BEYOND STOP DISASTERS 2.0: VIDEO GAMES AS TOOLS TO FOSTER PARTICIPATION IN LEARNING ABOUT DISASTERS AND DISASTER RISK REDUCTION

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Abstract

With the increasing popularity of video games over the last few decades, a significant research area for disaster studies has presented itself. Preliminary disaster video game research explored a multitude of disaster video games from various international organisations (e.g. United Nations Office for Disaster Risk Reduction [UNISDR], United Nations: Educational, Scientific and Cultural Organisation [UNESCO]), governments (e.g. Canada, Australia), non-government organisations (e.g. Save the Children, Christian Aid), researchers (e.g. Earth Observatory of Singapore) and mainstream disaster video games. This preliminary research demonstrated that video games have an ability to convey messages regarding disaster and disaster risk reduction (DRR), including portrayals of hazards, vulnerabilities, capacities and numerous disaster discourses. Yet, there is a paucity of studies on these games in the disaster research literature. Hence, a necessity exists for innovative research to explore how disaster video games could contribute to DRR learning strategies of the future.

This thesis worked to link video games to disaster studies through the sphere of DRR education, participation and the learning theory of constructivism. Unlike conventional video game research approaches, this project conceptualised an innovative participatory methodological framework for video game research. This framework is based upon constructivist learning theory and active learner participation, to better foster the learning process and explore learning from the inside. Utilising this framework, this research considered how various 'serious' disaster video games (*Quake Safe House, Earth Girl 2, Sai Fah – The Flood Fighter, Stop Disasters!)* in educational environments like museums and schools, could foster player participation in learning about disaster and DRR. The perspectives of museum visitors (Te Papa in Wellington and Quake City in Christchurch), students (four Hawke's Bay school) and teachers, indicate the strengths and challenges of such video games in regards to game content, game mechanics, skill-building, player motivations and social interactions. These findings indicate video games cannot be stand-alone tools for the purpose of building disaster awareness in players.

Video games require greater integration into the teaching and learning processes to minimise the potential risk of such video games becoming tokenistic learning tools. The initial research findings were tested with academics, teachers, students and emergency management personnel in co-designing a teaching pedagogy, involving several group-based learning activities and a geo-referenced *Minecraft* world, to engage students in learning about disaster and DRR within their local area. Ultimately, the needs of the players and educators need to be factored in both the video game design and development process, and associated teaching and learning pedagogy, in order to foster meaningful player participation in learning about disaster and DRR.

Therefore, this thesis puts forward the argument that video games need to be repositioned from being perceived by scholars, educators and DRR practitioners as simply tokenistic learning activities to fully integrating video games within teaching pedagogy and the broader learning process. In turn, the empirical evidence collected from three case studies, forming the basis of this research project, highlights how disaster video games can facilitate deeper engagement and understanding of disasters and DRR when social interactions, metagaming and gameplay, are taken into more serious consideration. Thereby, demonstrating how disaster video games could potentially contribute to DRR learning strategies of the future, becoming a new cadre to the existing DRR education tool kit.

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Chapter 1 Introduction

1.1 Introduction

'*In the days of Atys the son of Manes, there was great scarcity through the whole land of Lydia. For some time the Lydians bore the affliction patiently, but finding that it did not pass away, they set to work to devise remedies for the evil. Various expedients were discovered by various persons; dice, and (knuckle)-bones, and ball, and all such games were invented, except tables, the invention of which they do not claim as theirs. The plan adopted against the famine was to engage in games one day so entirely as not to feel any craving for food, and the next day to eat and abstain from games. In this way they passed eighteen years. Still the affliction continued and even became more grievous. So the king determined to divide the nation in half, and to make the two portions draw lots, the one to stay, the other to leave the land. He would continue to reign over those whose lot it should be to remain behind; the emigrants should have his son Tyrrhenus for their leader. The lot was cast, and they who had to emigrate went down to Smyrna, and built themselves ships, in which, after they had put on board all needful stores, they sailed away in search of new homes and better sustenance*' (Rawlinson, 1861, p. 181-182).

The account of the Ancient Greek historian Herodotus, as translated by Rawlinson (1861), suggests disasters and games are inherently linked. For the Lydians, the invention of games and the immersive power of play and social interaction, presented the population with tools to enhance their capacities during the 18 years famine due to climate cooling (McGonigal, 2011). As such, the Lydians use of games seems akin to a disaster risk reduction (DRR) strategy. McGonigal (2011) suggests three key values emerged from the use of games by the Lydians. Primarily, the games raised the quality of life in a time of adversity, providing positive emotions, experiences and social connections. Further, the rules of the games, play on one day and eat on another, enabled the coordination of scarce resources, social cooperation and civic participation. Finally, games introduced the Lydians to conceptualising and practicing a more sustainable way of life. Beyond what these games achieved, notably these games did not solve the problem of famine and the collapse of the food supply, nor did the games allow for the testing and development of new methods to get or make food. However, in modern-day society, games at large are being developed to support the solving of real problems and driving collective action toward scientific, social, economic and environmental challenges (McGonigal, 2011).

The account of Herodotus not only supports the idea that games are part of human culture but also supports the claims of Huizinga (1950), whereby play is a necessary cultural activity (Becker, 2017). Importantly, scholars like Rieber (1996) suggest that the playing of games is a natural way to learn[1]. Therefore, games can serve as mechanisms for learning (Becker, 2017; Gee, 2007; Young et al., 2012). Scholarship demonstrates that video games are one of several innovative tools that can foster player participation in learning (Becker, 2017; Gee, 2007; Schifter & Cipollone, 2015; Squire, 2005; Young et al., 2012). Primarily, this can be linked to games having: 1/ a goal to provide players with a purpose; 2/ rules that unleash creativity and foster strategic thinking; 3/ a feedback system to motivate to keep playing and demonstrate that the goal is achievable; and 4/ voluntary participation, where a game can be freely entered or left when tasked with intentionally and challenging gameplay, to provide a fun experience (Kapp, 2012; McGonigal, 2011). In today's ever-increasing technology-driven society, video game designers and developers have ascended to powerful positions in society, whereby they have honed their craft, creating immersive and engaging video games that facilitate cooperation and collaboration, while continually innovating new methods to motivate players in problem-solving complex challenges (McGonigal, 2011).

Unlike mainstream video games that are developed for entertainment, 'serious' video games aim to engage players in attaining purposeful learning outcomes. International organisations (e.g. United Nations Office for Disaster Risk Reduction [UNDRR][2], United

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[1] Learning is a process of continual active engagement through practice, thinking and conversation, forming a foundational basis of understanding and knowledge. Understandings are built upon and challenged through social interactions, contributing toward learner defined learning outcomes and motivations.

[2] On 1 May 2019, The United Nations Office for Disaster Risk Reduction officially changed its acronym from UNISDR to UNDRR. This thesis retains the acronym UNISDR, where appropriate, for consistency with the published chapters.

Nations: Educational, Scientific and Cultural Organisation [UNESCO]), governmental organisations (e.g. Canada, Australia), non-government organisations (e.g. Save the Children, Christian Aid), and researchers (e.g. Earth Observatory of Singapore, Lewis and Clark College) are developing 'serious' disaster video games to raise player awareness of disaster and DRR (Gampell & Gaillard, 2016; Solinska-Nowak et al., 2018). However, the literature implies that such 'serious' disaster video games are often one-off deliverables, receiving no follow-up research to investigate or formally assess the effectiveness of these games on building disaster and DRR awareness. In contrast, scholars like Gee (2005a, 2005b, 2007) argue that mainstream video games still embody deep and meaningful learning practices, even though this is not the primary aim. Complex mainstream video games that task the players with the simple goal of survival, like role-playing games (RPG) (e.g. *Fallout 4*) or simulation games (e.g. *Frostpunk*), can portray disaster concepts and discourses, without the intention to impart disaster awareness in players. However, again there is limited research to examine their ability to foster player engagement in learning about disasters.

This thesis builds upon the preliminary research of Gampell and Gaillard (2016), to explore how disaster video games both 'serious' and mainstream can foster participation in learning about disaster and DRR. It intends to address emerging themes and bridge several understudied gaps in knowledge surrounding video games as disaster learning tools with empirical evidence. While there is an increasing pursuit by game developers, educators and organisations to harness the power of video games for the purposes of learning about disasters and DRR, current methods of teaching are not configured adequately to ensure gaming is not merely a tokenistic teaching and learning activity (Becker, 2017; Cohen, 2011; Young et al., 2012). To echo the concerns of McGonigal (2011), people who write-off games as time-wasting activities, risk understanding how the immersive and experimental power of games can provide opportunities for problem-solving, creating new experiences and addressing real-world challenges. Therefore, this thesis puts forward the argument that video games need to be repositioned from being perceived by scholars, educators and DRR practitioners as simply tokenistic learning activities to fully integrating video games within teaching pedagogy and the broader learning process. In turn, the empirical evidence collected from three case studies, forming the basis of this research project, highlights how disaster video games can facilitate deeper engagement and understanding of disasters and DRR when social interactions, metagaming and gameplay, are taken into more serious consideration.

This introductory chapter commences with section 1.2, presenting an overview of disasters and DRR. The approaches of DRR education toward the integration of disaster and DRR knowledge into educational environments like museums and schools are also presented. Section 1.3 introduces the role of ancient games in human culture toward the 'serious' and mainstream video games of today. The section also demonstrates their connection to learning, in terms of game-based learning and game-based pedagogy. Section 1.4 begins to pull together video games and disaster through the lens of disaster popular culture. Section 1.5 develops the rationale behind undertaking this thesis, with section 1.6 detailing the research aims and objectives. Section 1.7 outlines constructivism as the epistemological foundation of the thesis, while section 1.8 conceptualises the methodological framework employed, reflective of participatory techniques and constructivist principles. Section 1.9 provides contextual information regarding the three case studies, including two New Zealand Museums and several schools located in Hawke's Bay, alongside the video games utilised within these case studies. Section 1.10 highlights the research significance of this thesis, followed by section 1.11 that concludes this chapter with the overarching thesis structure.

1.2 A brief overview of disasters and disaster risk reduction

Natural hazards like floods, fires, earthquakes and tsunamis, are commonly associated with disasters. A disaster is frequently described as creating serious disruption to the functioning of a community[3] or society, due to hazardous events interacting with conditions of exposure, vulnerability and capacities, affecting livelihoods, and causing damages and/ or casualties that exceed the coping abilities of the affected area or people (Quarantelli, 1998; United Nations International Strategy for Disaster Reduction

[3] 'Community' is an inherently paradoxical and elusive term, escaping making clear definitions about the particular group of people (Titz et al., 2018). While the term is retained within definitions of disaster and disaster risk, efforts have been made in the thesis, where possible, to clearly define the group or approach.

[UNISDR], 2017; Wisner et al., 2012). Hence, a hazard becomes a disaster as the impact of the hazard threatens the lives and livelihoods of vulnerable and marginalised people who lack access to resources and protection measures (Cannon, 1994; Chmutina & von Meding, 2019; Gaillard, 2015; Hewitt, 1983; Jackson et al., 2017; Peek, 2008).

The close association of natural hazards to disasters has influenced the approach of disaster research. Traditionally, disaster research has been conducted with a dominant hazard focused approach, otherwise known as the hazard paradigm (Gaillard & Mercer, 2013; Hewitt, 1983). The hazard paradigm was mainly driven by science and technology measures focused upon the mitigation of the physical hazard (Gaillard & Mercer, 2013; Jackson et al., 2017). Problematically, the hazard paradigm separates disasters from everyday life, asserting that disasters result from extreme and unpredictable natural hazards due to people having insufficient levels of risk perception (Gaillard & Mercer, 2013; Hewitt, 1983; Kates & Clark, 1996; Wisner et al., 2004).

The competing vulnerability paradigm moves beyond focusing upon the occurrence of natural hazards and instead recognises that people's disaster risk stems from an unequal distribution and access to resources and power within society (Gaillard & Mercer, 2013; Gaillard et al., 2019; Hewitt, 1983; Jackson et al., 2017; O'Keefe et al., 1976; Wisner et al., 2004). People's vulnerability is shaped by political, economic and social factors, which constrains their access to resources, leading to their marginalisation in society (Gaillard, 2010; Wisner et al., 2012). Disaster scholars, therefore, argue against the disconnection of disasters from everyday life (Gaillard, 2010; Mercer, 2010; Wisner et al., 2004). To better address disaster risk, disaster research needs to consider vulnerability and emphasise the surrounding social environment versus focusing upon the natural hazard (Wisner et al., 2004; Wisner et al., 2012).

Disaster risk refers to the potential disaster losses, in lives, livelihoods, assets, occurring in a community or a society over some specified period (UNISDR, 2009). Primarily, disaster risk is a function of hazard and vulnerability (Kelman, 2018). A hazard is 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' (UNISDR, 2017). Whereas, vulnerability refers to the susceptibility or condition of a person, group or society, upon which the impacts of a hazard outweigh their capacities to anticipate, cope with, resist and recover (Cannon, 1994; Gaillard, 2010; Wisner et al., 2004). Capacities reflect the set of diverse knowledge, skills and resources people can claim, access and fall back on when dealing with hazards and disasters (Gaillard et al., 2019). Notably, capacities are not the opposites to vulnerability (Wisner et al., 2012), but rather capacities are an extension of everyday life. This means everyone, even the most vulnerable and marginalised, has some capacities in facing hazards and disasters (Gaillard et al., 2019). Therefore, strategies to reduce the risk of disaster should directly involve those concerned to identify their capacities and vulnerabilities rather than enforcing an approach that cannot address the root causes of their disaster risk.

UNISDR (2009) defined DRR as 'the concept and practice of reducing disaster risks through systematic efforts to analyse and manage causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and environment, and improved preparedness for adverse events' (UNISDR, 2009, pg. 10-11). To address disaster risk, the three approaches to DRR, prevention, mitigation and preparedness, must complement, build upon and work in unison to reduce the impacts from a disaster through hazard prevention, vulnerability reduction and enhancing capacities (Gaillard & Mercer, 2013; Solecki et al., 2011). Problematically, the hazard paradigm continues to be the dominant approach at both international and national levels. Scholars have critiqued the failures of hazard-focused research in considering how social and economic frameworks generate vulnerability (Mercer, 2010; Wisner et al., 2004). Therefore, the conceptual differences between the hazard and vulnerability paradigms affect the implementation of DRR measures (Jackson et al., 2017). Jackson et al. (2017) suggest by framing disasters as 'natural', DRR measures cannot address the root causes of vulnerability and instead will only result in reactive management to the hazard. Hence, scholars' comment that the separation of disasters from broader socio-cultural, economic, environmental and political contexts is a barrier to effective DRR strategies toward the reduction of vulnerability and enhancement of capacities (Schipper & Pelling, 2006; Weichselgartner & Pigeon, 2015).

