Secretariat, Suva, Fiji, 2018. ISBN 978-982-202-051-9. https://www.forumsec.org/wp-content/uploads/2018/09/Vanuatu-Climate-Change-2.pdf

Devarajan, S., Azam, J-P. & O'Connell, S., World Bank e-Library. (1999). Aid dependence reconsidered, *Policy Research Working Papers July 1999.* doi.org/10.1596/1813-9450-2144. https://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-2144

Dewey, J. (1934). Individual psychology and education, *The Philosopher no.12, 1934.* In: Association for Supervision and Curriculum Development (ASCD). (2012) What is the purpose of education? *ASCD Education Update volume 54 no. 7, July 2012*. http://www.ascd.org/publications/newsletters/ education-update/jul12/vol54/num07/What-Is-the-Purpose-of-Education%C2%A2.aspx

Diethelm, P. & McKee, M. (2009). Denialism: What it is and how should scientists respond. *European Journal of Public Health, Vol. 19, No. 1*, 2–4

Dikli, S. (2003). Assessment at a distance: Traditional vs Alternative Assessments. *The Turkish Online Journal of Educational Technology (TOJET) July 2003 ISSN: 1303-6521 volume 2 Issue 3 Article 2*

Dornan, M. & Newton-Cain, T., Asian Development Bank. (2015). Vanuatu and Cyclone Pam: an update. *Pacific Economic Monitor, Midyear review, July 2015*. Asian Development Bank, Manila, Philippines. https://www.adb.org/ sites/default/files/publication/161669/ pem-july-2015.pdf

Dunlap, R. (2013). Climate Change Skepticism and Denial: An Introduction. *American Behavioral Scientist*, *57(6),* 691-698 doi: 10.1177/0002764213477097

Dunn, R., Honigsfeld, A., Doolan, L., Bostrom, L., Russo, K., Schiering, M., Suh, B. & Tenedero, H. (2009). Impact of learning-style instructional strategies on students' achievement and attitudes: Perceptions of educators in diverse institutions. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 82:3,* 135-140. doi: 10.3200/TCHS.82.3.135-140

Ear, S. (2007) Does Aid Dependence Worsen Governance? *International Public Management Journal, 10:3*, 259-286. doi: 10.1080/10967490701515580

Education Policy and Data Centre (EPDC). (2018). *National Education Profile: 2018 Update: Vanuatu*. https://www.epdc.org/sites/default/files/documents /EPDC_NEP_2018_Vanuatu.pdf

Edutopia. (2021). *Why is assessment important?* George Lucas Educational Foundation. https://www.edutopia.org/assessment-guide-importance

Environmental Protection Agency (EPA). (2021). *The Origins of EPA*. https://www.epa.gov/history/origins-epa

Ertz, M. & Sarigöllü, E. (2019). The Behavior-Attitude Relationship and Satisfaction in Proenvironmental Behavior. *Environment and Behavior*, 51(9-10), 1106-1132. doi: 10.1177/0013916518783241

Estrella, M & Salismaa, N. (2012). *The role of ecosystems management for disaster risk reduction*. In: Gupta, A and Nair, S. (Eds). (2012). *Ecosystem Approach to Disaster Risk Reduction*, National Institute of Disaster Management, New Delhi, India. https://www.preventionweb.net/publications/view/26498

European Union-Pacific Technical and Vocational Education and Training (EU-PacTVET) project. (2017). *Student Guide and Learning Resources – Regional Certificate 4 in Resilience and Health (CR4101H & CR4102H).* University of the South Pacific - Pacific Technical and Further Education (TAFE), Suva, Fiji. www.usp.ac.fj/pacifictafe

Fletcher, J., Salter, Z. & Longnecker, N. (2014). *TeachWild evaluation report*. The University of Western Australia, Perth. doi:10.13140/RG.2.1.4189.0726

Fletcher, S., Thiessen, J., Gero, A., Rumsey, M., Kuruppu, N. & Willetts, J. (2013). Traditional Coping Strategies and Disaster Response: Examples from the South Pacific Region. *Journal of Environmental and Public Health, Volume 2013, Article ID 264503.* Hindawi Publishing Corporation. http://dx.doi.org/10.1155/2013/264503.

Food and Agricultural Organisation of the United Nations (FAO). (2020). *The Pacific Islands: Tropical Cyclone Harold: Situation report, May 2020.* http://www.fao.org/fileadmin/user_upload/emergencies/docs/Sit%20Rep_Cyclone%20Harold_6May2020.pdf

Foshay, A. (1991). The Curriculum Matrix: Transcendence and Mathematics. Journal of Curriculum and Supervision, 1991. In: Association for Supervision and Curriculum Development (ASCD). (2012) What is the purpose of education? *ASCD Education Update volume 54 no. 7, July 2012*. http://www.ascd.org/publications/newsletters/education-update/jul12/vol54/num07/What-Is-the-Purpose-of-Education%C2%A2.aspx

Geoscience, Energy and Maritime Division (GEM), Pacific Community. (2017). *Framework for Resilient Development in the Pacific: Pacific Resilience Partnership..* https://gem.spc.int/projects/frdp and http://www.resilientpacific.org/pacific-resilience-partnership/

Gero, A., Méheux, K. & Dominey-Howes, D. (2010). Integrating community-based disaster risk reduction and climate change adaptation: examples from the Pacific. *Natural Hazards and Earth Systems Sciences 11, 2011*, 101–113. doi:10.5194/nhess-11-101-2011

Goldkuhl, G. (2012). Pragmatism vs interpretivism in qualitative information systems research. *European Journal of Information Systems, (21), 2,* 135-146. http://dx.doi.org/10.1057/ejis.2011.54 Palgrave Macmillan http://www.palgrave-journals.com/pal/index.html

Government of the Republic of Vanuatu and Secretariat of the Pacific Community (SPC). (2015). *Vanuatu Climate Change and Disaster Risk Reduction Policy (VCCDRRP) 2016-2030*. Secretariat of the Pacific Community, Suva, Fiji. ISBN: 978-982-00-0938-7

Government of the Republic of Vanuatu. (2016?). *Intended Nationally Determined Contribution (INDC)*. https://www4.unfccc.int/sites/ndcstaging/Published Documents/ Vanuatu%20First/VANUATU%20%20INDC%20UNFCCC%20 Submission.pdf

Government of the Republic of Vanuatu. (2016). *Vanuatu 2030 - The People's Plan: National Sustainable Development Plan 2016-2030*. Department of Strategic Policy, Planning and Aid Coordination, Republic of Vanuatu, Port Vila, November 2016. https://www.greengrowthknowledge.org/national-documents/vanuatu-2030-peoples-plan-national-sustainable-development-plan-2016-2030

Granderson, A. (2017). The Role of Traditional Knowledge in Building Adaptive Capacity for Climate Change: Perspectives from Vanuatu. *Weather, Climate, and Society*, 9(3), pp. 545–561. https://doi.org/10.1175/WCAS-D-16-0094.1

Gray, S. (2016) *How to use the cooperative learning "carousel" strategy.* Shelley Gray Teaching. https://shelleygrayteaching.com/carousel/#:~:text=Carousel %20is%20a%20cooperative%20learning,complete%20a%20series%20of%20tasks.

Grimes, B. & Crawford, W. (2011). *Strong foundations for community based legal action in remote Aboriginal communities: NAAJA's perspective on best practice for legal education in remote Aboriginal communities*. North Australian Aboriginal Justice Agency. http://www.naaja.org.au/wp-content/uploads/2014/05/Strong-Foundations-NAAJAs-Legal-Development-Methodology.pdf

Guba, E. & Lincoln, Y. (1986). But is it Rigorous: Trustworthiness and authenticity in naturalistic evaluation. *New Directions for Program Evaluation, 1986, Issue 30*, pp. 73-84. https://doi.org/10.1002/ev.1427

Guba, E. & Lincoln, Y. (1994). *Competing paradigms in qualitative research*. In Denzin, N. & Lincoln, Y. (Eds.), *Handbook of qualitative research* (pp. 105-117). London: Sage. https://eclass.uoa.gr/modules/document/file.php/PPP356/Guba %20%26%20Lincoln%201994.pdf

Guest, G. & Fleming, P. (2015). Mixed Methods Research. Ch 19 of *Public Health Research Methods,* Guest, G & Namey, E. (Eds). Sage Publications. https://dx.doi.org/10.4135/9781483398839.n19

Hadjar, A., Krolak-Schwerdt, S., Priem, K. & Glock, S. (Eds). (2014). Gender and educational achievement. *Educational Research, 56:2,* 117-125. doi: 10.1080/00131881.2014.898908. https://doi.org/10.1080/00131881.2014.898908

Hammer, D. (1997). Discovery Learning and Discovery Teaching. *Cognition and Instruction*, *15:4,* pp 485-529. doi: 10.1207/s1532690xci1504_2. https://www.tandfonline.com/doi/abs/10.1207/s1532690xci1504_2?journalCode=hcgi20

Haq, M. (2014). *A comparative analysis of qualitative and quantitative research methods and a justification for use of mixed methods in social research.* Annual PhD Conference, University of Bradford Business School of Management, June 2014.

Harris, U. (2014). Communicating climate change in the Pacific using a bottom-up approach. *Pacific Journalism Review, 20*(2), 77-95.

Harrison, M., Research Community Officer, Intra-ACP GCCA+Pacific Adaptation to Climate Change and Resilience Building (PACRES), Pacific Centre for

Environment and Sustainable Development (PaCE-SD), University of the South Pacific (USP), Port Vila, Vanuatu. (2020) Personal communication on 27th June 2020.

Havea, P., Des Combes, H. & Hemstock, S. (2017). Preparing for better livelihoods, health and well-being - A key to climate change adaptation. In: Leal Filho, W. (Ed.), 2017, *Climate change adaptation in Pacific countries : Fostering resilience and improving the quality of life* (Climate change management). Cham, Switzerland: Springer. doi:10.1007/978-3-319-50094-2_5

Havea, P., Hemstock, S. & Des Combes, H. (2018). Improving health and well-being through climate change adaptation. *Advances in Health and Disease. Nova Biomedical, 4. Nova Science Publishers Inc., New York,* 215-230. ISBN 987-1-53613-346-2

Havea, P., Siga, A., Rabuatoka, T., Tagivetaua Tamani, A., Devi, P., Senikula, R. & Des Combes, H. (2019). Using vocational education to support development solutions in the Pacific: An emphasis on climate change and health. *Applied Environmental Education & Communication, 1-16*, 1-16. doi:10.1080/1533015X.2019.1569571

Hawley, A., Sherry, E. & Johnson, C. (2004). A biologist's perspective on amalgamating traditional environmental knowledge and resource management. *British Columbia (BC) Journal of Ecosystems and Management 5(1):*36–50. Retrieved at www.forrex.org/jem/2004/vol5/no1/art5.pdf

Hay, J. (2002). *Seminar paper 5: Integrating disaster risk management and adaptation to climate variability and change: Needs, benefits and approaches, from a South Pacific perspective.* In: United Nations Development Programme (UNDP). (2002). *A climate risk management approach to disaster reduction and adaptation to climate change.* UNDP Expert Group Meeting, Havana, Cuba, 17-19 June, 2002. https://www.ipcc.ch/apps/njlite/srex/index.php?chapter=6&page=7

Heale, R. & Twycross, A. (2015). Validity and reliability in quantitative research. *Evidence-Based Nursing, January 2015*. http://dx.doi.org/10.1136/eb-2015-102129.