1.2.1 Disaster risk reduction education

The Sendai Framework for Disaster Risk Reduction, and previously the Hyogo Framework for Action, refer to education as a priority strategy for reducing the risk of disasters (Aghaei et al., 2018; UNISDR, 2007, 2015). Wisner (2006) positions education as encompassing both formal and informal knowledge sharing and the engagement of groups of people like children, youth or professionals. Educational environments include not only formal public and private school systems but also through public discourse within museums. Since the 1970s, DRR education has aimed to facilitate people's engagement in disaster risk awareness. Initially, scientists and technical experts produced brochures, handbooks and lesson plans for 'community outreach', awareness campaigns and classroom teaching on a small scale (Petal, 2008). The International Decade of Natural Disaster Reduction during the 1990s saw the emergence of significant awareness-raising efforts and hazard education in schools. However, this was again directed from the top-down (Petal, 2008). Unfortunately, the assessments conducted at the end of this period revealed disaster knowledge was not translating into practice (Petal, 2007, 2008). Theoretically, DRR strategies like DRR education should integrate various people's perspectives in the process (Gaillard et al., 2015; UNISDR, 2015a, United Nations International Strategy for Disaster Reduction Science and Technical Advisory Group [UNISDR STAG], 2015). However, in reality, scientific and technical personnel approach the development of educational materials from the top-down, neglecting the bottom-up perspectives of teachers and students (Luna, 2017; Petal, 2007, 2008). Problematically, the ever-increasing plethora of new DRR educational material like booklets, games, posters and activities for children and the general public are still heavily top-down initiatives, lacking testing and evaluation to determine their potential to foster disaster risk awareness (Petal, 2008). The following two sub-subsections outline the potential provision of DRR education within museums and schools.

1.2.1.1 Disaster risk reduction education in museums

Museums Aotearoa (2005) assert that the educational role of museums lies at the core of their public service. Scholars suggest museums are increasingly shifting their focus toward addressing visitor needs, enthusiasms and contemporary social issues like popular culture or environmental concerns (Filippoupoliti & Sylaiou, 2015; Hein, 2006). Museums are engaging with a diverse, multicultural landscape. They are increasing efforts to exhibit and embrace the everyday experience of ordinary people, inclusive of marginalised audiences rather than having a sole focus upon the canon of knowledge (Filippoupoliti & Sylaiou, 2015; Hein, 2006). Museum scholarship reflects this increase in the emphasis, popularity and standard inclusion of interactive and multisensory exhibits (Brabazon, 2006; Hein, 2006; Lui, 2011; Moore, 1997). Significantly, museum curators and collections aim to appeal to the everyday person or child, regardless of their status within or from the school education system (Hein, 2006). Considering DRR as a human right, museums have a duty to act as a public institution for people to engage in and access information to enhance their knowledge of disaster and DRR (McGhie, 2020).

Museums can provide people with access to information on past events, the skills needed to deal with them, alongside the exploration of past and current challenges and sources of disaster risk (McGhie, 2020). Therefore, the ten essentials for making cities resilient (see UNISDR, 2015b), which aligns with the Sendai Framework, provides museums with a practical framework to implement DRR at the local level (McGhie, 2020). McGhie (2020) details methods for museums to achieve these ten essentials. In particular, the provision of educational and awareness-raising programmes and facilities to enable people's participation in understanding how vulnerability influences not only their disaster risk but also minority and indigenous groups. As such, museums can play a crucial role in supporting the efforts of DRR education and fostering people's participation in DRR (McGhie, 2020). Thereby, museums can create an inclusive space for discovery-based learning, through visitor interactions with exhibitions/ displays and structured learning, via targeted education activities and programmes (Filippoupoliti & Sylaiou, 2015; Museums Aotearoa, 2005), that can offer an opportunity to enhance the capacities of all museum visitors in facing and managing disasters (McGhie, 2020).

1.2.1.2 Disaster risk reduction education in schools

Scholarship positions children and youth as a distinctly vulnerable group (Amri et al., 2017; Delicado et al., 2017; Peek, 2008; Ronoh, 2017), although, children are not merely passive 'victims' in confronting disaster (Anderson, 2005; Peek, 2008). Literature supports children holding unique ideas, knowledge and perspectives about their environment and disaster risks (Delicado et al., 2017; Gaillard & Pangilinan, 2010), and therefore, the participation of children and youth in DRR (Hart, 1992). The Sendai Framework for Disaster Risk Reduction formally acknowledges the role of children and youth as 'drivers of change', advocating for their contribution toward DRR, in accordance to legislation, national practise and educational curricula (UNISDR, 2015a). Yet child-centred DRR approaches are generally driven by adults, with children primarily excluded from the decision-making process and their DRR knowledge disassociated (Anderson, 2005; Peek, 2008). Children do not set the agenda, conduct the research, make policy decisions or hold positions of power. However, there is growing anecdotal evidence of children's agency in DRR when supported by adults (Amri et al., 2017; Delica, 1998). Children can use their knowledge and skills to protect themselves and others from danger, while additionally promoting DRR within their communities. In practice, children should have a platform to participate and be engaged in DRR initiatives that work to build their disaster awareness and reduce disaster risk upon their terms.

Outside of the home, children spend the majority of their time at school (Bhebhe et al., 2019). Therefore, Wisner (2006) propositions that students, from primary school to university, can actively work with teachers and local people to explore hazards, vulnerability and capacities. Increasingly, there is a call for the integration of DRR knowledge into not only the curricula of schools and universities but also within the public and professional education institutes (UNDRR, 2019). The educational curriculum and teaching pedagogy are rationalised as primary drivers for engaging students in disaster-related knowledge (Wisner, 2006). Ronan (2014) commented that 72% of reporting countries for the 2013 Global Assessment Report (GAR) indicated the inclusion of DRR in the national educational curriculum. However, the core indicators and self-reporting process may not accurately report the actual level of curricula uptake across a country. While disaster awareness and DRR are national priorities, students could complete their education without exposure to disaster educational material (Johnson, 2011; Selby & Kagawa, 2012).

Additionally, the curriculum works within an educational system. Hence, the ability for the successful dissemination of information relies upon the functionality of the overall educational system (Wisner, 2006). Wisner (2006) outlined that school disaster curricula are often earth science focused or preparedness and drill centred with few integrating the two focuses. Fewer develop their local curriculum and even fewer study the school's hazards and 'communities' (Wisner, 2006). However, to mainstream DRR education within the curriculum, teachers must also have an understanding of disaster and DRR (Luna, 2012). Therefore, the integration of disaster and DRR into the curriculum requires trained teachers, supported with teaching and learning materials, influenced by their inclusion in DRR planning, to increase hazard awareness and behaviour change from the classroom to the 'community' (Luna, 2012; Mutch, 2014; Wisner, 2006).

Wisner (2006) suggests active, experiential learning, as an effective learning method, should feature in a disaster curriculum. Although, due to the need for teachers to ensure students cover all necessary material for the examination, the current curriculum design and commonly observed top-down, passive student learning via transmission-orientated teaching approaches do not enable students opportunities to actively engage and critically investigate topics (Ültanır, 2012) like disaster concepts within their local area. DRR education must, therefore, navigate several challenges, including but not limited to, the lack of disaster prevention literacy of stakeholders (authorities, teachers, students and the public), a lack of disaster and DRR education in the formal curriculum alongside minimal assessments by researchers, organisations and practitioners surrounding the effectiveness of DRR education methods (Aghaei et al., 2018; Petal, 2008).

1.3 Ancient board games to 'serious' and mainstream video games

Cultural anthropology positions games as being culturally universal, found throughout history and the globe (Mäyrä, 2008). However, knowledge is limited about the games played in the ancient world due to a lack of necessary information like game names, rules, origins, geographical distribution or time period (Sebbane, 2001). Board games are amongst the earliest and seemingly most popular games from the ancient world – found throughout Egypt, Greece, Persia, and Rome, and played by people from all classes ranging from emperors to children (Kowalski, 2004; Mäyrä, 2008; Sebbane, 2001). Ancient board games are classed as games of chance, race and strategy (Kowalski, 2004). The ancient Greek game *astragalos, tali* to the Romans, or more commonly known today as knucklebones, is possibly the first game with scoring rules (Kowalski, 2004). Early anthropologists related ancient games to religious elements. Scholars believe priests and priestesses used games like *tali* in ancient divination practices, similar to modern-day practices in some European and African groups (Kowalski, 2004; Mäyrä, 2008). Dice games are attributed to the ancient Egyptians, dating back to the *Royal Game of Ur* in around 2560 BCE. The Egyptian board game *senet* (played around 2400 BCE and similar to backgammon), became popular with Romans. They modified the game to be played with three dice and eventually devolved to two dice as seen in modern-day board games (Kowalski, 2004). *Mancala,* dating back to 5000BCE and a possible precursor of *senet,* involves mathematical strategy but is played without dice. Today, several variations of *Mancala* are found across the globe. Strikingly, the number of ancient board games signifies their immense popularity in the ancient world, not only as an enjoyable pastime but also as a mechanism for learning (Becker, 2017; Kowalski, 2004; McGonigal, 2011). However, different societies throughout history have perceived the immersive power of games to be both positive and negative (Mäyrä, 2008). As such, games have seen laws and restrictions integrated to minimise their perceived disruptive effects on society like gambling (Mäyrä, 2008). Regardless, the diversity of ancient board games, alongside their evolution into modern-day games, conveys that games are a common cultural pillar of human society (Becker, 2017; Kowalski, 2004).

Gaming (referred to here in regards to video games) has evolved from a spare-time activity of a small social group into a primary entertainment industry of modern society (Brand et al., 2019; Quandt et al., 2015). Video games are interactive systems, situated around a set of rules that engages players in overcoming challenges while receiving feedback to monitor progress toward the achievement of an overall goal (Clark et al., 2016; Kapp, 2012). In 1962, a group of students from Massachusetts Institute of Technology developed the first 'video game' *Spacewar!.* However, it was not until the integrated circuit was available in 1971, that the video game industry was born (Brand et al., 2019; Wolf, 2012, 2017). *Spacewar!*, gave rise to two derivative versions developed as coin-operated video games. The first being *Galaxy Game* in 1971, followed by *Computer Space,* which became the first commercial coin-operated video arcade game (Wolf, 2012). In 1972, video games entered the home with Atari releasing the first home console *PONG* (Wolf, 2012). Despite the exhilaration and enthusiasm surrounding video games, the industry experienced an initial crash in 1977, before the success of *Space Invaders* in 1978 and subsequently packaged with the Atari VCS 2600 as the first console game bundle (Wolf, 2012). The release of *Space Invaders* rang in the golden age of video arcade games with overwhelming commercial and mainstream success until the 1982/ 1983 video game industry crash that primarily affected the United States. Poorly designed video games and a mentally of 'quantity not quality' had a severe impact upon the industry until the release of the Nintendo Entertainment System (NES) in 1985 (Martinet et al., 2020; Wolf, 2012). Since then, video games have become a globally ubiquitous feature in society, no longer restricted to home consoles or computers but extending to new platforms like smartphones and the internet (de Aguilera & Mendiz, 2003; Beavis, 2017; Brand et al., 2019; McGonigal, 2011; Sanford et al., 2015; Wolf, 2012).

Games at large, but video games especially, hold a central role within mainstream popular culture (Becker, 2017; Quandt et al., 2015; Wolf, 2017). The late 1970's/ early 80's saw video game adaptations of movies and television shows, and subsequently, popular video game characters like *Pac-Man* began featuring in films and television shows (Wolf, 2017). Today, video games have entered into comics, board games and even has active communities of fans attending international festivals, playing online together or dedicated internet sites (Brand et al., 2019). Significantly, the infiltration of video games from their virtual realms into various aspects of culture signals the need to integrate video games into everyday life as platforms to facilitate collaboration and participation to achieve meaningful outcomes for society (McGonigal, 2011).

Despite the ever-increasing popularity of video games, they have often been subject to significant challenges and controversy. Historically, ancient board games experienced similar debates and concerns (Mäyrä, 2008). Governments, parents, educators, health practitioners and the media have often discredited video games as learning tools, based on unproven claims that video game content is associated with negative social behaviours like violence and addiction (de Aguilera & Mendiz, 2003; Granic et al., 2014; Ivory, 2013; Quandt et al., 2015; Sanford et al., 2015). Current research is pushing back upon such claims with longitudinal studies demonstrating there are no links between violent video game content and violent behaviour (Drummond et al., 2020). Although the debate continues, research shows many people consider video games to have a less detrimental effect on people's behaviour and more significant beneficial effects like problem-solving and learning (Quandt et al., 2015).

While games are challenging to define, there is an acknowledgement that games are potent vehicles for play, with play recognised as an essential mediator for learning (Becker, 2017; Brand et al., 2019; Reiber, 1996). The connection between games and learning is not a contemporary phenomenon (Salen, 2008). There was initial optimism during the late 1980s for video games to deliver educational experiences, except video game design could not match these expectations. As a result, formal education began distancing itself from the use of video games for learning (Becker, 2017). However, research from around 2014 shows a re-emergence of video games as potential learning tools (Beavis, 2017; Becker, 2017; Brand et al., 2019; Clark et al., 2016; Sanford et al., 2015). Academics, educators and video game developers have tried to develop video games with an emphasis upon education rather than entertainment, often referred to as 'serious' games (Becker, 2017; Sanford et al., 2015). 'Serious' video games are used in various educational and training environments, including but not limited to schools, medicine and the military (Brand et al., 2019; Sanford et al., 2015). For educators, 'serious' games can address global issues like world hunger, homelessness or disasters and have clear learning objectives (Sanford et al., 2015). Although mainstream games are primarily designed for entertainment, their game design naturally embodies deep and meaningful learning practices (Gee, 2003, 2005a, 2005b, 2007). Hence, mainstream video games could provide educators with more significant opportunities to engage students and foster critical thought and reflection (Gee, 2003, 2005a, 2005b, 2007; Kapp et al., 2014; Schifter et al., 2013; Squire, 2006).

Although, scholars have advocated for the ability of mainstream video games to foster deep learning and complex problem-solving (Gee, 2005a, 2005b; Squire 2008), some educators and 'serious' game developers are not necessarily convinced (Beavis, 2017; Sanchez, 2014; Sanford et al., 2015). Wouters et al. (2013) found that while 'serious' games were more effective versus traditional methods of learning and retention, they were no more motivating. Further, the content and design of 'serious' games can be problematic, risking to trivialise the significance of the game content through simplification and lack of immersion (Sanford et al., 2015). However, video game researchers universally acknowledge that video games can engage and challenge players, provide players with complex representations and experiences, foster collaborative learning, promote deep and meaningful understandings while also enabling curriculum and learning that connects with youth (Beavis, 2017; Gee, 2007). More pressing is how video games, both 'serious' and mainstream, can support teaching and learning.