Hemstock, S., Buliruarua, L-A., Chan, E., Chan, G., Jacot Des Combes, H., Davey, P., Farrell, P., Griffiths, S., Hansen, H., Hatch, T., Holloway, A., Manuella-Morris, T., Martin, T., Renaud, F., Ronan, K., Ryan, B., Szarzynski, J., Shaw, D., Yasukawa, S., Yeung, T. & Murray, V. (2016). Accredited qualifications for capacity development in disaster risk reduction and climate change adaptation. *Australasian Journal of Disaster and Trauma Studies Volume 20, Number 1.* http://trauma.massey.ac.nz/issues/2016-1/AJDTS_20-1_Hemstock.pdf

Hemstock, S., Des Combes, H., Martin, T., Vaike, F., Maitava, K., Buliruarua, L-A., Satiki, V., Kua, N. & Marawa, T. (2017). A Case for Formal Education in the Technical, Vocational Education and Training (TVET) Sector for Climate Change Adaptation and Disaster Risk Reduction in the Pacific Islands Region. In: Leal Filho, W. (Ed.). (2017). *Climate change adaptation in Pacific countries : Fostering resilience and improving the quality of life* (Climate change management). Cham, Switzerland: Springer. doi:10.1007/978-3-319-50094-2

Hemstock, S., Des Combes, H., Buliruarua, L., Maitava, K., Senikula, R., Smith, R. & Martin, T. (2018) Professionalizing the "resilience" sector in the Pacific Islands

Region: Formal education for capacity building. In: Klepp, S., & Chavez-Rodriguez, L. (Eds.). (2018). *A critical approach to climate change adaptation : Discourses, policies, and practices* (Routledge advances in climate change research). Abingdon, Oxon: Routledge. doi:10.4324/9781315165448

Hemstock, S. & Pierce, C. (2020). *The Vanuatu "whole island approach".* Department of Geography, Bishop Grosseteste University, Lincoln, UK.

Hemstock, S., Jione, S., Charlesworth, M. & Dumaru, P. 2020. Climate Change and the Role of Education. In: Myers, S., Hemstock, S. and Hanna, E. (Ed). *Science, Faith and the Climate Crisis*, Emerald Publishing Limited, pp. 65-77. https://doi.org/10.1108/978-1-83982-984-020201007

Hill, L. (1994). Traditional scientific knowledge in Papua New Guinea. In: Morrison, J., Geraghty, P. and Crowl, L. (1994). *Science of Pacific Island Peoples, Vol. 4*: 107-119. Institute of Pacific Studies, University of the South Pacific. Suva, Fiji.

Hines, J., Hungerford, H. & Tomera, A. (1987). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. *The Journal of Environmental Education, 18(2)*, 1-8.

Hoover, W. (1996). The practice implications of constructivism. *SEDL Letter*, *9*(3), 1-2. https://sedl.org/pubs/sedletter/v09n03/practice.html

Houde, N. (2007). The six faces of traditional ecological knowledge: challenges and opportunities for Canadian co-management arrangements. *Ecology and Society 12(2)*: 34. Available at http://www.ecologyandsociety.org/vol12/iss2/art34/

Hyde, J. (2005). The Gender Similarities Hypothesis. *American Psychologist, September 2005.* American Psychological Association 0003-066X/05/Vol. 60, no. 6, 581–592. doi: 10.1037/0003-066X.60.6.581. http://humanbehaviors.free.fr/References%20-%20Articles/The%20gender%20similarities%20hypothesis.pdf

Ilisko, D., Skrinda, A. & Micule, I. (2014). Envisioning the future: bachelor's and master's degree students' perspectives. *Journal of Teacher Education for Sustainability*, *v16 n2 2014,* 88-102. doi:10.2478/jtes-2014-0013

Illeris, K. (2007). What do we actually mean by experiential learning? *Human Resource Development Review Vol. 6, No. 1 March 2007* 84-95. doi: 10.1177/1534484306296828 © 2007. https://journals-sagepub-com.bishopg.idm.oclc.org/doi/pdf/10.1177/1534484306296828

Illeris, K. (2009). *A comprehensive understanding of human learning*. In Illeris, K. (Ed.). (2009). *Contemporary Theories of Learning: Learning theorists … in their own words*. Taylor and Francis e-Library. Master e-book ISBN 0-203-87042-5. https://ebookcentral.proquest.com/lib/bishopg/detail.action?docID=425525.

Institute for Teaching and Learning Innovation (ITALI), University of Queensland. (2015). *Experiential Learning: An overview*. https://itali.uq.edu.au/files/1264/Discussion-paper-Experiential_learning_an_overview.pdf

Intergovernmental Panel on Climate Change (IPCC). (2013). *Climate Change 2013: The Physical Science Basis. Working Group I Contribution to the Fifth Assessment Report of the IPCC*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. https://www.ipcc.ch/report/ar5/wg1/

Intergovernmental Panel on Climate Change (IPCC): Christensen, J., Krishna Kumar, K., Aldrian, E., An, S.-I., Cavalcanti, F., de Castro, M., Dong, W., Goswami, P., Hall, A., Kanyanga, J., Kitoh, A., Kossin, J., Lau, N.-C., Renwick, J., Stephenson, D., Xie, S.-P. & Zhou,T. (2013). *Climate Phenomena and their Relevance for Future Regional Climate Change. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_Chapter14_FINAL.pdf

Intergovernmental Panel on Climate Change (IPCC). (2014). Annex II: Glossary [Mach, K.J., Planton, S. & von Stechow, C. (eds.)]. In: Climate Change 2014: *Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, Pachauri, R.K. & Meyer, L.A. (eds.)]. IPCC, Geneva, Switzerland, pp. 117-130. https://www.ipcc.ch/site/assets/uploads/2018/02/AR5_SYR_FINAL_Annexes.pdf

Intergovernmental Panel on Climate Change (IPCC) (2021). Summary for Policymakers. In *Climate Change 2021: The Physical Science Basis: Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., Zhai, P., Pirani A., Connors, S., Péan, C., Berger, S., Caud, N., Chen, Y., Goldfarb, L., Gomis, M., Huang, M., Leitzell, K., Lonnoy, E., Matthews, J., Maycock, T., Waterfield, T., Yelekçi, O., Yu, R. & Zhou, B. (eds.)]. Cambridge University Press. In Press.

Intergovernmental Panel on Climate Change (IPCC). (2022) Summary for Policymakers [Pörtner, H-O., Roberts, D., Poloczanska, E., Mintenbeck, K., Tignor, M., Alegría, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V. & Okem, A. (eds.)]. In: *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Pörtner, H-O., Roberts, D., Tignor, M., Poloczanska, E., Mintenbeck, K., Alegría, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V., Okem, A. & Rama, B. (eds.)]. Cambridge University Press. In Press.

International Institute for Educational Planning (IIEP), United Nations Educational, Scientific and Cultural Organisation (UNESCO). (2021A). *Learning Portal: Issue Brief 1: Quality and learning indicators.* https://learningportal.iiep.unesco.org/en/issue-briefs/monitor-learning/quality-and-learning-indicators

International Institute for Educational Planning (IIEP), United Nations Educational, Scientific and Cultural Organisation (UNESCO). (2021B). *Learning Portal: Issue Brief 3: Effective and appropriate pedagogy.* https://learningportal.iiep.unesco.org/en/ issue-briefs/improve-learning/teachers-and-pedagogy/effective-and-appropriate-pedagogy

Irwin, J. (2012). *Paulo Freire's Philosophy of Education: Origins, Developments, Impacts and Legacies.* Continuum International Publishing Group, London and New York. ISBN 978-0-8264-2638-3. www.continuumbooks.com

Janisch, C., Lui, X. & Akrofi, A. (2007) Implementing Alternative Assessment: Opportunities and Obstacles. *The Educational Forum, Volume 71, Spring 2007*. https://files.eric.ed.gov/fulltext/EJ763213.pdf

Jha, J. & Kelleher, F. (2006*). Boys' Underachievement in Education: An Exploration in Selected Commonwealth Countries*. Commonwealth Secretariat and Commonwealth of Learning, London, UK. ISBN: 0-85092-845-1 / 978-0-85092-845-7. http://oasis.col.org/bitstream/handle/11599/168/BoysUnderachievement.pdf?sequence=1

Johannesson, P. & Perjons, E. (2014). *Research Paradigms.* In: An Introduction to Design Science. Springer, Cham. https://doi.org/10.1007/978-3-319-10632-8_12

Johnson, D. & Johnson, R. (2018). *Cooperative Learning: The Foundation for Active Learning.* Active Learning - Beyond the Future, Sílvio Manuel Brito, IntechOpen, doi: 10.5772/intechopen.81086. https://www.intechopen.com/books/active-learning-beyond-the-future/cooperative-learning-the-foundation-for-active-learning

Johnson, D., Johnson, R. & Holubec, E. (1994). *What is cooperative learning? In: The New Circles of Learning: Cooperation in the classroom and school*, Association for Supervision and Curriculum Development (ASCD), Alexandria, Virginia, USA. http://www.ascd.org/Publications/Books/ Overview/The-New-Circles-of-Learning.aspx (Creative Commons License)

Kabonga, I. (2017), Dependency Theory and Donor Aid: A Critical Analysis. *Africanus Journal of Development Studies, vol. 46*. doi: 10.25159/0304-615X/1096 Unisa Press, 2017. https://upjournals.co.z a/ind ex.php/Africanus/index

Kagawa, F. & Selby, D. (Eds.). (2009). *Education and Climate Change : Living and Learning in Interesting Times*. Taylor and Francis, New York. ISBN13: 978-0-415-80585-8(hbk) ISBN13: 978-0-203-86639-9(ebk)

Kagawa, F. & Selby, D. (2012). Ready for the Storm: Education for Disaster Risk Reduction and Climate Change Adaptation and Mitigation. *Journal of Education for Sustainable Development*, Vol 6, Issue 2, 2012, 207-217. https://journals.sagepub.com/doi/pdf/10.1177/0973408212475199

Kahn, P. & O'Rourke, K. (2005). Understanding enquiry-based learning. *Handbook of enquiry and Problem-Based Learning.* Barrett, T. et al (Eds). Galway: CELT. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.461.5829&rep=rep1&type=pdf

Kamoen, N., Holleman, B., Mak, P. & Sanders, T. (2011). Agree or Disagree? Cognitive Processes in Answering Contrastive Survey Questions. *Discourse Processes, June 2011*. doi: 10.1080/0163853X.2011.578910. Routledge, London, UK.

Kaushik, V. & Walsh, C. Pragmatism as a Research Paradigm and Its Implications for Social Work Research. *Social Sciences*, 2019; 8(9): 255. Multidisciplinary Digital Publishing Institute (MDPI) Open Access Journal. https://doi.org/10.3390/socsci8090255.

Keles, O., Uzun, N. & Gilbertson, K. (2016). Cognitive structures of university students about environmental education, climate change and consumption concepts. *Asia-Pacific Forum on Science Learning and Teaching, 17*(2).

Kenni, L. & Wijewickrama, E. (2020). Vanuatu: a real test for local emergency response. *The Interpreter*, July 23, 2020. Lowy Institute, Sydney, Australia. https://www.lowyinstitute. org/the-interpreter/vanuatu-takes-emergency-response-amid-covid-19

Key Differences. (2018). *Difference between questionnaire and interview.* https://keydifferences.com/difference-between-questionnaire-and-interview.html#:~:text=Questionnaire%20implies%20a%20form%20consisting,in%20the%20question%20answer%20session.

King, M. (1948). Speech at Morehouse College, 1948. In: Association for Supervision and Curriculum Development (ASCD). (2012). What is the purpose of education? *ASCD Education Update volume 54 no. 7, July 2012*. http://www.ascd.org/publications/newsletters/education-update/jul12/vol54/num07/What-Is-the-Purpose-of-Education%C2%A2.aspx

Kira, E. & Komba, S. (2015). Comparison between the Understanding Levels of Boys and Girls on the Concepts of Environmental Degradation, Meteorology and Climate Change in Tanzanian Secondary Schools. *Journal of Education and E-Learning Research*, *2*(4), 79–86. https://www.asianonlinejournals.com/index.php/JEELR/article/view/107

Kitagawa, K. (2019). Questioning ‘integrated’ disaster risk reduction and ‘all of society’ engagement: Can ‘preparedness pedagogy’ help? *Compare, 49*(6), 851-867. doi:10.1080/03057925.2018.1464385

Klepp, S. & Chavez-Rodriguez, L. (Eds.). (2018). *A critical approach to climate change adaptation: Discourses, policies, and practices* (Routledge advances in climate change research). Abingdon, UK: Routledge. doi:10.4324/9781315165448

Kolb, D. (1984). Experiential learning: Experience as the source of learning and development (Vol 1), Englewood Cliffs, New Jersey, Prentice-Hall. In: Mcleod, S. (2017). Kolb’s learning styles and experiential learning cycle, *Simply Psychology,: Kolb - Learning Styles*. https://www.simplypsychology.org/learning -kolb.html (Creative Commons License)

Kolb, A. & Kolb, D. (2008). The Learning Way: Meta-cognitive Aspects of Experiential Learning. *Simulation & Gaming 2009, 40(3),* 297-327. https://journals.sagepub.com/doi/abs/10.1177/1046878108325713

Krosnick, J. (1991). Response strategies for coping with the cognitive demands of attitude measures in surveys. *Applied Cognitive Psychology, 5(3)*, pp. 213-236. John Wiley & Sons. 0888 4080/91/030213

Kuhn, T. (1970). *The Structure of Scientific Revolutions* (2nd Edition). University of Chicago Press, Section V, pp. 43-51. ISBN: 0-226-45803-2 (hardback); 0-226-45804-0 (paperback)

Kunkle, K. & Monroe, M. (2016). *Misconceptions and psychological mechanisms of climate change communication.* In: Monroe, M. & Krasny, M. (Eds) (2016*). Across the Spectrum: Resources for Environmental Educators, edition 3.* North

American Association for Environmental Education, University of Florida, Cornell University & the US Environmental Protection Agency.

Kuter, U. & Yilmaz, C. (2001). Survey Methods: Questionnaires and Interviews. In: University of Maryland, USA: *Choosing Human-Computer Interaction (HCI) Appropriate Research Methods*. https://www.researchgate.net/profile/Ugur-Kuter/publication/267366565_Survey_Methods_Questionnaires_and_Interviews/links/5489a6ca0cf225bf669c6e2c/Survey-Methods-Questionnaires-and-Interviews.pdf

Latai-Niusulu, A., Nel, E. & Binns, T. (2020). Positionality and protocol in field research: Undertaking community-based investigations in Samoa. *Asia Pacific Viewpoint Vol. 61, No. 1, 2020,* pp 71-84. Victoria University of Wellington and John Wiley & Sons, Australia, Ltd. ISSN 1360-7456. doi: 10.1111/apv.12252

Le Dé, L., Rey, T., Leone, F. & Gilbert, D. (2018). Sustainable livelihoods and effectiveness of disaster responses: a case study of tropical cyclone Pam in Vanuatu. *Natural Hazards* 91, 1203–1221 (2018). https://doi.org/10.1007/s11069-018-3174-6

Leal Filho, W. & Pace, P. (Eds.). (2016*). Teaching education for sustainable development: Implications on learning programmes at higher education*. Cham, Switzerland: Springer. https://doi.org/10.1007/978-3-319-32928-4_1

Leal Filho, W. (Ed.). (2017). *Climate change adaptation in Pacific countries : Fostering resilience and improving the quality of life* (Climate change management). Cham, Switzerland: Springer. doi:10.1007/978-3-319-50094-2

Lefale, P. (2010). *Ua'afa le Aso* Stormy weather today: traditional ecological knowledge of weather and climate. The Samoa experience. *Climatic Change (2010)100*: 317-335. doi: 10.1007/s10584-009-9722-z

Legates, D., Soon, W., Briggs, W. & Monckton of Brenchley, C. (2015). Climate consensus and 'misinformation': A rejoinder to agnotology, scientific consensus, and the teaching and learning of climate change. *Science & Education : Contributions from History, Philosophy and Sociology of Science and Mathematics, 24*(3), 299-318. doi:10.1007/s11191-013-9647-9

Leonard, S., Mackenzie, J., Kofod, F., Parsons, M., Langton, M., Russ, P., Ormond-Parker, L., Smith, K. & Smith, M. (2013). *Indigenous climate change adaptation in the Kimberley region of north-west Australia. Learning from the past, adapting in the future: Identifying pathways to successful adaptation in indigenous communities.* National Climate Change Adaptation Research Facility (NCCARF), Gold Coast, Queensland, Australia. ISBN: 978-1-925039-87-0. NCCARF publication 116/13.

Lexico. (2021). *UK Dictionary: rigour*. https://www.lexico.com/definition/rigour

Leydon, J. & Turner, S. (2013). The challenges and rewards of introducing field trips into a large introductory geography class. *Journal of Geography*, *112*(6), 248–261. doi: 10.1080/00221341.2013.833279

Lincoln, Y., Lynham, S. & Guba, E. (2011). Paradigms and perspectives in contention. *The Sage Handbook of Qualitative Research* (Eds. Denzin, N. & Lincoln, Y.), pp 91-95. Sage Publications, Inc., Thousand Oaks, California, USA. ISBN 978-1-4129-7417-2.

Longworth, M. (1994). *Tropical cyclone experiences in Vanuatu*. UK Meteorological Office, Bracknell, UK.

Lourenço, O. (2012). Piaget and Vygotsky: Many resemblances, and a crucial difference. *New Ideas in Psychology 30 (2012),* 281–295. www.elsevier.com/locate/newideapsych

Lovelock, J. (2009). *The vanishing face of Gaia: a final warning*. Allen Lane (Penguin Press), London, UK.

Lower, M. (2021). The Communities of Inquiry pedagogy in higher education. *Academia Letters*, *Article 268*. https://doi.org/10.20935/AL268

Lutz, W., Muttarak, R. & Striessnig, E. (2014). Universal education is key to enhanced climate adaptation. *Science* 28 Nov 2014, Vol. 346, Issue 6213, pp. 1061-1062. https://doi.org/10.1126/science.1257975. https://science.sciencemag.org/content/346/6213/1061

Lynas, M. (2007). *Six degrees: Our future on a hotter planet*. Penguin Random House, London, UK. ISBN 9781426203855.

Lynch, J. & Crowley, T. (2001). *Languages of Vanuatu: A new survey and bibliography.* Pacific Linguistics, the Australian National University (ANU). doi: 10.15144/PL-517.

Macfarlane, M. (2000*). Background information on Vanuatu.* Kiwanis Club of Port Vila, Vanuatu. Kiwanis International – NZSP Division 1 (Auckland and Vanuatu). http://www.kiwanis.org.nz/dv01evbk.htm

Mahuri, D. (2019). *Teacher's perceptions of socio-cultural practices on students' academic achievement in North Pentecost, Vanuatu.* Thesis submitted in fulfilment of the requirement of the degree of Master of Arts in Education, School of Education, University of the South Pacific, Suva, Fiji.

Mamon, M., Suba, R. & Son, I. (2017). Disaster risk reduction knowledge of grade 11 students: Impact of senior high school disaster education in the Philippines. *International Journal of Health System and Disaster Management, 5*(3), 69-74. doi:10.4103/ijhsdm.ijhsdm_16_17

Manohar, N., Liamputtong, P., Bhole, S. & Arora, A. (2017). Researcher Positionality in Cross-Cultural and Sensitive Research. In: Liamputtong, P. et al (eds.), *Handbook of Research Methods in Health Social Sciences*. Springer, Singapore. https://doi.org/10.1007/978-981-10-2779-6_35-1

Marshall, M. (1996). Sampling for qualitative research*. Family Practice, Vol. 13, no. 6,* 522-525. Oxford University Press.

Martinich, A., Encyclopedia Britannica. (2021). *Epistemology.* https://www.britannica.com/topic/epistemology

Maslin, M. (2019). Five climate change misconceptions debunked. *The Conversation, UK.* Available at https://theconversation.com/five-climate-change-science-misconceptions-debunked-122570

McClelland, S. (1994). Training Needs Assessment Data-gathering Methods: Part 1, Survey Questionnaires. *Journal of European Industrial Training*, *Vol.18 No.1*, pp. 22-26. https://doi.org/10.1108/03090599410054317

McCright, A. (2010). The effects of gender on climate change knowledge and concern in the American public. *Population and Environment*, *32*, 66–87.