1.3.1 Connecting video games to game-based learning and game-based pedagogy

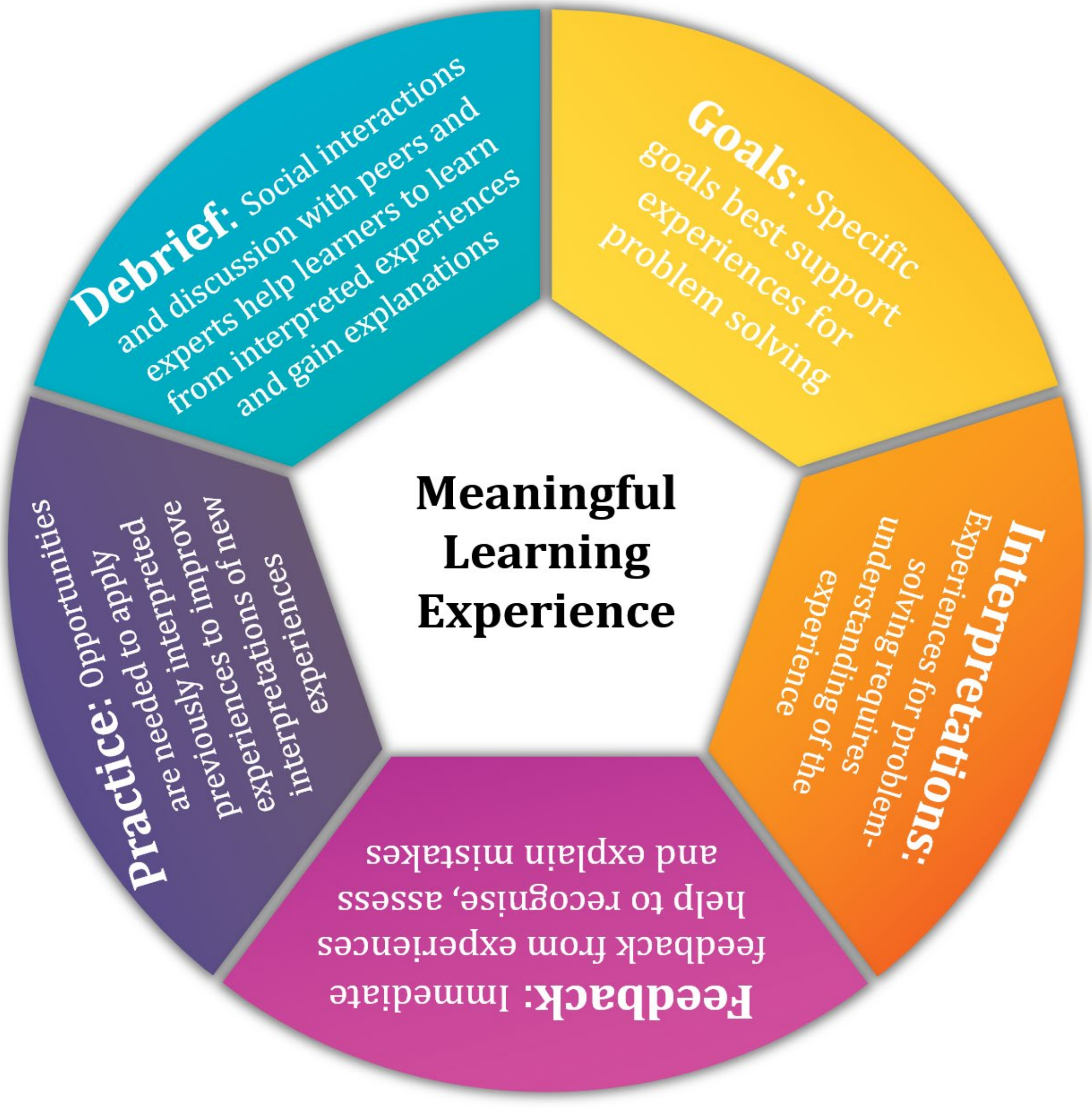
Education has seemingly gone beyond the acquisition of necessary literacy skills toward high ability literacy skills like critical interaction and complex problem-solving (Salen, 2008). Therefore, the pedagogical approach to support this transition requires changes toward not only the approach in accessing and analysing information but also the tools and technologies involved (Salen, 2008). Nousiainen et al. (2018) note that in twenty-first century education there is an increase in, and expectation of teachers to use novel methods, technologies and tools to engage learners and promote their key competencies (Kapp, 2012). Video games are these tools, except video games need to be better understood beyond the claim that all video games teach and all video games prompt learning (Becker, 2017). Despite the emerging evidence to support video games, both 'serious' and mainstream, in offering opportunities for teaching and learning, this does not result in a guaranteed learning experience (Clark et al., 2016; Nousianen et al., 2018; Turkay et al., 2014; Wouters et al., 2013). With research still suggesting a video game's effectiveness stems solely from the game's effect, video game research around learning must move beyond a simple analysis or proof of concept toward exploring how theoretical design decisions, in terms of the video game and teaching pedagogy, can influence learning outcomes (Clark et al., 2016; Salen, 2008; Young et al., 2012).

Scholars like Gee (2008) argue that meaningful learning, and therefore a well-designed video game, needs to meet five conditions, namely goals, interpretations, feedback, practice and debriefing (Figure 1.1). However, similar to how learning goes beyond the confines of the classroom, the concept of learning through gaming should also be recognised as going beyond the video game (Salen, 2008). Ultimately, there is little knowledge upon how video games can be effectively utilised for learning within educational contexts like schools and museums (Beavis, 2017). For example, Nousiainen et al. (2018) highlight the underrepresentation of the teacher's role in enhancing the potential benefits of video games on learning outcomes in the literature. Yet, the success of a video game as a classroom-learning tool is highly dependent upon the teacher (Prestridge, 2017). Significantly, if a teacher does not have sufficient knowledge about video games at large, or competence to adapt their teaching beliefs and pedagogies, there is an immense risk that the video game becomes a novelty rather than a powerful teaching and learning tool (Becker, 2017; Nousiainen et al., 2018). Hence, there is an urgent requirement to understand and recognise the multi-dimensional nature of video games and their influence upon teaching and learning.

Becker (2017) suggests that to understand how learning can be achieved through games, one must consider their connection from two different perspectives, the learner and the teacher. In other words, game-based learning (how people learn from games) and game-based pedagogy (how people can teach with games). Game-based learning and game-based pedagogy are interrelated and complementary, similar to the ancient Chinese philosophy of Yin-Yang (Figure 1.2). Numerous learning theory categories (behaviourism, cognitivism, humanism, constructivism, social learning) and instructional approaches (didactic, instructionist, cognitive, hermeneutic, bricolage) underpin both of these perspectives (Becker, 2017; Wu et al., 2012). Notably, the principles contained within these theories are not fixed and overlap in different areas. While this can create specific challenges in the research process, the application and combination of different principles may serve to generate richer understandings of game-based learning (Wu et al., 2012). Therefore, Section 1.7 outlines constructivism, in particular cognitive and social constructivism, as the epistemological approach underpinning this thesis and

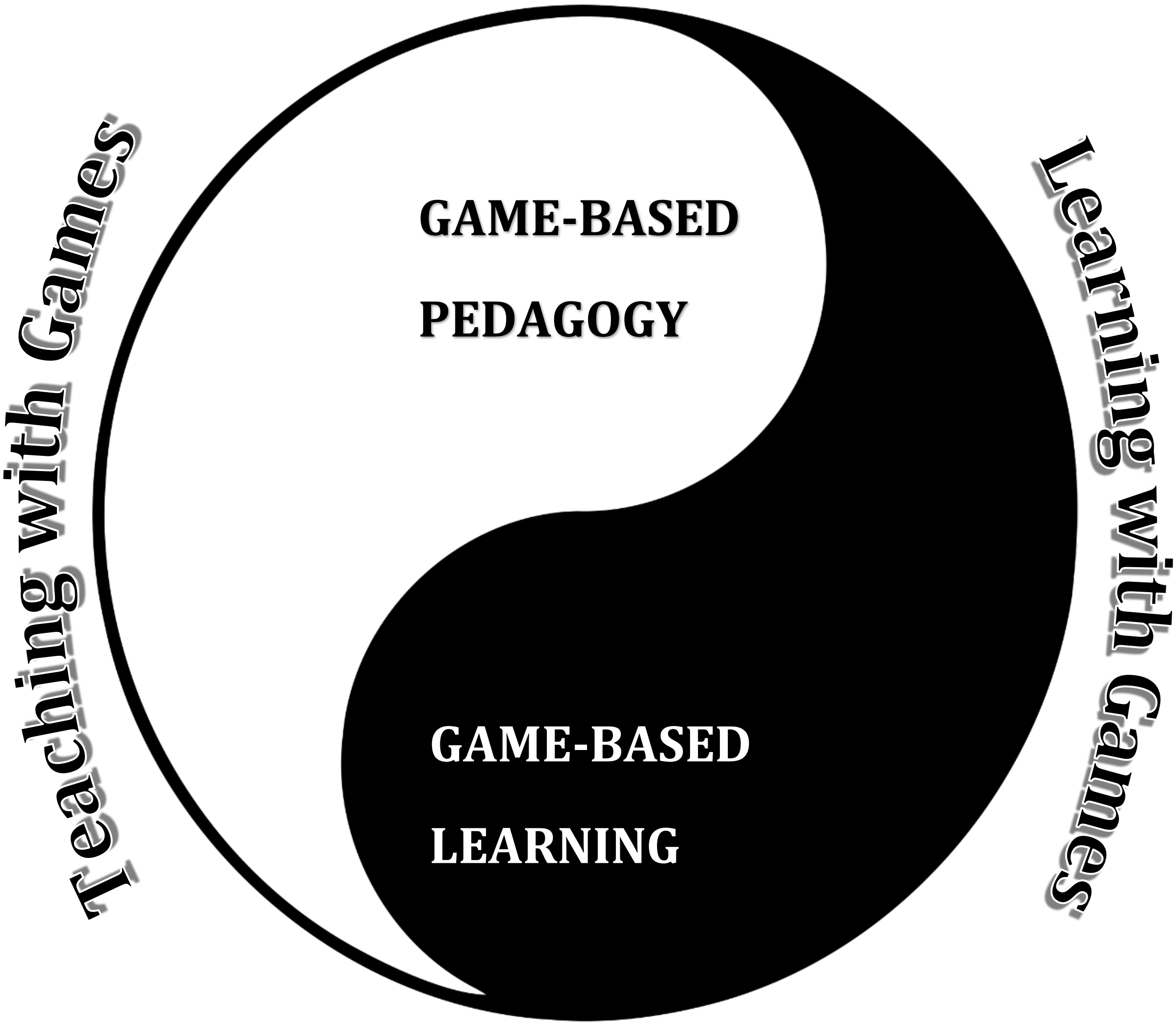
Section 1.8 as the participatory methodological approach in an attempt to attain deeper understanding toward how video games can be used as learning tools.

Figure 1.1: Five elements and their learning conditions for a well-designed video game to facilitate meaningful learning experiences



Source: Adapted from Gee (2008)

Figure 1.2: Conceptualising the relationship of game-based learning and game-based pedagogy



Source: Adapted from Becker (2017)

1.4 Connecting video games to disasters through disaster popular culture

The popularity of video games amongst people of all ages, genders and nationalities, alongside society's fascination with disasters (Quarantelli & Davis, 2011), allows the connection of video games and disasters through the lens of disaster popular culture. The prominence of disasters within popular culture can shape peoples' knowledge of disasters and their response (Webb, 1998; Wisner et al., 2004). As such, disaster popular culture captures critical cultural dimensions and perceptions, allowing researchers an insight into how people conceptualise and reflect upon disasters within everyday life (Gampell & Gaillard, 2016; Quarantelli & Davis, 2011; Wachtendorf, 1999; Webb, 1998, 2007). However, research into popular culture is not straight forward as the continuous evolution of what is and what is not considered popular, makes this an extremely active research area (Dynes, 2000; Quarantelli & Davis, 2011; Webb, 2007). Researchers must recognise that 'the people' will always know more than the academics trying to understand and conduct research within this area (Brabazon, 2006). Webb (2007) suggests disaster popular culture researchers must understand how disasters are interpreted through various contexts. As such, consideration is needed for how the vast depiction of disasters within movies, books, music videos, the media and video games are produced, by whom and how the content can influence people's perceptions of disasters. Researchers suggest that the development of pre-planned and strategically distributed disaster popular culture items by people from outside of a disaster area can create negative stereotypes of race, class and gender, whereas local survivor popular culture often reflects messages of unity (Wachtendorf, 1999; Webb, 2007). Therefore, it is essential to consider the discourses being presented through various disaster video games and how this may influence the development of disaster and DRR awareness in players.

Several 'serious' and mainstream disaster video games reflect the concerns of scholars regarding the particular negative discourses that can be portrayed. 'Serious' disaster video games often reflect the top-down and technocratic approaches of the specific organisation responsible for funding video games development. Such 'serious' video games may not acknowledge any underlying social dimensions that contribute toward people's vulnerability, or they may treat natural hazards as compartmentalised events.

Mainstream disaster video games can reflect various disaster myths around scapegoating and looting, with over exaggerations of a natural hazard (Gampell & Gaillard, 2016). However, with consideration to the suggestion of Webb (2007), the interpretation of disasters in these cases may not necessarily have a negative influence upon people's understanding of disasters but could spark meaningful discussions. For example, *Mafia III* is a mainstream video game set in 1968 within the fictional location of New Bordeaux, based upon the real city of New Orleans, where racism and bigotry are integrated into the game design and game mechanics. Significantly, *Mafia III* provocatively confronts gamers of different ages and ethnicities with the racial and political history of the era (Leonard, 2020). Players experience challenges within the game world, like areas denoted for 'whites-only' or increased police attention when moving through a white suburb. Beyond this, Delray Hollow, a predominately black suburb in the southwest region of New Bordeaux reflects the impacts of natural hazards, particularly Hurricane Barbara which has left parts of the area flooded, loss of economic resources in the area and highlights issues of vulnerability and marginalisation (Figure 1.3). Importantly, due to the prominent position video games hold within society, the content and game design of games like *Mafia III* can be a strong driver of highlighting issues, sparking discussion and reflection upon real dimensions of reality. However, this comes back to the researcher's understanding of the material, both video games and disasters.

Figure 1.3: Screen capture from mainstream game *Mafia III* showing a flooded area of the game world

Source: Author's own (2020)

Table 1.1, Table 1.2, Table 1.3 and Table 1.4 present an overview of 'serious' and mainstream disaster video games, in the form of a 'Gamecade'.. This builds upon the initial rendition of the Gamecade by Gampell and Gaillard (2016), by adding further disaster video games that have been identified. The Gamecade shows an evolution of 'serious' and mainstream disaster video games over time, with earlier video games located on the far left moving toward more recent on the far right. The video games are categorised according to the most appropriate genre, or if the video game exhibits characteristics of two genres, it is placed in-between. 'Serious' disaster video games are denoted by a yellow background fill, while games that are playable on multiple platforms are colour coded in purple font. While efforts have been made to identify as many 'serious' and mainstream disaster video games as possible, the Gamecade is not an exhaustive collection. There are no doubt many other disaster video games missing, as many of the video games featured in the Gamecade were originally developed for a European or American context. Despite the driving force of East Asia (China, Japan, South Korea and Taiwan) in the global video game market, acknowledging Japan's strong influence on arcade games in the 1970's, the development of well-known game consoles like the Sony Playstation and Nintendo Switch, or the Japanese Role Playing Game (JRPG) video game genre, there is limited scholarship available (Lee & Pulos, 2016). Hence, video games may be missing due to language or regional accessibility barriers, or are no longer available for purchase/ download or advertised. However, the Gamecade indicates the range of 'serious' and mainstream disaster video games that have been developed over time.