Mcdonald, J. (2020). Vanuatu Alone in Rebuilding After Cyclone Harold. *The Diplomat*, May 1, 2020. https://thediplomat.com/2020/05/vanuatu-alone-in-rebuilding-after-cyclone-harold/

McKeown, R. (2002). *Education for sustainable development toolkit*. Energy, Environment and Resources Centre, University of Tennessee, Knoxville, USA. esdtoolkit@utk.edu

McLeod, S. (2014). The interview research method. *Simply Psychology, 2014, February 05*. https://www.simplypsychology.org/interviews.html

McLeod, S. (2017). Behaviourist Approach. *Simply Psychology, 2017, February 05.* https://www.simplypsychology.org/behaviorism.html

McLeod, S. (2019). Constructivism as a theory for teaching and learning. *Simply Psychology, 2019, August 17*. https://www.simplypsychology.org/ constructivism.html

McLeod, S. (2019).   Likert scale*.* *Simply Psychology, 2019, August 03*. https://www.simplypsychology.org/likert-scale.html

McLeod, S. (2022). Vygotsky's Sociocultural Theory of Cognitive Development. *Simply Psychology, 2022, May 05*. https://www.simplypsychology.org/vygotsky.html

McMillen, L., Ticktin, T., Friedlander, A., Jupiter, S., Thaman, R., Campbell, J, Veitayaki, J., Giambelluca, T., Nihmei, S., Rupeni, E., Apis-Overhoff, L., Aalbersberg, W. & Orcherton, D. (2014). Small islands, valuable insights: systems of customary resources use and resilience to climate change in the Pacific. *Ecology and Society, 19(4)*: 44. http://dx.doi.org/10.5751/ES-06937-190444

McNamara, K. (2013). Raising awareness about climate change in Pacific communities. *Environmental Education Research, 19*(6), 864-871. doi:10.1080/13504622.2013.769046

McNamara, K. & Prasad, S. (2014). Coping with extreme weather: communities in Fiji and Vanuatu share their experiences and knowledge. *Climatic Change* 123**,** 121–132. https://doi.org/10.1007/s10584-013-1047-2

McNamara, K., Hemstock, S. & Holland, E. (2015). *PACE-SD guidebook: Participatory vulnerability and adaptation assessment.* Pacific Centre for Environment and sustainable Development (PACE-SD), University of the South Pacific, Suva, Fiji.   https://www.pacificclimatechange.net/ document/pace-sd-guidebook-participatory-vulnerability-and-adaptation-assessment

McNaught, R., Warrick, O. & Cooper, A. (2014). Communicating climate change for adaptation in rural communities: A Pacific study. *Regional Environmental Change, 14*(4), 1491-1503. doi:10.1007/s10113-014-0592-1

Melnik, A-S. & Botez, N. (2014). Formal, Non-Formal and Informal Interdependence in Education.   *Economy Transdisciplinarity Cognition*, *Vol.17, Issue 1/2014*, 113-118. http://www.ugb.ro/etc

Merriam, S., Johnson-Bailey, J., Lee, M-Y., Kee, Y. Ntseana, G. & Muhamad, M. (2001). Power and positionality: negotiating insider/outsider status within and across cultures. *International Journal of Lifelong Education, Vol. 20, no. 5 (September-October 2001)*, pp 406-416. doi: 10.1080/02601370120490

Merriam-Webster Dictionary. (2020). *Definition of resilience*. https://www.merriam-webster.com/dictionary/resilience

Mias-Mamonong, A., Flores, Y., Barth, B., Radford, C. & members of the Sorsogon City Technical Working Group. (2010). Participatory climate change assessments: A toolkit based on the experience of Sorsogon City, Philippines. *Cities and Climate Change Working Paper Series no. 1,* United Nations Human Settlements Programme (UN-HABITAT), Nairobi, Kenya. http://www.fukuoka.unhabitat.org/programmes/ccci/pdf/PHI1_Paticipatory_CC_Assessment.pdf

Middleton, F. (2020). *Reliability vs validity: What's the difference?* https://www.scribbr.com/methodology/reliability-vs-validity/

Ministry of Climate Change (MCC), Government of Vanuatu. (2015). *The 2015 Annual Report of the Ministry of Climate Change Adaptation, Meteorology and Geo-Hazards, Energy, Environment and National Disaster Management Office.* PMB 9054, Port Vila. https://environment.gov.vu/images/Reports/MCCA_AnnualRpt_2015.pdf

Ministry of Education, Republic of Vanuatu. (2010). *Vanuatu National Curriculum Statement, 2010*. Ministry of Education, PMB 9028, Port Vila. ISBN: 978-982-9126-01-6

Ministry of Education (MOE), Republic of Vanuatu. (2011). *Annual Statistical Report, 2009.* Policy and Planning Unit, MOET, PMB 9028, Port Vila, Vanuatu. https://education.gov.vu/docs/statistics/Annual%20Statistics%20Digest%20for%20the%20Ministry%20of%20Education_2009.pdf

Ministry of Education and Training (MOET), Government of Vanuatu. (2015). *Vanuatu National Timetabling Policy for Primary, Years 1 to 6*. Ministry of Education and Training, PMB 9028, Port Vila, Vanuatu.

Ministry of Education and Training (MOET), Government of Vanuatu. (2018). *Learner Guide, Units 5 & 6, Certificate III in Resilience.* Ministry of Education and Training, PMB 9028, Port Vila, Vanuatu.

Ministry of Education and Training (MOET), Government of Vanuatu. (2019). *2018 Annual Report*. Ministry of Education and Training, PJB 9028, Port Vila, Vanuatu.

Ministry of Education and Training (MOET), Government of Vanuatu. (2019). *Teacher's Guide Social Science Year 5*. Ministry of Education and Training, PMB 9028, Port Vila, Vanuatu. ISBN 978-982-9178-11-4.

Ministry of Education and Training (MOET), Government of Vanuatu. (2019). *Teacher's Guide Science Year 5*. Ministry of Education and Training, PMB 9028, Port Vila, Vanuatu. ISBN 978-982-9178-10-7.

Ministry of Education and Training (MOET), Government of Vanuatu. (2020). *Education Statistics: Basic tables of 2019.* Policy and Planning Division, Ministry of Education and Training, PMB 9028, Port Vila, Vanuatu.

Ministry of Education and Training (MOET), Government of Vanuatu. (2020) *2019 Annual Report*. Ministry of Education and Training, PMB 9028, Port Vila, Vanuatu.

Ministry of Education and Training (MOET), Republic of Vanuatu. (2020). *Teacher's Guide Science Year 6.* Ministry of Education and Training, PMB 9028, Port Vila, Vanuatu. ISBN 978-982-9178-34-3.

Ministry of Education and Training (MOET), Republic of Vanuatu. (2020). *Teacher's Guide Social Science Year 6.* Ministry of Education and Training, PMB 9028, Port Vila, Vanuatu. ISBN 978-982-9178-36-7.

Ministry of Education and Training (MOET), Government of Vanuatu. (2021). *Education Statistics: Basic tables of 2020*. MOET, PMB 9028, Port Vila, Vanuatu. https://moet.gov.vu/docs/statistics/2020%20MoET%20Education%20Statistics%20Report_2020.pdf

Ministry of Education and Training (MOET), Government of Vanuatu. (2022). *Education Statistics: Basic tables of 2021.* Policy and Planning Division, MOET, PMB 9028, Port Vila, Vanuatu. https://education.gov.vu/docs/statistics/2021%20MoET%20STATISTICAL%20REPORT_2021.pdf

Mishra, S. & Suar, D. (2007). Do lessons people learn determine disaster cognition and preparedness? *Psychology and Developing Societies 19(2)*, 143-159. Sage Publications, Los Angeles. doi:10.1177/097133360701900201

Mochizuki, Y. & Bryan, A. (2015). *Climate Change Education in the Context of Sustainable Development: Rationale and Principles*. www.sagepublications.com Vol 9(1): 4–26 10.1177/0973408215569109. https://journals.sagepub.com/doi/pdf/10.1177/0973408215569109

Monbiot, G. (2006). *Heat: How to stop the planet burning*. Allen Lane (Penguin Press), London, UK.

Mondragon, C. (2018). Forest, Reef and Sea-level rise in North Vanuatu: Seasonal Environmental Practices and Climate Fluctuations in Island Melanesia. In Nakashima, D. et al. (2018). *Indigenous Knowledge for Climate Change Assessment and Adaptation*. Cambridge University Press and UNESCO: Cambridge and Paris. doi: 10.1017/9781316481066. ISBN Cambridge 978-1-107-13788-2

Morchain, D. Rethinking the framing of climate change adaptation: knowledge, power and politics. In: Klepp, S. & Chavez-Rodriquez, L. (Eds.) (2018*). A critical approach to climate change adaptation: discourses, policies and practices*. Routledge, London and New York. ISBN: 978-1-138-05629-9 (hbk) and 978-1-315-16544-8 (ebk)

Morse, J., Barrett, M., Mayan, M., Olson, K. & Spiers, J. (2002). Verification strategies for establishing reliability and validity in qualitative research. *International Journal of Qualitative Methods 2002, 1(2),* pp 13-22. https://doi.org/10.1177/160940690200100202

Moser, S. (2010). Communicating climate change: History, challenges, process and future directions. *Wiley Interdisciplinary Reviews: Climate Change, 1(1)*, 31–53. doi:10.1002/wcc.011

Motesharrei, S., Rivas, J., Kalnay, E., Asrar, G., Busalacchi, A., Cahalan, R., Cane, M., Colwell, R., Feng, K., Franklin, R., Hubacek, K., Miralles-Wilhelm, F., Miyoshi, T., Ruth, M., Sagdeev, R., Shirmohammadi, A., Shukla, J., Srebric, J., Yakovenko, V. & Zeng, N. (2016). Modeling sustainability: population, inequality, consumption, and bidirectional coupling of the Earth and Human Systems, *National Science Review*, *Volume 3, Issue 4, December 2016*, pp 470-494. https://doi.org/10.1093/nsr/nww081

Mulilis, J-P., Duval, T. & Lippa, R. (1990). The effect of a large destructive local earthquake on earthquake preparedness as assessed by an earthquake preparedness scale. *Natural Hazards*, 3(3), 357–371. Kluwer Academic Publishers, Netherlands. ISSN: 0921-030X (Print) 1573-0840 (Online)

Mullings, B. (1999). Insider or outsider, both or neither: some dilemmas of interviewing in a cross-cultural setting. *Geoforum, Volume 30, Issue 4, 1999*, pp. 337-350. ISSN 0016-7185. https://doi.org/10.1016/S0016-7185(99)00025-1.

Muralidharan, K. & Sheth, K. (2016). Bridging Education Gender Gaps in Developing Countries: The Role of Female Teachers. *The Journal of Human Resources, University of Wisconsin Press, 51(2*): 269-297. doi: 10.3368/jhr.51.2.0813-5901R1

Muttarak, R. & Lutz, W. (2014). Is Education a Key to Reducing Vulnerability to Natural Disasters and hence Unavoidable Climate Change? *Ecology and Society,* Mar 2014, Vol. 19, No. 1. Resilience Alliance Inc. Stable URL: https://www.jstor.org/stable/26269470

Naidu, S. (2010). Right to Education for All Children in Vanuatu – Are Girls Getting an Equal Opportunity to Education Compared to Boys. *Law, Social Justice & Global Development Journal (LGD).* http://www.go.warwick.ac.uk/elj/lgd/2010_2/naidu

Nakamura, N. & Kanemasu, Y. (2020). Traditional knowledge, social capital, and community response to a disaster: resilience of remote communities in Fiji after a severe climatic event. *Regional Environmental Change 2020* 20: 23. https://doi.org/10.1007/s10113-020-01613-w

Nakaseko, E., Kotera, S. & Nakazawa, M. (2022). Smoking and drinking behaviour, knowledge and attitudes among urban and rural public-school students in Efate island, Vanuatu: a comparative study. *Archives of Public Health (2022) 80:170* https://doi.org/10.1186/s13690-022-00929-9

Nalau, J., Becken, S., Schliephack, J., Parsons, M., Brown, C. & Mackey, B. (2018). The Role of Indigenous and Traditional Knowledge in Ecosystem-Based Adaptation: A Review of the Literature and Case Studies from the Pacific Islands. *Weather Climate and Society, Vol.10*, October 2018, 851-865. American Meteorological Society. https://doi.org/10.1175/WCAS-D-18-0032.1

Napoles, J. & MacLeod, R. (2013). Influence of teacher delivery and student progress on pre-service teachers' perceptions of teaching effectiveness. *Journal of Research in Music Education 61(3)*, 249 –261. doi: 10.1177/0022429413497234

National Advisory Board on Climate Change and Disaster Risk Reduction (NAB) News, Government of Vanuatu. (2019) *Vanuatu Climate Action Network launches Strike for the Climate Emergency*. https://www.nab.vu/news/vanuatu-climate-action-network-launches-strike-climate-emergency

National Advisory Board on Climate Change and Disaster Risk Reduction (NAB). (2020). *Pacific Climate Change Collaboration Influencing and Learning (PACCCIL) project.* https://www.nab.vu/project/pacific-climate-change-collaboration-influencing-and-learning-pacccil-project

National Advisory Board on Climate Change and Disaster Risk Reduction (NAB), Government of Vanuatu. (2021). *Home page*. https://www.nab.vu/

National Geographic Society. (2021*). Resource Library: Encyclopaedic Entry: Field work.* https://www.nationalgeographic.org/encyclopedia/field-work/#:~:text=Field%20work%20enables%20students%20and,people%2C%20culture%2C%20and%20society.