Table 1.1: Gamecade of 'serious' and mainstream disaster video games from 1988-2009[4]

GENRE	1988-89	1990	1991	1994	1995	1996	1997	1998	2001	2002	2003	2004	2005	2006	2007	2008	2009
GOD SIMULATIONS									Black & White (2001)				Black & White 2 (2005)				
																Spore (2008)	
CITY MANAGEMENT SIMULATIONS	Simcity (1989)	SimEarth (1990)	Civilization (1991)	Simcity 2000: Scenarios Vol. I: Great Disasters (1994)	SimTown (1995) Simcity 2000 (1995-2009)	SimPark (1996)		Simcity 3000 (1998)			Simcity 4 (2003)			Anno 1701 (2006)	Stop Disasters! (2007)		Tropico 3 (2009) Anno 1404 (2009) Red Cross Emergency Response Unit (2009)
																FloodSim (2008)	
PROBLEM SOLVING										Hurricane Strike! (2002)			Citizen Ship (2005) Stormwatchers (~2005)	Disaster Watch (2006)		Beat the Quake (2008)	

[4] Notes: i) Game titles in yellow correspond to 'serious' disaster video games, ii) Changing colour scale represents a change in 10 years, iii) Titles located in grey rows indicate a sharing of characteristics of the categories either side, iv) Titles with purple font are playable on various platforms

Table 1.2: Gamecade of 'serious' and mainstream disaster video games from 1988-2009[5]

GENRE	1988-89	1990	1991	1994	1995	1996	1997	1998	2001	2002	2003	2004	2005	2006	2007	2008	2009
ISOMETRIC ROLEPLAYING GAME	Wasteland (1988)						Fallout 1 (1997)	Fallout 2 (1998)		Pokémon Ruby and Sapphire Versions (2002)		Pokémon Emerald Version (2004)	Pokémon Mystery Dungeon: Blue Rescue Team and Red Rescue Team Versions (2005)				
FIRST/THIRD PERSON ROLEPLAYING GAME																Fallout 3 (2008)	
															S..T.A.L.K.E.R.: Shadow of Chernobyl (2007)	S..T.A.L.K.E.R.: Clear Sky (2008)	S..T.A.L.K.E.R.: Call of Pripyat (2009)
ACTION/ ADVENTURE										Grand Theft Auto: Vice City (2002)							
FIRST PERSON SIMULATION																	
FIRST PERSON ART/ EMPATHY																	
SIDESCROLLING																	
ARCADE																Roblox [Disaster] (2008-Present)	

[5] Notes: i) Game titles in yellow correspond to 'serious' disaster video games, ii) Changing colour scale represents a change in 10 years, iii) Titles located in grey rows indicate a sharing of characteristics of the categories either side, iv) Titles with purple font are playable on various platforms

Table 1.3: Gamecade of 'serious' and mainstream disaster video games from 2010-2020[6]

GENRE	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	TBD
GOD SIMULATIONS		From Dust (2011)										
CITY MANAGEMENT SIMULATIONS		Tropico 4 (2011) Anno 2020 (2011) Simcity for iphone (2011)	Supervolcano (2012)	Simcity (2013) Simcity Buildit (2013)	Tropico 5 (2014)	Cities: Skylines (2015)			Frostpunk (2018)	Tropico 6 (2019) Stop Disasters! (2019) Sid Meier's Civilization VI: Gathering Storm (2019)		
		Fate of the World (2011)			Earth Girl 2 (2014) This War of Mine (2014)	SerGIS (2015)	This War of Mine: The Little Ones (2016)		Earth Girl Volcano (2018)			
PROBLEM SOLVING	Quake Safe House (?)		Young Meterologist (2012) Before the Storm (2012)	Disaster Master (?) Build a Kit (?)								

[6] Notes: i) Game titles in yellow correspond to 'serious' disaster video games, ii) Changing colour scale represents a change in 10 years, iii) Titles located in grey rows indicate a sharing of characteristics of the categories either side, iv) Titles with purple font are playable on various platforms

Table 1.4: Gamecade of 'serious' and mainstream disaster video games from 2010-2020[7]

GENRE	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	TBD
ISOMETRIC ROLEPLAYING GAME					Wasteland 2 (2014)						Wasteland 3 (2020) Pokémon Mystery Dungeon: Rescue Team DX (2020)	
FIRST/THIRD PERSON ROLEPLAYING GAME	Fallout New Vegas (2010)					Fallout 4 (2015)			Fallout 76 (2018)			
	Metro 2033 (2010)	Infamous 2 (2011)		Metro Last Light (2013)		Survarium (2015)	Tom Clancy's The Division (2016)	Assassin's Creed Origins (2017)	Assassin's Creed Odyssey (2018)	Tom Clancy's The Division 2 (2019) Metro Exodus (2019)		S.T.A.L.K.E.R. 2 (2021)
ACTION/ ADVENTURE				Assassin's Creed IV: Black Flag (2013)	Assassin's Creed Rogue (2014)	Mad Max (2015)	Mafia III (2016)				Disaster Report 4 Plus: Summer Memories (2020)	
FIRST PERSON SIMULATION	Inisde the Haiti Earthquake (2010)										What's the Plan Stan? (2020)	OutBrk (TBD)
FIRST PERSON ART/ EMPATHY				9.03M (2013)								
SIDESCROLLING												
	Earthquake Response (2010)			Earth Girl (2013)	Sai Fah - The Flood Fighter (2014)		Tanah - The Tsunami and Earthquake Fighter (2016)					
ARCADE												

[7] Notes: i) Game titles in yellow correspond to 'serious' disaster video games, ii) Changing colour scale represents a change in 10 years, iii) Titles located in grey rows indicate a sharing of characteristics of the categories either side, iv) Titles with purple font are playable on various platforms

1.5 Statement of problem and rationale of thesis

Video games face significant hurdles on their path to becoming recognised as powerful learning tools. Despite mounting evidence supporting their educational capacity (Clark et al., 2016), video games still face prejudice in being recognised as learning tools. On the other hand, simulations are perceived as more valuable tools for teaching, learning and training (Sanchez, 2013). While video games are slowly gathering acceptance and traction for having a positive influence on learning (Becker, 2017), in particular, that video games can teach, build and strengthen specific skills alongside playing a useful role in formal education (Becker, 2017; Ibrahim et al., 2012a, 2012b), there are many more hurdles that video games need to overcome.

The agendas of organisations, practitioners and academics, among others, to transmit their particular educational content, often affect the efficiency of the video game to engage the target audience. This may potentially stem from the term 'serious' video game that conjures an emphasis upon the 'serious'/educational and training purpose of the game rather than encouraging the dimension of fun. Research suggests the focus on educational content in 'serious' games can result in the lack of player motivation, thereby disengaging the target audience from the educational material (Ibrahim et al., 2012a, 2012b; Royale, 2008). Research suggests such games often fail, as game designers cannot balance educational and playful contents (de Freitas, 2006; Kelle et al., 2011), or have no intention of integrating fun and entertainment into the game design (Sanchez, 2013). Additionally, Ibrahim et al. (2012b) found that many 'serious' video games are released before assuring their ability to achieve the intended objectives.

Similarly, despite the numerous 'serious' and mainstream disaster video games available (Table 1.1, Table 1.2, Table 1.3, Table 1.4), there is limited research to determine the influence of such disaster games on perceptions and understanding of disaster and DRR awareness. Also, the top-down technocratic approach of disaster organisations, practitioners and academics which underpin many 'serious' disaster video games, can focus too heavily on players' exposure to educational content, ignoring aspects of fun and gameplay experimentation. Ultimately, this type of game design could stifle any opportunity to engage players in building their awareness of disaster and DRR.

Conventional approaches to video game research mainly focus upon the potential effectiveness of game content and game design for learning. While these dominant approaches provide quantitative and qualitative data to indicate the potential of video games to support learning (Clark et al., 2016), they produce limited research to understand how connections to learning theory could enhance the learning outcomes of players via video games (Ibrahim et al., 2012a, 2012b; Wu et al., 2012). Wu et al. (2012) conducted a meta-analysis of 658 game-based learning studies and 567 did not identify any relevant learning theory for the particular study. Similarly, conventional approaches are utilised in the minimal disaster video game research available. In terms of disaster research, these conventional approaches do not facilitate collaborative methodologies to foster top-down and bottom-up perspectives, nor do they align to a learning theory, like constructivism. Fundamentally, disaster studies attempts to enhance people's understandings of disaster and DRR awareness by fostering people's participation and engagement in the process. Therefore, disaster video game research should return to connect to this fundamental approach. This strategy can offer insight not only into the assessment of how learning can occur with video games, but can also highlight how video games can be used for teaching by placing not only players but also teachers at the centre of the research process.

1.6 Aim and objectives of the thesis

Four specific objectives attempt to address the primary research question: To explore how disaster video games, both 'serious' and mainstream, can foster participation in learning about disaster and DRR.

- To build a typology of disaster video games demonstrating the connections to DRR
- To assess the impacts of existing disaster video games with a targeted audience to determine whether insightful knowledge is gained, with the potential to improve disaster awareness.
- To carry out an analysis of disaster video games in collaboration with a targeted audience to understand how each game scores in terms of game content, player motivation, skill-building and social interaction.
- To understand how video games may be used as tools for DRR.

To address these objectives, this thesis conceptualised a participatory methodological framework for video game research. This approach aligns with constructivist learning theory, utilising a combination of conventional research approaches alongside approaches associated with participatory toolkits. This learner-centred approach aimed at integrating the perspectives of participants especially in regards to issues around how game content, mechanics, skills, motivations and social interaction is pivotal in the ability of video games to be learning tools for disaster and DRR.

1.7 Constructivism as a conceptual approach

Pritchard and Woollard (2010) note that research has attached constructivist thinking to a history of 2000 years in Eastern tradition (e.g. Gautama Buddha - Buddhism, Heraclitus – a pre-Socratic philosopher, Lao Tzu – Taoism) and at least 300 years in Western thought (e.g. Immanuel Kant). Importantly, constructivism is more than a theory of learning; it is instead an epistemology (Pritchard & Woollard, 2010; Ültanır, 2012). An epistemology is a consideration and detailed study of the theory of knowledge, serving to understand the origins, the methods and the limits of knowledge (Pritchard & Woollard, 2010). Ültanır (2012) positions constructivism as both a scientific and meta theory that aims to explain the nature of knowledge and how people learn. Significantly, constructivists shift the emphasis from knowledge as an outcome, toward knowledge as a process (Ültanır, 2012).

Piaget's (1952) theory of cognitive constructivism proposes people must construct their knowledge rather than being given information and having an immediate understanding and ability to apply this information (Powell & Kalina, 2009; Schunk, 2012; Ültanır, 2012). Cognitive development can only occur when the learner's beliefs do not match observed reality, creating a disequilibrium or cognitive conflict in the learner (Schunk, 2012). Therefore, the learner seeks equilibration via adaptation, the process of assimilation and accommodation, to resolve the cognitive conflict (Powell & Kalina, 2009; Schunk, 2012; Ültanır, 2012). Piaget (1952) considers assimilation as the child bringing new knowledge to their schema (patterns of thought or behaviour) and accommodation as the child changing their schema to accommodate further information and knowledge (Powell & Kalina, 2009; Pritchard & Woollard, 2010; Schunk, 2012; Ültanır, 2012). Schunk (2012) suggests information must be partially understood (assimilated) before the promotion of knowledge change can occur (accommodation). Constructivist learning theory asserts that learners with minimal instruction can construct knowledge that includes both individual and social meanings. Personal experience and their reflections of these experiences, results in learners constructing knowledge through active engagement and self-regulation, that challenges their thinking and existing beliefs (Chow et al. 2011; Cohen, 2011; Hein, 1991; al Mahmud, 2013; Pritchard & Woollard, 2010; Ray et al. 2014; Schunk, 2012; Ültanır, 2012). Therefore, constructivism assumes individuals are active learners who develop knowledge for themselves, either via exogenous, endogenous or dialectical constructivism, refer to Table 1.5 (Schunk, 2012).

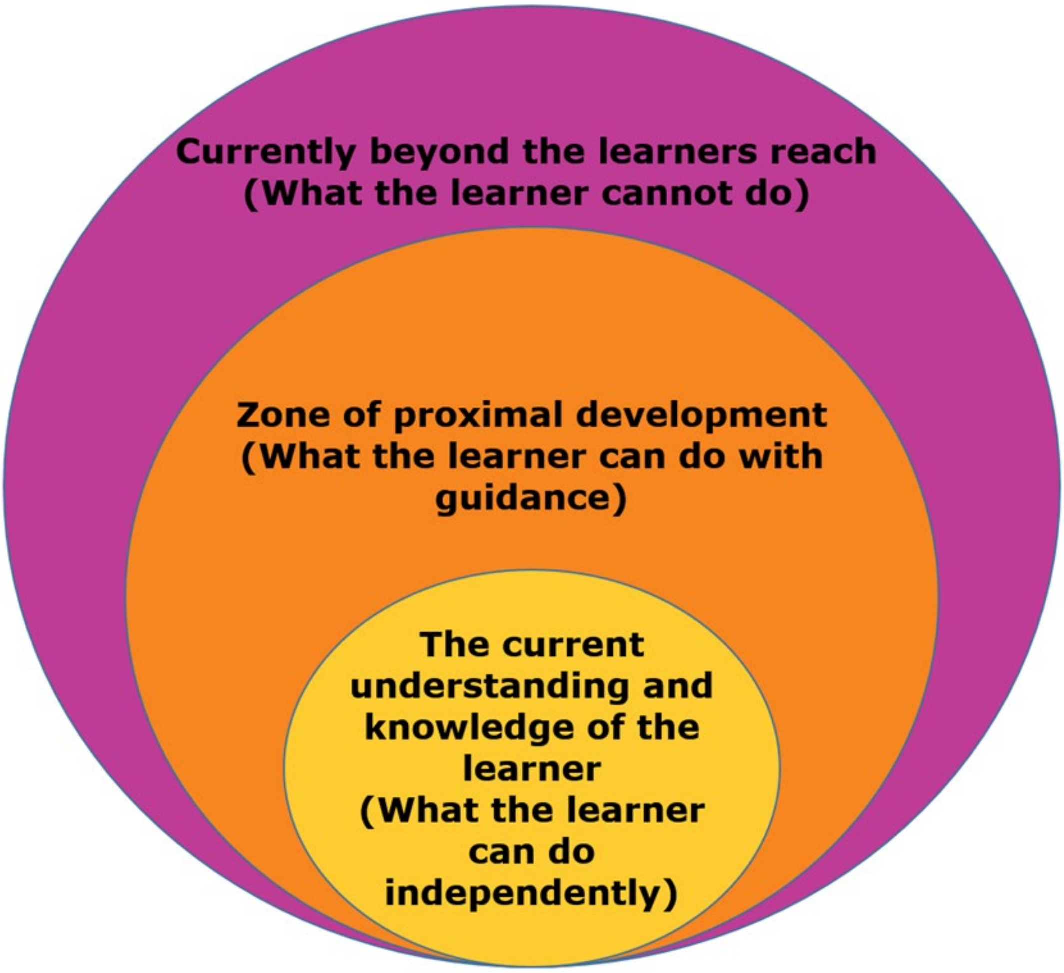
Table 1.5: Perspectives of constructivism