Natoli, T., International Federation of Red Cross and Red Crescent Societies (IFRC). (2020). *Laws and policies that protect the most vulnerable against climate-related disaster risks: Findings and lessons learned from Pacific Island countries.* IFRC, PO Box 303, CH-1211 Geneva 19, Switzerland. https://media.ifrc.org/ifrc/wp-content/uploads/sites/5/2020/05/PICs-Full-Report-_Natoli-2020.pdf

Newsom, J. (2007). *Stats Notes, Web Lecture 4: Sample size*. http://web.pdx.edu/~newsomj/pa551/lecture4.htm

Nilwo, F., Principal Education Officer, Curriculum Development Unit (CDU), Ministry of Education and Training, Republic of Vanuatu. (2020). Personal communication on 9th September 2020.

Nnamani, S. & Oyibe, O. (2016). Gender and academic achievement of secondary school students in Social Studies in Abakaliki Urban of Ebonyi State. *British Journal of Education Vol.4, No.8, August 2016*, 84-95. European Centre for Research Training and Development UK (www.eajournals.org)

Nolasco, M., Beguia, Y., Durante, E. & Tipones, G. (2015). Program for enhancing resilience to climate change: A basis for school-community partnership. *Asia Pacific Journal of Multidisciplinary Research, 3*(4.5), 158-166. P-ISSN 2350-7756; E-ISSN 2350-8442

Noonan, J. (2008). In Given, L. (ed), *Sage Encyclopedia of Qualitative Research Methods*. Sage Publications, Inc., Thousand Oaks, California, USA. ISBN 978-1-4129-4163-1

Nunn, P., Veitayaki, J., Ram-Bidesi, V. & Vunisea, A. (1999). Coastal issues for oceanic islands: implications for human futures. *Natural Resources Forum 23 (1999)*, 195-207. Pergamon (Elsevier Science). www.elsevier.com/locate/natresfor

Obed, L., Deputy Principal Academic, Malapoa College, Port Vila, Vanuatu. (2020). Personal communication on 23rd October 2020.

Ober, J. & Bakumenko, S., Refugees International. (2020). Issue brief: A new vulnerability: COVID-19 and tropical cyclone Harold create the perfect storm in the Pacific. *Reliefweb*, June 3, 2020. https://reliefweb.int/report/vanuatu/ issue-brief-new-vulnerability-covid-19-and-tropical-cyclone-harold-create-perfect

Ojala, M. (2013). Coping with Climate Change among Adolescents: Implications for Subjective Well-being and Environmental Engagement. *Sustainability 2013*, 5, 2191-2209; doi:10.3390/su5052191. ISSN 2071-1050. www.mdpi.com/journal/sustainability

Okesina, M. (2020). A Critical Review of the Relationship between Paradigm, Methodology, Design and Method in Research. *IOSR Journal of Research & Method in Education (IOSR-JRME) e-ISSN: 2320–1959. p-ISSN: 2320–1940 Volume 10, Issue 3 Ser. I (May - June 2020), pp* 57-68. www.iosrjournals.org

Olsen, W. 2004. *Triangulation in Social Research: Qualitative and Quantitative Methods Can Really Be Mixed*. In: *Developments in Sociology, 2004*, Ormskirk, UK, ISBN 1902796829. https://www.federica.eu/users/9/docs/amaturo-39571-01-Triangulation.pdf

Organisation for Economic Cooperation and Development (OECD). (2017). *Development aid at a glance: statistics by region: Oceania*. Organisation for Economic Cooperation and Development. http://www.oecd.org/dac/stats/documentupload/Oceania-Development-at-a-Glance.pdf

Organisation for Economic Cooperation and Development (OECD), Query Wizard for International Development Statistics (QWIDS). (2020). *ODA disbursements from all official donors for Vanuatu for all sectors, 2010 to 2018, in USD million*. Organisation for Economic Cooperation and Development. https://www.stats.oecd.org/qwids

Organisation for Economic Cooperation and Development, Query Wizard for International Development Statistics (QWIDS). (2020). *Aid disbursements to selected Pacific island countries from all official donors in USD millions, 2010-2018*. https://stats.oecd.org/qwids/#?x=2&y=6&f=3:51,4:1,1:1,5:3,7:1 &q=3:51+4:1+1:1+5:3+7:1+2:273,88,125,136,155,180,186+6:2010,2011,2012,2013,2014,2015,2016,2017,2018,2019

Orman, T. (2016). "Paradigm" as a Central Concept in Thomas Kuhn's Thought. *International Journal of Humanities and Social Science Vol. 6, No. 10; October 2016*. http://www.ijhssnet.com/journals/Vol_6_No_10_October_2016/8.pdf

Overton, J., Prinsen, G., Murray, W. & Wrighton, N. (2012). Reversing the tide of aid: investigating development policy sovereignty in the Pacific. *Journal de la Société des Océanistes 135 | 2012-2*. doi : 10.4000/jso.6713. http://journals.openedition.org/jso/6713 and https://doi.org/10.4000/jso.6713

Overton, J., Murray, W., Prinsen, G., Ulu, A. & Wrighton, N. (2018*). Aid, ownership and development: the inverse sovereignty effect in the Pacific Islands*. Routledge, Abingdon, UK. ISBN 978-0-367-00052-3 (hardback) and 978-0-429-44481-4 (ebook)

Oxford Learning Dictionaries. (2020). *Definition of resilience*. https://www.oxfordlearnersdictionaries.com/definition/ american_english/resilience

Pacific Centre for Environment & Sustainable Development (PaCE-SD), University of the South Pacific (USP). (2022*)* *Post-Graduate Diploma in Climate Change*. PaCE-SD USP, Suva, Fiji. https://pace.usp.ac.fj/education-2/

Pacific Centre for Environment and Sustainable Development (PaCE-SD). (2022). *Intra-ACP GCCA+ Pacific Adaptation to Climate Change and Resilience Building (PACRES) – USP component*. https://pace.usp.ac.fj/intra-acp-gcca-pacres-usp/

Pacific Climate Change Science and Adaptation Planning Programme (PACCSAPP) partners. (2015). *Country brochures: current and future climate of Vanuatu*.

https://www.pacificclimatechangescience.org/wp-content/uploads/2013/06/15_PACCSAP-Vanuatu-11pp_WEB.pdf

Pacific Community (SPC), Secretariat of the Pacific Regional Environment Programme (SPREP), Pacific Islands Forum Secretariat (PIFS), United Nations Development Programme (UNDP), United Nations Office for Disaster Risk Reduction (UNISDR) & University of the South Pacific (USP). (2016). *Framework for Resilient Development in the Pacific: An Integrated Approach to Address Climate Change and Disaster Risk Management (FRDP) 2017 – 2030*. The Pacific Community, Geoscience Division, Suva, Fiji. ISBN: 978-982-00-1034-5

Pacific Community, Statistics for Development Division. (2020). *Pacific Island Population Estimates: mid-year 2018*. https://sdd.spc.int/topic/population-estimates-and-projections

Pacific Islands Forum Secretariat (PIFS). (2007). *Pacific Aid Effectiveness Principles 2007*. Pacific Islands Forum Secretariat, Suva, Fiji. http://www.forumsec.org/wp-content/uploads/2017/11/Pacific_Aid_Effectiveness_Principles.pdf

Pacific Islands Forum Secretariat (PIFS), Council of Regional Organisations in the Pacific & UN Agencies in the Pacific. (2018). *First Quadrennial Pacific Sustainable Development Report: Executive Summary.* Pacific Islands Forum Secretariat, Suva, Fiji. ISBN: 978-982-202-054-0. https://www.forumsec.org/wp-content/uploads/ 2018/09/1st-Quadrennial-Pacific-Sustainable-Development-Report-2018.pdf

Pacific Regional Qualifications Unit (PRQU). (2016). *Student Guide and Learning Resources - Regional Certificate 4 in Resilience and Health : CR4101H and CR4102H.* Educational Quality and Assessment Programme (EQAP), PO Box 2083, Government Buildings, Suva, Fiji.

Pacific Regional Resilience Industry Standards Advisory Committee (PRR-ISAC). (2016). *Regional Certificate 4 in Resilience (CCA and DRR).* Pacific Regional Qualifications Unit, PO Box 2083, Government Buildings, Suva, Fiji.

Palinkas, L., Horwitz, S., Green, C., Wisdom, J., Duan, N. & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Adm.Policy Ment Health, 2015 September, 42(5)*, 533-544. doi:10.1007/s10488-013-0528-y

Paolini, A. (2015). Enhancing teaching effectiveness and student learning outcomes. *The Journal of Effective Teaching, Vol. 15, No.1, 2015*, 20-33.

Pascht, A. (2019). Klaemet jenj worlds: Approaching climate change and knowledge creation in Vanuatu. *Journal de la Société des Océanistes* 149 : 2, 2019.

Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Sage Publications, Inc., Thousand Oaks, California, USA. .

Pawluk A. & Braithwaite, I. (2014). Corporate influence on climate negotiations. *The British Medical Journal (BMJ) 2014,* 348. doi.org/10.1136/sbmj.g2616

Percival, G. (2008). *An assessment of indigenous environmental knowledge (IEK) in the Pacific region to improve resilience to environmental change*. Climate

Research Centre, University of New South Wales, Australia, April 2008. https://www.sprep.org/att/irc/ecopies/pacific_region/406.pdf

Perera, S. (2018). *Lecture 2: Research Paradigms*. Department of Demography, University of Colombo, Sri Lanka. http://www.natlib.lk/pdf/Lec_02.pdf

Petal, M. (2009). *Education in Disaster Risk Reduction*. https://www.researchgate.net/publication/312489763_Education_in_disaster_risk_reduction

Philips, R. & Vaughn, L. (2009). Diverse Ways of Knowing and Learning: The Impact of Culture. *The Open Medical Education Journal, 2009, Volume 2*, 49-56.