Perspective	Premise
Exogenous	Knowledge acquisition via reconstruction of the external world. The world influences the learner's beliefs via experience, exposure to models and teaching. Knowledge reflects external reality deemed accurate.
Endogenous	Previous knowledge is used to derive knowledge, not direct from environmental interaction. Knowledge does not reflect reality and is instead developed by cognitive abstraction.
Dialectical	Social and environmental interaction derives knowledge. Knowledge construction is not linked to either the external world or cognitive workings. Knowledge is a reflection of mental outcomes based on resulting interactions of the learner with the environment

Source: Adapted from Schunk (2012)

Piaget's theory of cognitive constructivism argues that social interaction is not required for cognitive development (Schunk, 2012); whereas Vygotsky's theory of social constructivism contends, social interaction is an integral part of the learning process (Powell & Kalina, 2009; Vygotsky, 1978). Vygotsky emphasises the importance of social interactions upon learning, whereby knowledge is not constructed individually but co-constructed between two people (Meece & Daniels, 2008; Pritchard & Woollard, 2010). Vygotsky (1978) suggests development occurs twice as in the interpersonal process transforms into an intrapersonal process, or more simply first on the social level/ between people than later on the individual level/ inside the learner. Central to social constructivist learning theory is the zone of proximal development (Figure 1.4). The zone of proximal development describes the difference between a person achieving independent problem solving compared to their potential problem-solving achievement with assistance from a more knowledgeable other (can be anyone from another student, teacher, adult, child) (Cicconi, 2013; Meece & Daniels, 2008; Powell & Kalina, 2009; Pritchard & Woollard, 2010; Schunk, 2012; Vygotsky, 1978; Wu et al., 2012). Wood et al., (1976) coined the term instructional scaffolding as an application to increase the learner's competence through the zone of proximal development. Whereby, the more knowledgeable other, provides 'scaffolding' through verbal or physical assistance to help the learner master a task or problem outside of their capabilities (Meece & Daniels, 2008; Powell & Kalina, 2009; Pritchard & Woollard, 2010; Schunk, 2012; Wood et al., 1976; Wu et al., 2012). However, the role of the more knowledgeable other is to facilitate and guide learning rather than dictate their learning process (Powell & Kalina, 2009). Ultimately, Vygotsky's theory, a form of dialectical constructivism, considers the social environment as critical for learning as knowledge is a social product and learning is a social process where social interaction transforms the learning experience (Pritchard & Woollard, 2010; Schunk, 2012).

Figure 1.4: Zone of proximal development



Source: Adapted from Pritchard and Woollard (2010)

Piaget's cognitive constructivism and Vygotsky's social constructivism are both critical theories of constructivism to understanding approaches toward enhancing both the teaching and learning process (Powell & Kalina, 2009). Table 1.6 outlines the guiding constructivist principles suggested by Hein (1991). As such, constructivism emphasises a need for interactive tools, activities, and material to actively and socially engage learners within the learning process (Schunk, 2012). Both cognitive and social constructivist teaching methods need to have interactive requirements to allow learners the opportunity to process, what they learnt in a group or from a more knowledgeable other, individually (Powell & Kalina, 2009). Such methods can reflect cooperative and collaborative approaches to learning (Pritchard & Woollard, 2010), with activities aligning with participatory techniques (Mercer et al., 2008). Hence, the following section details the rationale behind this thesis, including a participatory methodological approach in the research design.

Table 1.6: Guiding principles of constructivism

Principle	Explanation
Learning is an active process	The learner uses sensory input, engaging with the world to construct meaning. The learner is active, not passive.
People learn to learn while they learn	Learning by both constructing meaning and constructing systems of meaning.
Meaning construction is mental	Activities need to engage both the mind and physical action/ hands-on experience—reflective training.
Learning involves language	Language and learning are intertwined; the language used influences learning. People talk to themselves while learning.
Learning is a social activity	Learning is associated with connections with other people, teachers, peers, family. Learning uses conversation, interaction with others and knowledge application.
Learning is contextual	Their learning is based upon existing knowledge, beliefs and experiences. Learning is not through facts and theories processed separately in the mind.

Knowledge is required to learn	Cannot assimilate new knowledge without a structure formed from previous knowledge to build upon.
Learning takes time	Learning requires reflection, revisiting ideas, trying ideas and using ideas. Learning is a product of repetition and exposure.
Motivation is key	Motivation is essential for learning, which includes understanding the ways knowledge can be used, without knowing the reasons why one can be less involved in using the knowledge instilled.

Source: Adapted from Hein (1991)

1.8 Methodological framework – participation and participatory techniques

Popa and Guillermin (2015) note that monodisciplinary approaches are often inadequate to understand complex dynamics and diverse values and perspectives. Hence, methodological pluralism, utilising multiple methods to address a research problem, can generate deeper understandings through the combination of several methods from varying disciplines and approaches to conduct the research. Midgely et al. (2017) suggest there is a substantial value to be gained from methodological pluralism such as learning from different methodologies to enhance one's methodology, along with the ability to broaden the research methods as researcher understanding develops through the research process. However, methodological pluralism is not without its own set of challenges. Midgely et al. (2017) reference three associated challenges to achieving methodological pluralism, including philosophical (contradictions between paradigms), cultural (resistance of academic cultures toward methodological pluralism) and psychological (resistance toward learning new research methods). The challenges for methodological pluralism, as outlined by Midgely et al. (2017), are supported by the views of Popa and Guillermin (2015) who also suggest a need for reflexive methodological pluralism. Popa and Guillermin (2015) believe reflexive methodologies are especially necessary to avoid the disguising of dominant power structures like top-down technocratic processes as pluralism and instead work toward the identification of method combinations to facilitate knowledge building. By considering the methodologies utilised in disaster research, alongside video game studies focused upon learning, a reflexive methodology can be generated that can facilitate opportunities for constructivist based learning and data collection.

Video game scholars indicate that the methodological and conceptual diversity of video game research is problematic. Video game research pulls upon a range of quantitative (see Buelow et al., 2015; Chau et al., 2013; Miller et al., 2011; Pilegard & Mayer, 2016; Shute et al., 2015; Yang, 2012) and qualitative (see Cote & Raz, 2015; Eklund, 2015; Nilsson & Jakobsson, 2011; Pitkänen, 2015) research methods and approaches, often reflective of the researchers' disciplinary background (Lankoski & Björk, 2015). However, this methodological diversity means there is no one conceptual and methodological video game framework to allow interpretation and comparison of the research findings (Rebetez & Betrancourt, 2007). Unsurprisingly, the limited disaster video game research available at the commencement of this thesis also utilised conventional research approaches. In turn, such top-down and technocratic traditional research approaches reflect the conduction of DRR education research without the inclusion of the perspectives of the learners (Petal, 2007).

Similarly, this thesis initially followed a similar methodological direction, using existing research to inform the research approach. However, following the museum case study, the researcher's positionality as a gamer indicated the approach was not entirely suitable for answering the research question. Hence, two primary concerns emerged with only utilising conventional video game research approaches to explore whether disaster video games can foster participation in learning. Firstly, conventional approaches, like researcher designed questionnaires, quantitative data collection, or researcher designed interview questions, cannot deliver the missing bottom-up perspectives of participants nor include them in the design or direction of the research. Secondly, conventional approaches do not align with the fundamental principles of constructivism. In contrast, the inclusion of participatory methodologies into the research process can offer an alternative approach to address both of these concerns, and hence underpins the methodological framework of this thesis.

Participatory methodologies are increasingly utilised in efforts for DRR and academic research (Le De et al., 2015; Mercer et al., 2008). The perceived limitations of top-down strategies have seen the emergence of bottom-up research through a promotion of participation and involvement of local people (Cooke & Kothari, 2001; Mercer et al., 2008; Wisner et al., 2004). However, researchers often note that the participatory process is not reflected in practice (Cooke & Kothari, 2001; Delicado et al., 2017; Hore et al., 2020; Le De et al., 2015). The extractive nature of disaster research means the researcher, practitioner or organisation that is utilising a participatory process generally has a pre-determined objective that imposes an agenda upon the people involved (Le De et al., 2015; Mercer et al., 2008). In this context, consideration to who is included and who is excluded from the participatory process is necessary. While a participatory process may aim to be equitable, power relations cannot be disassociated from the process. The participatory process will still be subject to power relations, expectations, understandings and norms of everyday life from those people who are included and excluded by the process (Hore et al., 2020). Beyond this, the power relations potentially exhibited by the external facilitation of researchers or experts can shape the 'participatory' process (Hore et al., 2020), where ideally participants who request external facilitation, should design and conduct the research, according to their criteria and indicators of success to evaluate their research outcomes (Chambers, 1994a; Le De et al., 2015).

Participatory' tools aim to collaboratively draw on and foster knowledge, perceptions and priorities of those people who are excluded from top-down and technocratic initiatives driven by scientific knowledge that have a direct impact upon them and their livelihoods (Le De et al., 2015; Pelling, 2007; Saxena, 1998). Non-exhaustively, participatory techniques can include tools and activities like carousel, mapping, timelines, matrix ranking and Venn diagrams (Mercer et al., 2008). Quantitative participatory methods, like scoring and ranking, can offer opportunities to quantify the qualitative information by the participants in a way that conventional researcher driven methods cannot (Chambers, 2007; Mayoux & Chambers, 2005). Notably, the use of participatory techniques can allow, if used appropriately, voiceless insider groups an opportunity to share, enhance and analyse their knowledge of specific topics, using their own words and frameworks of understanding rather than being assumed and enforced by outsiders (Chambers, 1994a, 1994b; Cornwall, 2000; Mercer et al., 2008; Pain & Francis, 2003).

Participatory techniques, through their interactive and collaborative nature, can generate meaningful research outcomes by both promoting learning and the generation of research data through the constructivist learning theory of guided discovery (Mercer et al., 2008). Guided discovery has the learner draw upon past experience and existing knowledge to discover new information (Bruner, 1961). As such, this thesis has conceptualised a learner-centred methodological framework, underpinned by participatory techniques, in alignment with the epistemological approach of constructivism. This framework aims to move beyond conventional video game research methods that individually assess learning like pre and post-game questionnaires and often generate a narrow understanding of the broader learning process. Therefore, rather than simply being questioned and answers extracted (Cornwall, 2011), participatory tools facilitate the engagement of participants in self-regulated problem solving (Ivanitz, 1999; Mercer et al., 2008). The participatory techniques forming the foundation of the learner-centred methodological framework allow an unfiltered exploration into the patterns for how gamers think about and respond to disaster video games within various educational environments rather than drawing statistical representativity. Ultimately, the utilisation of participatory techniques refocuses the approach within the group of learners, facilitating a collaborative social environment that can foster the learning process as denoted by constructivist principles.

1.8.1 The researcher's positionality

It is important to recognise, that walking a line of neutrality in my positionality as both a gamer and a researcher was challenging. As a gamer, the concept of a 'serious' game equates to a game that is less engaging and immersive due to poor game design and forced expectation to learn the intended content. Personally, I would advocate, alongside other scholars, that mainstream games do have learning mechanics naturally embedded. Importantly, mainstream games are well designed with often beautifully rendered game environments. Simply put, the commercial underpinnings of a mainstream video game means, if a mainstream video game is bad, they will not sell. Therefore, players can learn new skills and thoughts through the portrayed discourses and game content while also having fun.

Beyond this, for mainstream games, the metagame dimension is enormous. Gamers can discuss mainstream games at length, sharing gameplay experiences, tips and guides, creating YouTube videos, gameplay streaming on dedicated websites or even attending conferences to interact with other gamers and game developers. However, the metagame for 'serious' video games is nearly non-existent. 'Serious' games as one-off projects cannot capture the same level of motivation, fan base nor will such games be often seen in mainstream media. However, as a researcher, the research process of this thesis indicated that 'serious' games have a role to play in providing an educational experience to players, though further work is needed to match mainstream games. While mainstream games may have greater appeal and learning potential, they are not necessarily appropriate for everyday educational environments. Hence, as both researcher and gamer, the personal intention of this thesis is to contribute to making the process of learning better for video games at large, albeit through 'serious' games or mainstream games.

To achieve this personal intention, I was conscious of the researcher relationship that I had with the informants, teachers and students. Despite, my own position on video games, it was important to understand the perspectives of other people toward video games. This meant not imposing my own views nor influencing the participants. At times, some participants initially presented views that were in strong opposition to video games as learning tools, referencing arguments around violent content, a lack of social interaction, not encouraging players to read books to enhance their vocabulary, or concerns that video games would replace teachers. However, often these people had never played a video game previously. Importantly, throughout the thesis process, stemming from the initial thesis proposal presentation to academic staff, I provided people access to video games like Earth Girl 2 to play themselves. This first-hand experience often challenged their pre-conceptions of video games and meant people were more willing to become part of a discussion around the utilisation of video games as learning tools. This type of approach in engaging people also moves away from emphasising the video game and instead reflects the epistemological approach of constructivism. Although, notably it was necessary to 'empty my cup' or be open-minded and allow the participants to share their perspectives and approaches to video games with me. For some people 'serious' games served their purpose but for others they were searching for elements that 'serious' games could not provide. Therefore, it was important to record these perspectives as observed and collected without introducing researcher bias where possible. This also links back into the critiques around the 'participatory' process, which in the case of the P-Tech in CitSci (refer to section 1.9.3 for further details), attempted to allow the participants an opportunity to co-design the research process to benefit their needs rather than the research agenda.