Phellas, C., Bloch, A. & Seale, C. (2011). *Structured methods: Interviews, questionnaires and observation.* In: Seale, C. (ed.). *Researching society and culture (3rd edition),* London. UK. Sage Publications. http://courseware.cutm.ac.in/wp-content/uploads/2020/06/interview.pdf

Pierce, C. (2019A). *Perceptions of climate change in a rural community in Vanuatu.* Article submitted to Vanuatu's National Advisory Board on Climate Change and Disaster Risk Reduction (NAB), 2019. Available from the author at charliepierce19@gmail.com

Pierce, C. (2019B). Realities of teaching climate change in a Pacific island nation. In: Leal Filho, W. & Hemstock, S. (Eds*) Climate Change and the Role of Education: Climate Change Management* (2020). Springer Nature Switzerland AG2020. doi: 10.1007/978-3-030-32898-6_18

Polk, J. (2006). Traits of Effective Teachers. *Arts Education Policy Review, 107:4*, 23-29. doi.org/10.3200/AEPR.107.4.23-29

Pouvalu, S. (2015). *Community Mapping & QGIS: A climate and disaster risk mapping tool-kit*. Pacific Centre for Environment and Sustainable Development, University of the South Pacific, Suva. Fiji. http://eugcca.usp.ac.fj/Home.aspx. ISBN 978-982-01-0940-7.

Pulford, B., Colman, A., Buabang, E. & Krockow, E. (2018). The Persuasive Power of Knowledge: Testing the Confidence Heuristic. *Journal of Experimental Psychology: General, 2018, Vol. 147, no.10,* 1431-1444. American Psychological Association. doi.org/10.1037/xge0000471

Queiros, A., Faria, D. & Almeida, F. (2017). Strengths and limitations of qualitative and quantitative research methods. *European Journal of Education Studies, Volume 3 Issue 9, 2017*. https://doi.org/10.5281/zenodo.887089

Rahman, M. (2016). The advantages and disadvantages of using qualitative and quantitate approaches and methods in language "testing and assessment" research: A literature review. *Journal of Education and Learning*, *Vol. 6, No.1, 2017.* http://dx.doi.org/10.5539/jel.v6n1p102.

Rai, P. & Khawas, V. (2019). Traditional knowledge system in disaster risk reduction: Exploration, acknowledgement and proposition. *Jàmbá: Journal of Disaster Risk Studies 11(1), a484.* doi:10.4102/jamba.v11i1.484

Rawat, A., Vasistha, H. & Soni, P. (2012). *Ecological approach to landslide remediation.* In: Gupta, A and Nair, S. (Eds). (2012). *Ecosystem Approach to Disaster Risk Reduction*, National Institute of Disaster Management, New Delhi, India. https://www.preventionweb.net/publications/view/26498

Rehman, A. & Alharthi, K. (2016). An Introduction to Research Paradigms. *International Journal of Educational Investigations, Vol. 3 no.8*, 51-59. ISSN2410-3446

Reid, A. (2019). Climate change education and research: possibilities and potentials versus problems and perils? *Environmental Education Research, 25:6*, 767-790. doi: 10.1080/13504622.2019.1664075

Relief Web, International Federation of Red Cross and Red Crescent Societies (IFRC). (2020). *Vanuatu: Tropical Cyclone Harold – Emergency Plan of Action (MDRVU008) DREF Operation update no. 2.* https://reliefweb.int/report/vanuatu/vanuatu-tropical-cyclone-harold-emergency-plan-action-mdrvu008-dref-operation-0

Republic of Vanuatu. (2017)*. Submission to the Paris Committee on Capacity-Building*. https://unfccc.int/files/cooperation_and_support/financial_mechanism/standing_committee/application/pdf/vanuatu_pccb_submission_317_2017.pdf

Republic of Vanuatu. (2019*). Voluntary National Review on the Implementation of the 2030 Agenda for Sustainable Development*. https://sustainabledevelopment.un.org/content/documents/23336Republic_of_Vanuatu_VNR_2019.pdf

Revkin, A. (2018). Climate change first became news 30 years ago. Why haven't we fixed it? *National Geographic Magazine, July 2018*. https://www.nationalgeographic.com/magazine/2018/07/embark-essay-climate-change-pollution-revkin/

Richmond, N. & Sovacool, B. (2012). Bolstering resilience in the coconut kingdom: Improving adaptive capacity to climate change in Vanuatu. *Energy Policy 50, November 2012*, 843-848. Elsevier. ISSN 0301-4215. http://www.elsevier.com.

Roberts, M. (2006). *Secondary Geography Handbook Chapter 9: Geographical Enquiry*. The Geographical Association, UK. https://www.geography.org.uk/download/ga_sechdbkchapter9.pdf

Robinson, S. & Gilfillan, D. (2017). Regional organisations and climate change adaptation in small island developing states. *Regional Environmental Change, 17*(4), 989-1004. doi:10.1007/s10113-016-0991-6

Romm, J. (2006). *Hell and high water: Global warming – the solution and the politics – and what we should do*. HarperCollins, USA. ISBN 0-06-117212-X

Rowley, J. (2012). Conducting research interviews. *Management Research Review Vol. 35 No. 3/4, 2012*, pp. 260-271. Emerald Group Publishing Limited 2040-8269 doi: 10.1108/01409171211210154

Saaty, T. (2008). Decision making with the analytic hierarchy process, *International Journal of Services Sciences, Vol. 1 No. 1*, 83-98.

Salter, Z. (2013). *Impact of whole-school education for sustainability on upper primary students and their families*. PhD thesis presented to the Graduate School of Education, University of Western Australia, Perth.

Sarabhai, K. & Vyas, P. (2017). The leapfrogging opportunity: The role of education in sustainable development and climate change mitigation. *European Journal of Education, 52*(4), 427-436. doi:10.1111/ejed.12243

Saris, E., Krosnick, J., Revilla, M. & Shaeffer, E. (2010). Comparing Questions with Agree/Disagree Response Options to Questions with Item-Specific Response Options, *Survey Research Methods (2010), Vol.4, No.1*, pp. 61-79. European Survey Research Association, ISSN 1864-336. http://www.surveymethods.org.

School Drug Education and Road Aware (SDERA). (2022). *Resilience Education.* Department of Education, Western Australia, Road Safety and Drug Education Branch. https://www.sdera.wa.edu.au/programs/resilience-education/

School Drug Education and Road Aware (SDERA). (2022). *Whole School Approach.* Department of Education, Western Australia, Road Safety and Drug Education Branch. https://www.sdera.wa.edu.au/programs/whole-school-approach/

Scotland, J. (2012). Exploring the Philosophical Underpinnings of Research: Relating Ontology and Epistemology to the Methodology and Methods of the Scientific, Interpretive, and Critical Research Paradigms. *English Language Teaching; Vol. 5, No. 9.* ISSN 1916-4742 E-ISSN 1916-4750 Published by Canadian Centre of Science and Education.

Scott, C. (2010). The enduring appeal of 'learning styles.' *Australian Journal of Education, 54*, 5–17. https://doi.org/10.1177/000494411005400102

Scott-Parker, B. & Kumar, R. (2018). Fijian adolescents' understanding and evaluation of climate change: Implications for enabling effective future adaptation. *Asia Pacific Viewpoint, 59*(1), 47-59. doi:10.1111/apv.12184

Secretariat of the Pacific Community (SPC) & Deutsche Gesellschaft für Internationale Zusammenarbait GmbH (GIZ). (2013). *Learning about climate change the Pacific way: A guide for Pacific teachers – Vanuatu*. Secretariat of the Pacific Community, Nouméa, New Caledonia. https://www.pacificclimatechange.net/sites/default/files/ documents/Vanuatu_2014_LaCCpw_Teacher_Guide.pdf

Secretariat of the Pacific Community (SPC) & Deutsche Gesellschaft für Internationale Zusammenarbait GmbH (GIZ). (2014). *Learning about Climate Change the Pacific Way: A Visual Guide – Vanuatu.* Secretariat of the Pacific Community, Nouméa, New Caledonia. ISBN 978-982-00-0981-3. https://www.spc.int/sites/ default/files/wordpresscontent/wp-content/uploads/2017/01 /Climate-change-vanuatu.pdf

Secretariat of the Pacific Community (SPC) & Government of the Republic of Vanuatu. (2015). *Vanuatu Climate Change and Disaster Risk Reduction Policy 2016-2030*. Secretariat of the Pacific Community, Suva, Fiji.

Secretariat of the Pacific Community (SPC). (2016). *The Tropical Cyclone Pam Lessons Learned Workshop Report, June 2015.* https://www.spc.int/sites/default/files/ wordpresscontent/wp-content/uploads/2016/12/TC-Pam-Lessons-Learned-Report.pdf

Seynaeve, G. (2008). Education and disaster risk reduction. *Prehospital and Disaster Medicine, 23*(4), 309-313. doi:10.1017/S1049023X00005938

Shannon-Baker, P. (2016). Making paradigms meaningful in mixed methods research. *Journal of Mixed Methods Research, 10(4)*, pp.319-334. https://doi.org/10.1177/1558689815575861.

Shoghi Effendi. (1933). *Letter to an individual dated 17th February 1933*. In: Bahá'í International Community. (1998). *Valuing Spirituality in Development: Initial Considerations Regarding the Creation of Spiritually Based Indicators for Development*. A concept paper presented to the World Faiths and Development Dialogue hosted by the President of the World Bank and the Archbishop of Canterbury at Lambeth Palace, London, England. https://www.bic.org/statements/valuing-spirituality-development

Siméoni, P. (2009). *Atlas du Vanouatou*. Editions Géo-consulte, BP 946, Port Vila, Vanuatu. ISBN 978-2-9533362-0-7.

Simon, C. (2021). *ReadWriteThink: Brainstorming and Reviewing Using the Carousel Strategy.* International Literacy Association/ National Council of Teachers of English. http://www.readwritethink.org/professional-development/strategy-guides/brainstorming -reviewing-using-carousel-30630.html#:~:text=According%20to%20Project% 20CRISS%2C%20Carousel,followed%20by%20whole %2Dclass%20reflection.

Singer, S. (2016). The Goldilocks approach to global warming. *American Thinker, February 2016.* http://www.americanthinker.com/articles/2016/02/ the goldilocks _approach_to_global_warming.html

Spencer, R. (2017). *An inconvenient deception: How Al Gore distorts climate science and energy policy*. Amazon Digital Services LLC e-book: ASIN B074XG6KX1. https://www.amazon.com/Inconvenient-Deception-Distorts-Climate-Science-ebook/dp/B074XG6KX1

Stanford, V. (2015) Aid dependency: the damage of donation. *This Week in Global Health (TWIGH) July 2015.* https://www.twigh.org/twigh-blog-archives/2015/7/31/aid-dependency-the-damage-of-donation

Stapp, W. (1969). The Concept of Environmental Education. *Journal of* Environmental Education, *1:1*, 30-31. doi: 10.1080/00139254.1969.10801479

Stevenson, R., Nicholls, J. & Whitehouse, H. (2017). What is climate change education? *Curriculum Perspectives*, April 2017. https//doi.org/10.1007/s41297-017-0015-9

Strachan, J. (2004). Gender and the formal education sector in Vanuatu. *Development Bulletin, no. 64,* 73-77. Development Studies Network. https://crawford.anu.edu.au/rmap/devnet/devnet/gen/gen_status.pdf

Striessnig, E., Lutz, W. & Patt, A. (2013). Effects of Educational Attainment on Climate Risk Vulnerability. *Ecology and Society*, Mar 2013, Vol. 18, No. 1. Resilience Alliance Inc. https://www.jstor.org/stable/26269263

Stuart, C., Sarah, H. & Ruci, S. (2018). Perspectives of artist-practitioners on the communication of climate change in the Pacific. *International Journal of Climate Change Strategies and Management, 10*(2), 323-339. doi:10.1108/IJCCSM-03-2017-0058

Students for Climate Action Vanuatu Facebook page on 17th March 2019. Still photograph extracted from https://www.youtube.com/watch?v=zFraf2PJXjg

Taherdoost, H. (2016). Sampling Methods in Research Methodology: How to Choose a Sampling Technique for Research. *International Journal of Academic Research in*

Management (IJARM), Vol. 5, no. 2, 2016, 18-27. ISSN 2296-1747. Helvetic Editions, Ltd, Switzerland. www.elvedit.com

Tam, M. (2000). Constructivism, Instructional Design, and Technology: Implications for Transforming Distance Learning. *Educational Technology and Society, 3* (2).