1.9 New Zealand museums and schools as case studies

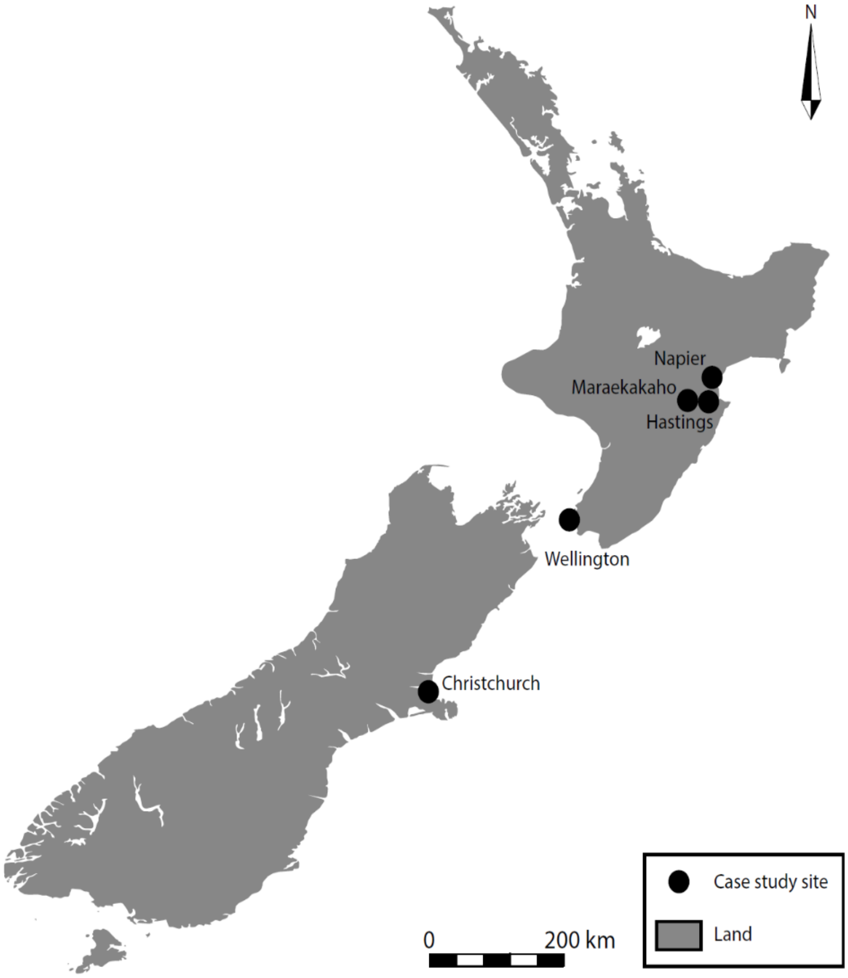
This thesis draws upon three New Zealand-based case studies to provide insight toward how different educational environments, namely museums and schools, can utilise disaster video games to foster participation in learning about disasters and DRR. New Zealand is an island nation, located within the southwest Pacific, which has a landscape shaped by earthquakes, volcanoes, storms and glaciers (Officials' Committee for Domestic and External Security Coordination [ODESC], 2007). Fieldwork was conducted in three different geographical locations across New Zealand, in particular Hawke's Bay, Wellington and Christchurch (Figure 1.5). Each geographical location is exposed to a range of natural hazards (Table 1.7), with all three locations having experienced significant earthquakes (Civil Defence Emergency Management Canterbury [Canterbury CDEM], 2020; Hawke's Bay Emergency Management Group [Hawke's Bay CDEM], 2020b; Wellington Region Emergency Management Office [WREMO], 2020).

The Wellington region, regularly experiences small and medium sized earthquakes due to several active faults within the area. In 1855, the Wellington region was the location of New Zealand's largest historic earthquake, experiencing a magnitude 8.2-8.3 earthquake. This earthquake resulted in surface ruptures, uplift, landslides and a tsunami. Timber-framed buildings sustained little damage; however, chimneys and brick buildings were severely damaged, and around seven deaths recorded (Grapes & Campbell, 2005; ODESC, 2007). Many of Wellington's residents remembered the earthquakes of 1848 and hence in the immediate aftermath, repairs commenced, business and politics resumed, newspapers published, alongside the 'civil defence' unit clearing debris and removing damaged buildings to reduce further damage to goods, buildings and loss of life or injury (Grapes & Campbell, 2005). The immediate response and determination of the local people, and the aspirations for Wellington to become the seat of Government (achieved in 1865), contributed to a quick recovery from the earthquake (Grapes & Campbell, 2005).

In 1931, the Hawke's Bay region experienced a magnitude 7.8 earthquake, destroying houses, buildings and infrastructure, followed by fires throughout the city of Napier (Hill & Gaillard, 2013). Hawke's Bay experienced landslips, uplifting of around 3500 hectares of the Ahuriri Lagoon seabed, alongside 256 deaths (Dowrick et al., 1995; ODESC, 2007). The earthquake came in a time of global and national economic depression, yet despite the economic challenges, reconstruction began the day of the earthquake alongside relief strategies (Hill & Gaillard, 2013). This process ensured on the short-term that there were temporary shelters, economic resources and a temporary business district to sustain the livelihoods and needs of the people, while providing adequate time for careful long-term reconstruction planning, hazard proofing and informing the New Zealand building standard (Hill & Gaillard, 2013).

More recently, the Canterbury earthquakes of 2010 (magnitude 7.1) and 2011 (magnitude 6.3), resulted in immense damage, liquefaction and flooding in Christchurch and 185 deaths (Gibbs et al., 2013; Potter et al., 2015). These earthquakes had a number of social impacts upon the local people, including mental well-being, ability to continue education, closure or relocation of social facilities; however, people did suggest an improved sense of social connectedness following the earthquake (Potter et al., 2015). There was a reduced amount of housing availability, closure of the Christchurch Central Business District and drop in employment (Potter et al., 2015).

Figure 1.5: Study sites in New Zealand



Source: Base map is from Free Vector Maps (https://freevectormaps.com/)

Table 1.7: List of possible natural hazards within the case study regions

Wellington	**Christchurch**	**Hawke's Bay**
Earthquakes	Earthquakes	Earthquakes
Tsunami	Tsunami	Tsunami
Flooding	Flooding	Flooding
Storms	Storms	Storms
Fire	Fire	Fire
Drought	Drought	Drought
Landslides	Landslides	Landslides
Volcanic Ash	Volcanic Ash	Volcanic Ash
	Snow	Coastal Erosion

Source: Canterbury CDEM (2020); Hawke's Bay CDEM (2020); WREMO (2020)

1.9.1 New Zealand museums as case study locations

This thesis included two New Zealand museums as study locations, the Museum of New Zealand Te Papa Tongarewa (Te Papa) and Canterbury Museum: Quake City (Quake City). Te Papa is located in Wellington on the North Island of New Zealand. Te Papa was established as a bicultural space as part of the efforts to recognise the Treaty of Waitangi.[8] Te Papa itself is located on the Wellington harbour and close to a major fault line on soft reclaimed land. Te Papa has been engineered to be safe in the event of an earthquake and feeds into the education surrounding hazards and disaster risk reduction. Museum entry is free to all visitors. Quake City is located in Christchurch on the South Island of New Zealand. Quake City was originally located in the Re:START Mall on Cashel Street in the central city of Christchurch before moving to its current location on Durham street North. Quake City was established to share stories from the aftermaths of the 4 September 2010 and 22 February 2011 Canterbury earthquakes. Quake City also provides the science behind the earthquake, displaying artefacts from the earthquake and a rebuild section with up to date information about recovery projects currently underway. Visitors must pay an entry fee into Quake City.

The rationale for selecting these two locations revolved around the frequent experience of natural hazards in these locations, in particular earthquakes, and the museum visitor's access to the EQC branded interactive video game display *Quake Safe House*. *Quake Safe House* tasks players with preparing a Wellington hillside home for an earthquake. This 'serious' interactive video game is primarily single player, though the game can be played with other people physically present in the museum. The player starts the game and is given a basic introduction to the overall goal of the game. Players need to 'Quake Safe' three areas, kitchen and dining, lounge and outside, by finding and securing objects with the right tool before the earthquake strikes. Players start the game, using the touch screen they must drag and drop the preventative earthquake tools on to the different objects. Once the time is up, the players see the consequences of their actions and are told the correct tool to use if their choice was incorrect (Figure 1.6). However, further information

[8] The Treaty of Waitangi is New Zealand's founding document, in Māori and English, which was signed in 1840 on the principle of biculturalism between the British Crown and Māori (Walker, 2020).

beyond the name of the tool is not provided in-game. The player is moved to the next scenario following the completion of the previous scenario, with the final screen presenting the players' overall percentage score for the game.

Figure 1.6: Photo of *Quake Safe House* feedback system for the consequence of player's actions

Source: Author's own (2016)

Fieldwork took place at Te Papa on 15-16 October 2016 and at Quake City on 18-19 March 2017. This involved attending the museum on opening and staying until close. To maintain some sense of coherency with the early work conducted by RiskRed and previous video game scholars, the thesis initially modified the RiskRed (2007) Stop Disasters! pre and post-game questionnaires to align with the Quake Safe House video game. The researcher undertook pre and post-game structured interview questions through the offline questionnaire software SurveyGizmo to record the museum participant's responses. Overall, 22 people participated in the study, with 11 people recorded at each study location. In order to explore the everyday gameplay experiences of museum visitors, the research approach had to be conducted within a format that replicated the everyday experiences of museum visitors and their interactions without being influenced by the researcher's presence. Hence, to gain a more accurate perspective, the researcher only approached museum visitors who made an initial interaction with *Quake Safe House* to participate. Additionally, the researcher did not provide any support to the participants, in line with constructivist learning theory. Instead, the researcher observed the overall process of the participant's gameplay and any other museum visitors who helped them with the gameplay. Reflecting upon the research methodology and the research findings from the museum case study (see Chapter 4 for more details) presented invaluable revelations that informed modifications in the overall research process especially for the school-based case studies, like the use of group activities and participatory techniques.

1.9.2 New Zealand schools as case study locations

Four schools located in Hawke's Bay chose to participate in the research. Between the four schools, the research involved a total of nine classes (one co-education intermediate school class, one all boy's high school geography class, two geography classes at an all girl's high school and an all girl's boarding school involving one intermediate class and four high school classes including one geography class and one social science class). These schools were located around Hawke's Bay, which meant each area was subject to different natural hazards identified for the region. Therefore, the students might have different understandings of their local natural hazards. The schools who participated in the process were able to give important insights into how different ages and genders may approach and perceive the use of video games for learning. Significantly, due to the number of hazards that the students may potentially be exposed to within Hawke's Bay, there existed an opportunity to use three 'serious' disaster video games that targeted different natural hazards relevant to the local context.

Earth Girl 2 (aka Earth Girl Tsunami) tasks players with saving people from the impacts of an earthquake and tsunami by using various DRR actions. The game is single player, single-player played with other people physically within the room and gathered around the same tablet. The player starts the game and can choose to either review the tutorial information or go straight to gameplay. The player has a choice of different game locations representing coastal communities, urban and rural settings. Players can seek advice from the NPCs (Non-Player Characters) who can give insights into the DRR actions or infrastructure that can form the basis of the players' toolbox (Figure 1.7). The player starts the scenario, using the touch screen of the tablet. The player then drags and drops the different prevention, mitigation and preparedness tools they chose to form their toolbox and place them on nodes located in the game world. When ready, the player triggers an earthquake. Depending upon the players choices, the earthquake may have an impact upon the game environment and this is observable to the player. The evacuation sequence then commences and the timer begins. Once the timer reaches zero, the tsunami occurs and moves to the feedback screen. The player receives feedback upon some of their gameplay decisions, the outcomes and the final scenario statistics including the number of people saved, the tsunami awareness level of the NPCs and infrastructure built, among other statistics for their scenario. The player subsequently retries the scenario, taking into account the feedback or alternatively move to the next scenario.

Figure 1.7: Local knowledge to inform the player's toolbox in *Earth Girl 2*

Source: Author's own (2017)

Sai Fah - The Flood Fighter follows the story of Sai Fah through the three stages of a flood, before, during and after the event. As the player progresses through the unfolding story, they are tasked with carrying out various flood safety and preparedness measures as directed by the various NPC characters (Figure 1.8). The 'serious' game is single player, though can be played with other people physically sitting around the same tablet within the room. The player starts the game and works their way through different stages, tapping on the screen to direct Sai Fah around the game environment and carry out different actions. At the end of each stage, the player is shown feedback upon the actions they successfully completed. After the successful completion of the stage, the player moves to the next part of the story.

Figure 1.8: *Sai Fah* gameplay screenshot showing information to build a sandbag wall

Source: Author's own (2016)

Stop Disasters! has five natural hazard scenarios (earthquake, flood, tsunami, hurricane and fire) in which the player must make decisions to prevent the loss of lives and reduce the level of damage from the particular hazard. The 'serious' game is single player, though can be played with other people physically situated around the computer/laptop and in the same room. It should be noted this description of *Stop Disasters!* relates to the version prior to the update of *Stop Disasters!* in 2019. The player starts their chosen game scenario and is given an overview of the objectives in order to successfully complete the scenario. The player uses the mouse to click on different squares in the game world to select an action for the particular tile. As the player makes decisions by building different physical and natural infrastructure, purchasing upgrades (Figure 1.9) or seeking information from the risk map, they unlock a key message that appears on the screen. The player continues to make decisions until they run out of the available budget and commence the hazard scenario or the allocated amount of time runs out which also triggers the hazard. The player is confronted with the outcomes of their choices through the feedback received with their gameplay statistics and an option to return to the game world and view the possible impacts from the hazard. The player is returned to the game scenario selection and can retry the scenario or another scenario.

Figure 1.9: *Stop Disasters!* tsunami scenario gameplay showing upgrades to community centre

Source: Author's own (2017)

Fieldwork took place in the schools on 20-23 June 2017 during class time, with sessions lasting approximately an hour. The research approach within the school-based sessions differed from the museum study. In the school case study, the research process mixed conventional research approaches (pre and post-game questionnaires) with participatory techniques (carousel and one-word). Students completed pre and post-game questionnaires through the offline software SurveyGizmo. In addition, group activities like the carousel, aimed to facilitate an interactive and social learning environment that aligned with constructivist principles. Overall, 171 students participated in the research ranging from Year 8-13 (age 12-18). In addition, teachers present at these sessions were asked to participate in a semi-structured interview which was conducted via email at the teachers' preference. These interviews not only gathered insight upon the teachers' own personal experience with disaster and DRR education but also considered how video games can be used as learning tools within the classroom (for more details on the school-based case studies see Chapter 5 and Chapter 7).

New Zealand social science teachers attending the New Zealand Social Sciences Conference in 2017 (SocCon17) also gave their perspectives upon how video games can be used for learning within the classroom. During the workshop, teachers played *Earth Girl 2* and *Sai Fah – The Flood Fighter* followed by a carousel with an associated scoring and ranking activity. This carousel gave greater understanding toward how different aspects of video games (content, mechanics, skills, motivations and social interactions) need to connect to the curriculum. Whereas, the scoring and ranking activity aimed to quantify what teachers perceived to be most important for the inclusion of video games within the classroom (see Chapter 7 for more details). Ultimately, the input of students and teachers were indispensable toward not only the assessment of the 'serious' disaster video games but also the enhancement of the teaching pedagogy and learning process.

1.9.3 Participatory Minecraft mapping in Maraekakaho, Hawke's Bay

An opportunity arose to test the research findings of this thesis by informing the approach of the P-Tech in CitSci project. P-Tech in CitSci was part of the first phase of the Resilience to Nature's Challenges National Science Challenge (RNC). The RNC aims to enhance New Zealand's ability to anticipate, adapt and thrive in facing natural hazards, working with scientists and stakeholders to co-create methods to build New Zealand's resilience. The P-Tech in CitSci project assessed the role and contribution of technology in fostering participation and citizen science to strengthen resilience to natural hazards.

Maraekakaho (MKK) is located in rural Hawke's Bay and commonly experiences floods, drought and bush fires. In 2007, MKK experienced extensive flooding that resulted in the evacuation of the students at Maraekakaho School. Therefore, students of Maraekakaho School, including two Year 5-6 classrooms (ages 9-10) and one Year 7-8 class (ages 11-12), were involved in in LEGO and *Minecraft* mapping for the purposes of learning about disaster and DRR within their local area. Importantly, the research process and teaching and learning process were co-designed with teachers, students, academics and emergency personnel in an attempt to align the teaching process within the requirements of the classroom-learning environment and reflect constructivist-learning theory.

The research team developed a geo-referenced Minecraft world of MKK using was open source spatial datasets (like Land Information New Zealand (LINZ) data). The intention was for students to carry the knowledge and understanding from the participatory activities surrounding disasters and DRR from the classroom and apply this information within the geo-referenced MKK *Minecraft* world. In this case, *Minecraft* was a mainstream game repurposed for the intention of teaching and learning. Significantly, *Minecraft* was not only playable by people within the same room and working upon the same device, but also had multiplayer capabilities allowing players to join into the same game world to collaborate together (Figure 1.10). The students were tasked with participatory mapping features of hazards, vulnerability and capacities within the game world. There was no end state to the game given the open sandbox game environment of Minecraft, though feedback of the students decisions were debriefed as a class with a capture of the game world presented on the television in the classroom.

Figure 1.10: Participatory *Minecraft* mapping gameplay showing multiplayer capabilities within the geo-referenced *Minecraft* world

Source: Author's own (2018)

Fieldwork took place throughout 2018 during class time on Wednesday and Thursday afternoon for 90 minutes. The accumulation of knowledge from the museum and school case studies alongside the input from the teachers about connecting video games into the classroom and curriculum informed P-Tech in CitSci. Additionally, the integration of the perspectives of teachers and students from Maraekakaho School into the process helped in co-developing a teaching pedagogy, as well as research process. This ensured that the process primarily aligned with their requirements, in the aim to engage students in learning about disasters and DRR (refer to Chapter 6 for details). As such, students completed various participatory activities as part of the 'metagame' including one-word activities to define 'community', carousels around hazards, vulnerability and capacities with a subsequent scoring and ranking assessment to quantify their responses and a 2D participatory mapping activity in addition to any other classroom lessons (refer to Chapter 2 and Chapter 6 for details upon these methods). As such, the students were engaged in interactive and social learning activities that aligned with constructivist principles. The geo-referenced *Minecraft* mapping took three different approaches (guided, targeted and hands-off) to understand the role of teachers in the learning process. Hence, this process contributed toward understanding how video games can be used to foster participation in disaster and DRR and the importance of considering the influence of the video game pedagogy for teaching and learning.

1.10 Significance of the research

This thesis challenges the dominant conventional approaches of video game research. As such, this thesis aims to integrate the fundamental principles of constructivist learning theory into not only the research methodology but also teaching pedagogy. Originally, the research emphasised the video game as being the central component to the learning process. Therefore, the original iteration of the methodological framework included conventional methods like pre and post-game assessments, as observed in the literature. However, the use of conventional quantitative and qualitative approaches in video game research were recognised as being misaligned with the epistemological approach of the thesis. To realign the methodological approach, group activities (e.g. carousel, scoring and ranking, one-word) gathered primarily qualitative but also quantitative data to understand the potential teaching and learning opportunities presented by video games in alignment with principles of constructivism. To our knowledge, the integration of learning theory into the methodological framework is a novel approach not previously utilised in existing research. The duality of the conceptualised methodological approach, not only gathered data around 'serious' disaster video games with museum visitors, students and teachers who are largely absent from disaster risk reduction education discussions (Luna, 2017; Petal, 2008), but also offered a potential teaching pedagogy to integrate video games into the educational environment. Thus, the conceptual and methodological approach of this thesis moves beyond the dominant approach observed within video game research (Table 1.8). As a result, the thesis provides empirical evidence directly from the players of disaster video games, and contributes to the limited body of disaster video game research. The findings have implications for not only disaster research, but also other areas utilising video games for learning, in understanding the teaching and learning process to enhance the building of awareness with the support of video games. The results of this thesis are relevant at the policy level, especially toward a contribution in the formalisation of a disaster curriculum.

Table 1.8: Dominant approach toward video game research versus the approach of this thesis

Dominant video game research approach	Approach adopted in this thesis
Positivist approach	Student-centred methodological approach underpinned by constructivism and participation
Focus on game content and motivation	Focus on interrelation of game content, mechanics, skill-building, player motivation and social interaction
Conventional methods (e.g. questionnaires, pre and post-game assessments)	Participatory tools alongside interviews and other conventional methods
Short-term assessment	Perceptions of the players and teachers toward the enhancement of the learning process
Focus on statistical representativity to confirm ability of video games to be used for learning	Investigating patterns for how players think and respond to a video game for the purpose of learning

1.11 Thesis structure

This thesis is written with publications. The subsequent chapters, following the introduction, comprise of five papers that are published and one manuscript still currently under review (Table 1.9). The introduction chapter, scientific peer-reviewed papers and conclusion chapter collectively form a comprehensive body of research, represented by this thesis. Importantly, an effort has been made to target different journals with different foci and emphasis to reflect the multi-disciplinary nature of video games and learning. This thesis not only aims to provide new theoretical insight around video games as learning tools but also seeks to provide practitioners, policy-makers and educators with practical information to better develop and utilise video games for learning.

Chapter two (agenda paper) builds upon the foundational research conducted in Stop Disasters 2.0 by Gampell and Gaillard (2016). This chapter develops a research agenda for exploring the contribution of video games to learning about disasters. The chapter provides a review of the existing literature surrounding dimensions of disaster and DRR, video games and constructivism, including an acknowledgement toward the importance of participation and play. The chapter concludes with several shortcomings of existing literature and the need for a video game research methodology that reflects the innate qualities of video games and the connection to constructivism.

Hence, the third chapter (methodology paper) examines the conventional methodological approaches used in video game research. The chapter highlights the tensions between such methods and the principles of constructivism. A ‘participatory’ methodological framework for video game research is conceptualised and proposed as an alternative approach for video game research that centres on video games supporting the learning process. This learner-centred approach recognises the connections between constructivism and the actively participatory nature of video games that can better facilitate the learning environment. The chapter outlines the emerging strengths and challenges of the framework based upon the experiences from the research case studies.

Chapter four (museum case study paper) details the initial field research conducted with the Earthquake Commission interactive video game display, *Quake Safe House*, located at Te Papa Museum in Wellington and Quake City in Christchurch. This case study utilised conventional methodological approaches, including structured pre and post-game interview questions alongside researcher observations. Upon reflection of the data collection process, a tension between the traditional approaches utilised and the epistemological framework underpinned by constructivist learning theory was identified. This reflection sparked the conceptualisation of the aforementioned ‘participatory’ methodological framework in chapter three. Several conclusions are drawn from the research findings relating not only to the influence of video game design upon the learning experience but also recommendations for greater inclusion of video games within a museum environment.

Chapter five (school case study paper) evaluates three ‘serious’ disaster video games, *Earth Girl 2*, *Sai Fah – The Flood Fighter* and *Stop Disasters!* for teaching and learning in the subject of geography. School students situated within Hawke’s Bay participated in pre and post-game questionnaires and student-centred group-based activities. This enabled an examination and comparison between the results of a conventional video game research approach with an approach aligned with the principles of constructivist learning theory. The chapter connects the methodological approach to a pedagogical social science teaching framework to indicate the potential of video games as learning tools. The inclusion of teachers' experiences and perspectives surrounding video games in the classroom, alongside the students' perspectives via the student-centred group-based activities, provides important insights into how video games can support and facilitate the learning process within the classroom directly from the participants. The chapter highlights the necessity of social group-based teaching tools to create meaningful contributions to teaching and learning.

Chapter six (*Minecraft* case study manuscript) gathers the experiences and lessons learnt from the previous museum and school case studies to investigate whether a geo-referenced *Minecraft* world can foster students' participation in learning about disaster and DRR. The chapter demonstrates how academics, teachers, students and local emergency management personnel can co-design a research process that simultaneously acts as a classroom lesson plan. Drawing upon the findings, the strengths and limitations of this scoping study indicate how mainstream video games like *Minecraft* can be repurposed and utilised as engaging disaster teaching and learning tools. As such, the chapter highlights the necessity for greater attention to considering video games as one tool among other tools connected to learning theory that can support the overall learning process in fostering participation in learning about disaster and DRR.

Chapter seven (policy paper) reflects upon the overall research process in an attempt to provide recommendations for the inclusion of video games within policies, the curriculum and the classroom for disaster risk education.

Chapter eight as the thesis conclusion pulls together the key research findings and highlights their contribution to wider understandings for how both 'serious' and mainstream disaster video games can foster participation in learning about disaster and DRR. This section makes recommendations for future disaster video game research alongside recommendations to enable disaster video games to best support the process of engaging and building disaster awareness.

Table 1.9: List of chapters/ articles included in this thesis[9]

Chapter (Article)	Title	Authors	Journal	Status
Chapter 2 (Article 1)	Beyond Stop Disasters 2.0: An agenda for exploring the contribution of video games to learning about disasters	Anthony Gampell JC Gaillard Meg Parsons Karen Fisher	Environmental Hazards	Published
Chapter 3 (Article 2)	On the use of participatory methodologies for video game research: Exploring disaster risk reduction in video games	Anthony Gampell JC Gaillard Meg Parsons	Methodological Innovations	Published
Chapter 4 (Article 3)	Exploring the use of the *Quake Safe House* video game to foster disaster and disaster risk reduction awareness in museum visitors	Anthony Gampell JC Gaillard Meg Parsons Loïc Le Dé	International Journal of Disaster Risk Reduction	Published
Chapter 5 (Article 4)	Disaster video games: An innovative approach to teaching and learning about disasters and disaster risk reduction	Anthony Gampell JC Gaillard Meg Parsons Loïc Le Dé	Journal of Geography	Published
Chapter 6 (Article 5)	Participatory *Minecraft* mapping: Fostering students participation in disaster awareness	Anthony Gampell JC Gaillard Meg Parsons Loïc Le Dé Graham Hinchliffe	Entertainment Computing	In Review
Chapter 7 (Article 6)	Fostering student participation in disaster risk reduction through disaster video games	Anthony Gampell JC Gaillard Meg Parsons Loïc Le Dé	Australian Journal of Emergency Management	Published

[9] The majority of content for every article remains as published or accepted for publication by the journal. However, in some instances, articles have been formatted or undergone minor revisions for thesis consistency.

Chapter 2 Beyond Stop Disasters 2.0: An agenda for exploring the contribution of video games to learning about disasters

2.1 Introduction

The rules of traditional learning engagement have changed. The world is experiencing a new technology-driven era (Cohen, 2011). However, methods of education have not progressed but rather remained rooted in traditional methods of teaching (Cohen, 2011). Technology has become a standard component of daily life, with the increasing accessibility to various electronic devices such as laptop computers, cell phones and tablets, the ease of access to information sits at the touch of a button. Various methods exist to access this information through apps, the internet and even video games. The increasing popularity of video games, amongst people of all ages, over the last few decades has signalled a significant research area for disaster studies, in terms of the disaster information being engaged with by players. The existing methods of education for building disaster and disaster risk reduction (DRR) awareness have primarily been driven from the top-down (Petal, 2007). However, video games are suggested to have the potential to increase user engagement through active participation, a staple concept of DRR practitioners (United Nations International Strategy for Disaster Reduction Science and Technical Advisory Group [UNISDR STAG], 2015). Video game participation differentiates from top-down education by allowing players to take control over the process of their personal learning development, building potential capacity to support self-centred learning (Chow et al., 2011; Cohen, 2011; al Mahmud, 2013; Ray et al., 2014; Schunk, 2012). A significant gap in knowledge arises, however, in terms of disaster research as a paucity of literature exists surrounding the usage of video games for building disaster awareness regardless of the fact that a multitude of 'serious' and mainstream disaster video games have been developed.

The objective of this chapter is therefore to set an agenda for an exploration into whether disaster video games, both 'serious' and mainstream, have the potential to build disaster and DRR knowledge in players. Preliminary disaster video game research revealed a definite requirement for further investigation into this dimension of disaster studies

(Gampell & Gaillard, 2016). An analysis of both 'serious' and mainstream disaster video games was found to potentially instil disaster awareness through the portrayal of hazards, vulnerabilities, capacities, disasters and DRR actions. These preliminary findings demonstrate the potential ability for disaster video games to promote a sustainable approach toward the practice of DRR, especially in terms of DRR education. Disaster video games demonstrate the potential ability to generate a variety of multiple solutions to a problem, stimulating and facilitating discussion surrounding the game, while additionally encouraging cooperation and collaboration, among many other potential outcomes. The agenda set here is not only of relevance for disaster studies, but also has significance for wider discussions regarding video games including perceptions of video games as learning tools. The following section briefly reviews concepts associated with disaster, such as vulnerability and capacity, leading into an overview of DRR and DRR education. The third section examines the theory behind games at large and fundamental gaming components of participation and play. The fourth section then begins to pull together the preceding components and demonstrate the linkages to the learning theory of constructivism. Finally, the fifth section addresses, in the context of disaster studies, the gaps in existing knowledge and considers why a constructivist perspective can provide a more sustainable approach toward the practice of DRR.

2.2 Disaster, DRR and DRR education

Disasters are events involving natural/human-made hazards that inflict harmful consequences upon infrastructure, livelihood and/or lives (Gaillard, 2015; United Nations International Strategy for Disaster Reduction [UNISDR], 2009; Wisner et al., 2012). However, it is necessary to accentuate that disasters are not natural events (Cannon, 1994; Collins, 2013; Petal, 2007). Disasters are steadily becoming understood as the result of human actions, affecting the social, political, environmental and economic sectors (Mercer, 2010). Increasingly, disaster scholars and practitioners are warning against separating disasters from the framework of everyday life (Gaillard, 2010; Mercer, 2010; Wisner et al., 2004), with emphasis placed on the influence of social conditions on disaster risk. Disaster risk encompasses hazard magnitude, occurrence potential, frequency, onset speed and spatial extent, while also acting as a function of susceptibility to loss, injury and death (Burton et al., 1978; Wisner et al., 2012). Disaster risk is a central concept to the overall research and has been depicted through the disaster risk mnemonic $DR = Hx[(V/C) - M]$ (Wisner et al., 2012) where DR stands for disaster risk, H for hazard, V for vulnerability, C for capacity for personal protection and M symbolises large-scale risk mitigation via preventative action and social protection (Wisner et al., 2012). A brief overview of these concepts is presented in the following paragraph.