Tangarasi, K., Data Officer, USP Emalus Campus, Port Vila. (2022). Personal communication, 14th February 2022.

Taylor, S. & Kumar, L. (2016). Global Climate Change Impacts on Pacific Islands Terrestrial Biodiversity: A Review. *Tropical Conservation Science Vol. 9 (1)*, 203-223. Sage Publications. https://doi.org/10.1177/194008291600900111

TeacherVision. (2021). *Teaching Resource: Cooperative Learning*. https://www.teachervision.com/professional-development/cooperative-learning

TES Global. (2018). *What is pedagogy?* https://www.tes.com/news/what-is-pedagogy-definition

Thaman, R., (2000). *Traditional environmental knowledge and community-based environmental conservation in Fiji: Current status and priorities for its protection and utilisation*. Working paper no. 7, Geography Department, University of the South Pacific, Suva, Fiji. https://www.sprep.org/att/IRC/eCOPIES/Countries/fiji/83.pdf

Thanassoulis, E., Deya, P., Petridisa, K., Goniadisb, I. & Georgiou, A. (2017). Evaluating higher education teaching performance using combined analytic hierarchy process and data envelopment analysis, *Journal of the Operational Research Society 68:4,* 431-445. doi: 10.1057/s41274-016-0165-4

The Universal House of Justice. (2017) *Message to the Bahá'ís of the World dated 1 March 2017*. https://universalhouseofjustice. bahai.org/involvement-life-society/20170301_001

Thomas, G. & Munge, B. (2015). *Best Practice in Outdoor Environmental Education Fieldwork*. In: Robertson, M., Lawrence, R., Heath, G. (Eds) *Experiencing the Outdoors. Researching Environmental Learning*. SensePublishers, Rotterdam. https://doi.org/10.1007/978-94-6209-944-9_14

Tigona, R., Vanuatu Rainfall and Agro-Meteorology Outlook. (2020). *Melsisi today.* https://www.facebook.com/photo.php?fbid=10223576036291953&set=gm.3726440214092601&type=3&theater&ifg=1

Torani, S., Majd, P., Maroufi, S., Dowlati, M. & Sheikhi, R. (2019). The importance of education on disasters and emergencies: A review article. *J Educ Health Promot*. *2019*, 8:85. doi:10.4103/jehp.jehp_262_18

Torri, M. & Herrmann, T. (2011). Spiritual beliefs and ecological traditions in indigenous communities in India: enhancing community-based biodiversity conservation. *Nature and Culture*, *6*(2), 168+. https://link-gale-com.ezproxy3.lib.le.ac.uk/apps/doc/A263659330/EAIM?u=leicester&sid=EAIM&xid=801cf6

Tourangeau, R., Rips, L. & Rasinski, K. (2000). *The Psychology of Survey Response.* Cambridge University Press, Cambridge, UK, and New York, USA. ISBN 0 521 57246 0 hardback; ISBN 0 521 57629 6 paperback.

Trundle, A., Barth, B. & McEvoy, D. (2018). Leveraging endogenous climate resilience: urban adaptation in Pacific Small Island Development States.

Environment & Urbanization, International Institute for Environment and Development (IIED), 5 3, Vol 31(1), 53–74. https://journals.sagepub.com/doi/pdf/10.1177/0956247818816654

Tryon, D. (1976). New Hebrides Languages: An internal classification. *Pacific Linguistics, Series C, no. 50*. Department of Linguistics, Australian National University, Canberra. ISBN 0 858 83 152 X

Tuisavusavu, A. (2017). *Analysis of traditional farming practices in Vanua Levu, Fiji: Implications for building local community resilience in climate change adaptation*. M.Sc thesis submitted to the Pacific Centre of Environment and Sustainable Development (PACE-SD), University of the South Pacific, Suva, Fiji.

Tuladhar, G., Yatabe, R., Dahal, R. & Bhandary, N. (2015). Disaster risk reduction knowledge of people in Nepal. *Geoenvironmental Disasters* 2:5. doi: 10.1186/s40677-014-0011-4

Ullah, R. & Ullah, H. (2019). Boys versus girls' educational performance: Empirical evidences from global north and global south. *African Educational Research Journal, 7(4):* 163-167. doi: 10.30918/AERJ.74.19.036. ISSN: 2354-2160

United Nations Children's Fund (UNICEF). (2012). *Climate Change and Environmental Education*. https://www.unicef.org/publications/files/CFS_Climate_E_web.pdf

United Nations Children's Fund (UNICEF) & United Nations Educational Scientific and Cultural Organisation (UNESCO). (2012). *Disaster risk reduction in school curricula: Case studies from thirty countries*. UNICEF, Geneva, Switzerland and UNESCO, Paris, France. ISBN 978-92-3-001087-4

United Nations Children's Fund (UNICEF) Education Section. (2019). *Risk-informed education programming for resilience: Guidance note*. UNICEF, New York, USA. https://www.unicef.org/documents/risk-informed-education-programming-resilience-guidance-note

United Nations Department of Economic and Social Affairs (UNDESA). (1982). *Agenda 21: Section IV – Means of Implementation: Ch. 36 - Promoting education, public awareness and training.* https://www.un.org/esa/dsd/agenda21/res_agenda21_00.shtml

United Nations Department of Economic and Social Affairs (UNDESA). (2015). *Transforming our world: the 2030 Agenda for Sustainable Development*. A/RES/70/1 https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf and https://sdgs.un.org/2030agenda

United Nations Development Programme (UNDP). (2002). *A climate risk management approach to disaster reduction and adaptation to climate change.* UNDP Expert Group Meeting, Havana, Cuba, 17-19 June, 2002. https://www.ipcc.ch/apps/njlite/srex/index.php?chapter=6&page=7

United Nations Development Programme (UNDP). (2008). *Community-based adaptation to climate change (CBA)*. UNDP, Energy and Environment Group, 304 East 45th St.,9th Fl, New York, NY 10017. www.undp-adaptation.org/project/cba

United Nations Development Programme (UNDP). (2012). Nguna-Pele Marine and Land Protected Area Network, Vanuatu. *Equator Initiative Case Study Series*.

New York, NY. https://www.equatorinitiative.org/wp-content/uploads/2017/05/case_ 1348163605.pdf

United Nations Educational Scientific and Cultural Organisation (UNESCO). (1990). *World Declaration on Education for All and Framework for Action to Meet Basic Learning Needs*. https://unesdoc.unesco.org/ark:/48223/pf0000127583

United Nations Educational, Scientific and Cultural Organisation (UNESCO) Institute for Statistics. (2012). *International Standard Classification of Education (ISCED) 2011*. ISBN 978-92-9189-123-8 Ref: UIS/2012/INS/10/REV. Montreal, Canada.

United Nations Educational, Scientific and Cultural Organisation (UNESCO). (2015). *Not just hot air: Putting climate change education into practice*. UNESCO Open Access Repository, Paris, France. ISBN 978-92-3-100101-7 https://www.uncclearn.org/wp-content/uploads/library/unesco01_0.pdf

United Nations Educational, Scientific and Cultural Organisation (UNESCO). (2019). *Changing minds, not the climate*: *UNESCO mobilizes to address the climate crisis*. ERI-2019/WS/6. https://unesdoc.unesco.org/ark:/48223/pf0000370750. locale=en

United Nations Educational, Scientific and Cultural Organisation (UNESCO). (2020). *Climate change education and awareness*. http://en.unesco.org/themes/addressing -climate-change/climate-change-education-and-awareness

United Nations Educational, Scientific and Cultural Organisation (UNESCO). (2020). *The UN Decade of Education for Sustainable Development (ESD).* https://en.unesco.org/themes/education-sustainable-development/what-is-esd/un-decade-of-esd

United Nations Educational, Scientific and Cultural Organisation (UNESCO). (2020). *Integrating action for climate empowerment into nationally determined contributions: a short guide for countries*. ED-2020/WS/21 REV. https://unesdoc.unesco.org/ark:/48223/pf0000373762.

United Nations Educational, Scientific and Cultural Organisation's Institute of Statistics (UIS). (2021). *Vanuatu: Literacy rate, 2018.* UNESCO Institute for Statistics. http://uis.unesco.org/en/country/vu

United Nations Educational, Scientific and Cultural Organisation's Institute of Statistics (UIS). (2021). *Vanuatu: Total population by age group, 2018.* UNESCO Institute for Statistics. http://uis.unesco.org/en/country/vu

United Nations Environment Programme (UNEP). (2021). *Why does UN Environment Programme matter?* https://www.unep.org/about-un-environment/why-does-un-environment-matter

United Nations Framework Convention on Climate Change (UNFCCC). (2015). *Report of the Conference of the Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015: Addendum: Decisions adopted by the Conference of the Parties*. https://unfccc.int/sites/default/files/resource/docs/2015/cop21/eng/ 10a01.pdf

United Nations Framework Convention on Climate Change (UNFCCC). (2017). *Submissions to the Paris Committee on Capacity-Building: Vanuatu.*

https://unfccc.int/files/cooperation_and_support/financial_mechanism/standing_committee/application/pdf/vanuatu_pccb_submission_31_7_2017.pdf

United Nations Framework Convention on Climate Change (UNFCCC). (2019). *The Paris Agreement: essential elements*. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

United Nations Framework Convention on Climate Change (UNFCCC). (2020). *The Paris Committee on Capacity Building (PCCB)*. https://unfccc.int/pccb

United Nations Inter-Agency Secretariat of the International Strategy for Disaster Reduction (UN/ISDR). (2005). *Hyogo Framework for Action 2005-2015.* www.unisdr.org/wcdr

United Nations International Children's Emergency Fund (UNICEF). (2020). *UNICEF Education COVID-19 Case Study Fiji and Vanuatu – Responding to overlapping emergencies, 18 November 2020.* https://www.unicef.org/lac/en/media/20166/file

United Nations International Strategy for Disaster Reduction (UNISDR). (2008) *Indigenous knowledge for disaster risk reduction: Good practices and lessons learned from experiences in the Asia-Pacific region.* www.unisdr.org Bangkok, Thailand.

United Nations Office for Disaster Risk Reduction (UNDRR). (2015). *Sendai Framework for Disaster Risk Reduction 2015-2030*. https://www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf

United Nations Office for Disaster Risk Reduction (UNDRR) & Centre for Research on the Epidemiology of Disasters (CRED). (2020). *Human cost of disasters: An overview of the last 20 years 2000-2019*. UNDRR & CRED. https://reliefweb.int/report/world/human-cost-disasters-overview-last-20-years-2000-2019

United Nations Office for Disaster Risk Reduction (UNDRR). (2019). *Strategic approach to capacity development for implementation of the Sendai Framework for Disaster Risk Reduction: a vision of risk-informed sustainable development by 2030: Full Concise Guide.* https://www.preventionweb.net/files/58211_fullconciseguide.pdf

United Nations Office for Disaster Risk Reduction (UNDRR), Prevention Web. (2020). *Capacity Development: Strategic Approach to Capacity Development for Implementation of the Sendai Framework: Section 3. Action Areas for Capacity Development for DRR: 6. 1 Education for Disaster Risk Reduction*. https://www.preventionweb.net/files/58211_section3.6.pdf

United Nations Office for Disaster Risk Reduction (UNDRR). (2021). *Terminology: Disaster and Hazard.* UNDRR, Geneva, Switzerland. https://www.undrr.org/terminology/disaster

United Nations Office for the Coordination of Humanitarian Affairs (OCHA). (2020). UN emergency funding released in response to Tropical Cyclone Harold. *Reliefweb, April 13, 2020*. https://reliefweb. int/report/vanuatu/un-emergency-funding-released-response-tropical-cyclone-harold

United Nations Sustainable Development. (1992). *Agenda 21.* https://sustainabledevelopment.un.org/outcomedocuments/agenda21

United States (US) National Parks Service. (2021). *Gaylord Nelson.* https://www.nps.gov/people/gaylord-nelson-apis.htm

University of the South Pacific – Pacific Technical and Further Education (USP-Pacific TAFE). (2022). *Certificate IV in Resilience (Climate Change Adaptation and Disaster Risk Reduction): Annex 2: Qualification Document Level 4 Resilience.* USP-Pacific TAFE, Suva, Fiji. https://www.usp.ac.fj/pacific-tafe/

University of the South Pacific. (2011). *News: USP – strengthening Pacific's education in climate change.* The University of the South Pacific, Laucala Campus, Suva, Fiji. http://www.usp.com.fj/news/story.php?id=780

Valentin, F., Détroit, F., Spriggs, M. J. & Bedford, S. (2016). Early Lapita skeletons from Vanuatu show Polynesian craniofacial shape: Implications for Remote Oceanic settlement and Lapita origins. *Proceedings of the National Academy of Sciences of the United States of America*, *113*(2), 292–297. https://doi.org/10.1073/pnas.1516186113

Van Houtte, M. (2004). Gender context of the school and study culture, or how the presence of girls affects the achievement of boys. *Educational Studies Vol. 30, No. 4, December 2004* ISSN 305±5698 (print) / ISSN 1465±3400 (online) /04/040409-15. Taylor & Francis Ltd. doi: 10.1080/0305569042000310336

Vanderbilt University Centre for Teaching. (2021). *Student Assessment in Teaching and Learning.* https://cft.vanderbilt.edu/student-assessment-in-teaching-and-learning/

Vanuatu Institute of Technology (VIT). (2019*). Graduate tracer study, Certificate III in Resilience (Climate Change and Disaster Risk Reduction), September 2019*. Unpublished report commissioned by the Department of Foreign Affairs and Trade, Government of Australia.

Vanuatu Institute of Technology (VIT). (2021). *Our courses: CCRE30219: Certificate III in Resilience (Climate Change and Disaster Risk Reduction).* Vanuatu Institute of Technology, Port Vila, Vanuatu. https://vit.edu.vu/our-courses/ccre30219-certificate-iii-in-resilience-climate-change-and-disaster-risk-reduction/

Vanuatu Ministry of Education and Training (MOET), Vanuatu Institute of Technology (VIT), Pacific Community (SPC) & Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. (2018). *Learner Guide, Certificate III in Resilience, Units 5 & 6*. Ministry of Education and Training, Port Vila, Vanuatu.

Vanuatu National Statistics Office (VNSO), Ministry of Finance and Economic Management, Government of Vanuatu. (2021). *2020 National Population and Housing Census: Basic Tables Report, Volume 1*. Vanuatu National Statistics Office, PMB 9019, Port Vila, Vanuatu. www.vnso.gov.vu .

Vanuatu Qualifications Authority (VQA). (2018 and 2019). *Unit of Competency Detail for Certificate I in CCDRR Units 1.1 to 1.7 and 2.1 to 2.4 (CGHR0116, CGCK0216, CGCV0316, CGCC0416, CGCE0516, CGMC0616, CGCA0716, CGHV0116, CGCR0216, CGRM0316 and CGCA0416) and Certificate III in Resilience Units 1 to 9 (CGCS0118, CGPC0218, CGDH0318, CGDK0418, CGIF0518, CGRR0618, CGCB0718, CGSH0818 and CGRA0918).* Vanuatu Qualifications Authority, PO Box 153, Port Vila. https://vqa.edu.vu/index.php/accredited-courses-quick/336-certificate-i-in-climate-change-adaptation-and-disaster-risk-reduction; https://vqa.edu.vu/index.php/accredited-courses-quick/450-ccar30219-certificate-iii-in-resilience-climate-change-and-disaster-risk-reduction

Vanuatu Rainfall and Agro-Meteorology Outlook (VRAO). (2020). *Food donations to Santo and Pentecost*. https://www.facebook.com/groups/ 361220933947896/permalink/ 3831868486883106/

Vare, P. & Scott, W. (2007). Learning for a change: exploring the relationship between education and sustainable development. *Journal of Education for Sustainable Development, Vol 1(2)*: 191–198. doi: 10.1177/097340820700100209

Vaughter, P. (2016). *Unmaking disasters: Education as a tool for disaster response and disaster risk reduction*. United Nations University Institute for the Advanced Study of Sustainability (UNU-IAS) Policy Brief 6/2016. Tokyo, Japan.

Vize, S. (2013). Using education to bring CC Adaptation to Pacific Communities. *Journal of Education for Sustainable Development* 6:2 (2012), 219–235. https://journals.sagepub.com/doi/pdf/10.1177/0973408212475202

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA, USA: Harvard University Press.

Wahlstrom, R. (1998). A Holistic Approach to Environmental Education. *Peace Research*, February 1998, Vol. 30, No. 1, 64-82. Canadian Mennonite University. https://www.jstor.org/stable/23607540

Wajih, S. (2012). *Traditional environmental wisdom and disaster risk reduction.* In: Gupta, A and Nair, S. (Eds). (2012). *Ecosystem Approach to Disaster Risk Reduction*, National Institute of Disaster Management, New Delhi, India. https://www.preventionweb.net/publications/view/26498

Walid, M. (2017). Towards a mega-Pacific island education curriculum for climate adaptation, blending traditional knowledge in modern curriculum. In: Leal Filho, W. (Ed.), 2017, *Climate change adaptation in Pacific countries : Fostering resilience and improving the quality of life* (Climate change management). Cham, Switzerland: Springer. doi:10.1007/978-3-319-50094-2_5

Walshe, R. & Nunn, P. (2012). Integration of indigenous knowledge and disaster risk reduction: A case study from Baie Martelli, Pentecost Island, Vanuatu. *International Journal of Disaster Risk Science 3***,** 185–194. https://doi.org/10.1007/s13753-012-0019-x

Walshe, R., Seng, D., Bumpus, A. & Auffray, J. (2017) Perceptions of adaptation, resilience and climate knowledge in the Pacific – the cases of Samoa, Fiji and Vanuatu. *International Journal of Climate Change Strategies and Management* (IJCCSM) 10: 2, 303-322. https://www.emerald.com/insight/content/ doi/10.1108/IJCCSM-03-2017-0060/full/html

Webb, J. (2020). What difference does disaster risk reduction make? Insights from Vanuatu and Tropical Cyclone Pam. *Regional Environmental Change 2020* 20: 20. https://doi.org/10.1007/s10113-020-01584-y

Weir, T., Dovey, L. & Orcherton, D. (2017). Social and cultural issues raised by climate change in Pacific Island countries: an overview. *Regional Environmental Change 17***,** 1017–1028 (2017). https://doi.org/10.1007/s10113-016-1012-5. https://link.springer.com/article/10.1007/s10113-016-1012-5

Wellington, J. (2000). *Educational Research: Contemporary issues and Practical Approaches.* Continuum Publications, London and New York. ISBN 0-8264-4971-9

Westoby, R., McNamara, K., Kumar, R. & Nunn, P. (2020). From community-based to locally led adaptation: Evidence from Vanuatu. *Ambio.* Springer, 49: 9, 1466–1473. doi: 10.1007/s13280-019-01294-8.

Westoby, R., Clissold, R. & McNamara, K. (2020). Alternative entry points for adaptation: examples from Vanuatu. *Weather, Climate and Society*. American Meteorological Society. https://doi.org/10.1175/wcas-d-20-0064.1

Williams, C. (2007). Research Methods. *Journal of Business and Economic Research,* March 2007, Vol. 5, No.3, 65-71. https://ismirajiani.files.wordpress.com/2012/12/quantitative-qualitative-and-mixed-methods.pdf.

Woodward, K. (2014). *A political memoir of the Anglo-French Condominium of the New Hebrides*. ANU Press, the Australian National University, Canberra. ISBN 9781925021981 (paperback) 9781925022209 (ebook)

World Bank. (2019). *Vanuatu: Population aged 65 and above (% of total population)* https://data.worldbank.org/indicator/SP.POP.65UP.TO.ZS?end=2019&locations=VU&start=1960

World Health Organisation (WHO). (2020). *Listings of WHO's response to COVID-19.* https://www.who.int/news/item/29-06-2020-covidtimeline

World Health Organisation (WHO). (2021). *Classification of Diseases (ICD); List of Official ICD-10 updates.* https://www.who.int/standards/classifications/classification-of-diseases/list-of-official-icd-10-updates

World Population Review. (2020). *2020 World Population by Country*. https://worldpopulationreview.com/

Wrighton, N. (2010). *Participation, power and practice in development: a case study of theoretical doctrines and international agency practice in Tuvalu*. Thesis for Masters in Development Studies submitted to the School of Geography, Environment and Earth Sciences, Victoria University of Wellington, Wellington, New Zealand. http://researcharchive.vuw.ac.nz/xmlui/bitstream/handle/10063/1579/thesis.pdf?sequence=2

Xiao, C. & McCright, A. (2012). Explaining gender differences in concern about environmental problems in the United States. *Society & Natural Resources*, *25*, 1067–1084. doi: 10.1080/08941920.2011.651191

Yilmaz, K. (2013). Comparison of Quantitative and Qualitative Research Traditions: epistemological, theoretical and methodological differences. *European Journal of Education, Vol. 48, No. 2, Adult Learning Systems in a Comparative Perspective (June 2013)*, pp 311-325. https://www.jstor.org/stable/26357806

Zainal, Z. (2007). Case study as a research method. *Jurnal Kemanusiaan bil.9, Jun 2007*. https://jurnalkemanusiaan.utm.my/index.php/kemanusiaan/article/view/165

Zelezny, L., Chua, P. & Aldrich, C. (2000). New ways of thinking about environmentalism: Elaborating on gender differences in environmentalism. *Journal of Social Issues*, *56*, 443–457.