Disasters are often associated with natural hazards (Gaillard, 2015), though a hazard only becomes a disaster after affecting vulnerable people (Cannon, 1994). The failure to consider how social and economic systems generate vulnerability in hazard focused research has been critiqued by numerous scholars (Mercer, 2010; Wisner et al., 2004, 2012). Accordingly, there has been a shift in focus for disaster and DRR research, which incorporates vulnerability to better address disaster risk (Wisner et al., 2012). The core notion to recognise is that vulnerability is subject to a broad spectrum of factors that influence the impacts experienced from a hazard. Marginalised individuals and communities are often considered most vulnerable due to various socio-economic factors, hazardous living locations, belonging to minority groups and/or are politically weak (Gampell & Gaillard, 2016). The social environment, as mentioned earlier, serves to shape and mediate the vulnerability status of an individual or community most notably in terms of harm susceptibility (Wisner et al., 2012). However, such individuals and communities can possess capacities that can balance vulnerability at an individual level, local level or by a larger entity such as government (Wisner et al., 2012). It is important to note that capacities should not be thought of as polar opposite to vulnerability (Wisner et al., 2012). While marginalised groups can be relatively vulnerable, they can still possess capacities to resist, cope, recover and overcome disaster (Gaillard, 2010; Gampell & Gaillard, 2016). DRR scholars and practitioners, emphasise the need to recognise, enhance and use capacities to reduce the risk of disaster (Wisner et al., 2012).

Risk mitigation is the final component of the disaster risk mnemonic. Wisner et al. (2012) suggest preventative actions and social protection accomplishes larger-scale risk mitigation. Disaster prevention, including both active action (hazard avoidance) and passive action (reduction of potential spatial and temporal effects), intends to avoid adverse impacts from a hazard by focusing upon the hazard (UNISDR, 2009; Wisner et al., 2012). However, complete avoidance of a hazard is often not feasible (UNISDR, 2009). Therefore, mitigation focuses upon limiting the potentially adverse impacts of a hazard (UNISDR, 2009), either through direct mitigation, addressing symptoms of vulnerability and encompassing hazard resistant construction plus the exchange of hazard-related knowledge while indirect mitigation targets the root causes of vulnerability to enable better sustainable resource access (Wisner et al., 2012). Social protection is the level of protection/ degree of preparedness, granted through state activities or those of other social intuitions like non-governmental organisations (Cannon, 1994), aiming to build capacities which effectively manage emergencies and achieving successful transitions from response through to recovery (UNISDR, 2009). Capacity enhancement at a household/community level can involve activities like warning systems, contingency planning, evacuation routes and meeting points, livestock protection, stockpiling equipment and supplies in order to strengthen people's strategies when facing hazards and to cope with the disruption to daily life (Cannon, 1994; UNISDR, 2009; Wisner et al., 2012).

Disasters, as argued previously, are to be considered unnatural events (Collins, 2013) whereby the risk of disaster largely results from societies' and people's vulnerabilities as reflected in everyday interactions within the social, political and economic environments (Gampell & Gaillard, 2016). DRR works to increase people's awareness, especially among the vulnerable, through hazard prevention, reducing vulnerability and enhancing capacities to reduce the impacts of a disaster (Solecki et al., 2011). It is evident that the three approaches, prevention, mitigation and preparedness, must work together to successfully mitigate disaster risk. The context of different environments including the complexities of and the structure of daily life for individuals mean the actions, approaches and knowledge transfer for the successful reduction of disaster risk must complement and build upon each other, which includes public awareness and education (Gaillard & Mercer, 2013).

DRR aims to reduce disaster risk through systematic efforts to analyse and manage causal factors of disaster via risk mitigation, preventative action and improved preparedness, which includes education initiatives (International Federation of Red Cross and Red Crescent Societies [IFRC], 2013; UNISDR, 2009). DRR education is a process of sharing knowledge amongst different actors to raise awareness toward reducing risk (Petal, 2007). The International Decade for Disaster Reduction (IDNDR) during the 1990s saw top-down directed efforts toward education (Petal, 2007). However, the end of the IDNDR revealed the knowledge failed to make its way into practice (Petal, 2007). Since the 2005 World Conference on Disaster Reduction in Kobe, Japan, efforts redoubled resulting in an influx of new educational material (Petal, 2007). This material came in various forms of media and popular culture such as books, songs, board games and video games, requiring an appreciation for the roles of both formal and informal education (Petal, 2007; Quarantelli & Davis, 2011).

Risk reduction education is frequently conducted by scientific, academic and technical experts, emergency managers and NGOs, with teachers and communication experts rarely part of such discussions (Petal, 2007). The lack of teacher and player engagement in the overall process was noted during preliminary research, with most educational disaster video games targeted towards students (Gampell & Gaillard, 2016). Yet, all stakeholders need to be part of the education process, where various views can be integrated from both the top-down and bottom-up. An inclusive process will work toward ensuring DRR messages are universally consistent while allowing contextual variations (IFRC, 2013). Luna (2012) suggests DRR education requires mainstreaming through the curriculum. However, this requires teachers having an understanding of DRR, something not generally learnt at tertiary level (Luna, 2012). Petal (2007) suggests an understanding of child and adult thought processes, imagination and learning is vital to the success of disaster education. Such discussions could lead to beneficial impacts in terms of disaster risk education, reviewing whether key messages have been received through disaster video games and game mechanics that could improve knowledge extraction, retention and practical usage of this knowledge. Disaster risk education is a core link connecting video games to DRR and enables the exploration of disaster video games as a potentially effective future learning tool involving active participation.

Participatory methodologies are increasingly utilised in DRR (Le De et al., 2015). Participatory methodologies act as an alternative to the top-down technocratic approaches, which often dominate the DRR process (Le De et al., 2015). The participatory process can empower those considered voiceless, while concurrently providing a platform for top-down and bottom-up convergence (Chambers, 2008). Active participation is a core fundamental of video games. The utilisation of player knowledge and experience to solve puzzles in game, via the games mechanics demonstrate how video games could empower players to generate solutions and lay the foundation for greater learning. The next section begins to tease apart various aspects of games and game mechanics, linking them to learning.

2.3 Games, Participation and Play

Games, including video games, form a central part of popular culture. Strict definitions of what is or is not a video game is problematic due to the continuous expansion of video games and the diversity of content (Granic et al., 2014), though this presents positive potential for links to other creative industry involvement. Similarly, popular culture is not clearly defined, with Dynes (2000) arguing that popular culture should remain an adaptive, unrestrictive and fluid concept for the purpose of research as restrictive boundaries limit the potential areas for exploration. The next sections, therefore, do not set specific parameters for what may or may not be considered a video game or popular culture but, rather, will serve to highlight and cover broad concepts relevant to this study beginning with a brief overview of core game dimensions and mechanics.

Key components of video games, Kapp (2012) suggests, are player engagement through instant feedback and constant interaction related to the challenges of a game, defined by a set of rules that work within a system to create an emotional reaction, which results in a quantifiable outcome within an abstract version of a larger system. The elements that play a crucial role in the creation of the virtual spaces players engage with are encapsulated in Table 2.1.

Table 2.1: Video game terminology and associated definitions adapted from Kapp (2012)

Term	Definition
Game	A system where players engage in an abstract challenge, defined by rules, interactivity and feedback, resulting in a quantifiable outcome drawing out an emotional reaction.
System	Set of interconnected elements occurring within the game space. A score related to behaviour in turn related to strategy is linked to action, actions are limited by rules.
Players	Person(s) involved in interacting with game content or other players.
Abstract	The abstraction of reality taking place between a narrowly defined game space resulting in the elements of a realistic situation or the essence of a situation but not an exact replica.
Challenge	Process of achieving goals and outcomes that are not straightforward. A challenge engages players to achieve the winning state, boredom stems from when a challenge no longer exists.
Rules	Rules define the game. Rules structure the game defining the play sequence, winning state and beliefs of fair play within the game environment.
Interactivity	Relates to the interaction of players with one another, the game system, and the content presented within the game.
Feedback	Instant, clear and direct information provided to players. Players process the positive/negative feedback information received, attempting corrections or changes
Quantifiable outcomes	A defined clear winning state, players are completely aware of whether they have won or lost without ambiguity.
Emotional reaction	Games evoke strong emotion from players. Ranging from victory satisfaction to the agony of defeat, can include emotions of sadness and frustration.

Source: Gampell and Gaillard (2016)

Participation is one of two critical components to gaming. Granic et al. (2014) highlight that players actively engage with the system, an aspect delineating games from other activities. Movies, for example, provide a passive experience rather than an active experience (Heaven, 2015). The camera defines the movies' parameters and follows actor(s) as they navigate an environment and guide movie viewers (Heaven, 2015; Wixon, 2006). In contrast, video games place players into a game world, requiring self-navigation and active decision-making. Games like the *Fallout* series require players to create a character that becomes the interface for players to engage with the post-apocalyptic open game world. Players navigate their character through the game world and control various decisions ranging from behavioural, moral and conversational. This active element to games offers the potential to generate and evoke deeper emotion and experience in players (Heaven, 2015; Wixon, 2006), as players can place a version of themselves or an alter ego into the game world which can present a platform for learning. A list of the video games mentioned in text is provided in the list of references.

The concept of play is the second critical component to gaming (Granic et al., 2014; Rieber, 1996; Zanon & Kronborg, 2013). Research into the benefits of playing video games specifically is limited, although the functions and benefits of play are numerous (Granic et al., 2014). Play is extremely difficult to define, but acknowledged as an important mediator for learning (Rieber, 1996). Rieber (1996) organises play around four themes: play as progress, as power, as fantasy and as self, depicted in Table 2.2. These four themes connect play to the educational philosophy of experimentalism, also referred to as pragmatic constructivism. This educational philosophy is a method of assessing an environment and through experimentation find ways to improve the environment (Rieber, 1996). Examples of such games include *Stop Disasters!* that tasks players with assessing the level of risk for a variety of natural hazards and attempting to find the best method of reducing the impacts from the hazard. Similarly, mainstream city management video games like *SimCity*, *Tropico 5* and *Anno 2070* are more complex requiring players to assess their city's needs in regards to traffic, pollution, water, energy, security as well as preparing for a disaster situations, to keep their city running efficiently. Participation and play collaboratively establish that games require players to be actively engaged in the process, while the act of play reflects the educational philosophy of constructivism, in turn presenting the rationale for games to be learning tools.

Table 2.2: Theories of play adapted from Rieber (1996)

Play as:	Definition
Progress	Means to improve or enable psychological or social needs.
Power	Refers to contests or competitions, where winners and losers are declared.
Fantasy	The role of liberating the mind to engage in creative and imaginative thinking.
Self	Quality of the experience is valued over secondary outcomes, such as learning.

The emerging scholarship on play and games (Kapp, 2012; Rieber, 1996) highlights that video games are effective learning tools. The combinations of components that create a video game provide an opportunity for players to undergo self-regulated learning (Rieber, 1996; Zanon & Kronborg, 2013). In order to explore the usefulness of video games as DRR learning tools, consideration of learning theory is necessary to consider.

2.4 Constructivism: the foundation for video game learning theory

The use of video games for educational purposes is supported by learning theory (Ray et al., 2014). Learning theory refers to conceptual frameworks illustrating the absorption, processing and retention of information during learning through cognitive, emotional, environmental and experiential influences (Schunk, 2012). Constructivist framings of learning, in particular, assert that learners, through active engagement and self-regulation, construct their knowledge based upon their own experiences and reflecting upon those experiences, which links with literature on participation and suggests the potential capacity of video games to support student-centred learning (al Mahmud, 2013; Chow et al., 2011; Cohen, 2011; Ray et al., 2014; Schunk, 2012).

The core assumption of constructivism assumes individuals are active learners developing knowledge for themselves (Schunk, 2012). Video games provide an environment where such direct learning through active participation can occur. Players gain access to various experiences through video games which are otherwise unattainable (Gredler, 2004; Zanon & Kronborg, 2013), like the aftermath of the Haiti earthquake (*Inside the Haiti Experience*), civilian survival during a war (*This War of Mine*) or visualising the effects of climate change by terraforming planets (*Spore*). Such virtual environments present an opportunity for instructional scaffolding, allowing engagement at an experiential level, managing cognitive load but permitting users to experiment with practical theories and hypotheses in a controlled virtual space (Gredler, 2004; Schunk, 2012; Zanon & Kronborg, 2013). Video games allow players to observe the consequences of their actions which facilitate assessments of success or morality (Squire, 2006; Zanon & Kronborg, 2013). This process leads players toward another application of constructivism: self-regulation. The observation of consequences by players teaches self-regulation by encouraging active engagement in the process by setting goals, monitoring and evaluating progress, and going beyond basic requirements by exploring interests (Geary, 1995; Schunk, 2012). Examples may include the receiving of feedback at the end of the scenario from *EarthGirl 2* and *FloodSim* providing gameplay information, highlighting areas that players could focus their efforts in an attempt to improve upon their play through. Scoresby and Shelton (2011) argue such self-regulation and self-control over their actions forces players to more strongly identify and take responsibility for their actions, resulting in a positive learning experience (Zanon & Kronborg, 2013).

The nature of player engagement and learning effectiveness from video games is not well understood and engagement is often negatively perceived (Boyle et al., 2012; Granic et al., 2014). Preliminary disaster video game research derived a key conclusion that often DRR video games were not subjected to effectiveness evaluations (Gampell & Gaillard, 2016) highlighting a crucial gap in the DRR video game nexus. Existing video game literature is generally concerned with player exposure to game content and the impacts such content has upon player behaviour (Ivory, 2013; Schuurman et al., 2008). Often, video game literature focuses on negatively perceived game content such as the violence demonstrated in games (Ivory, 2013) like *Grand Theft Auto*. Such approaches should also consider other game mechanisms like player motivation, skill building and social interaction and underlying roles of formal and informal education before deriving an extreme conclusion. Preliminary research suggests that, disaster video games, with the intention of building disaster knowledge in players, are often information dense and set some form of learning objectives (Gampell & Gaillard, 2016). *Sai Fah–The Flood Fighter* requires players to achieve set goals in order to progress through the level and move to the next. However, preliminary research also demonstrated that mainstream disaster video games could portray DRR messages, with exploration into the other game mechanics. While gameplay still requires players to achieve certain goals, the games often possess a larger degree of flexibility providing players an opportunity to set their own agendas, explore and experiment which therefore helps players take ownership of their personal learning.

2.5 Video games as tools for a more sustainable approach toward DRR awareness

Despite the growing prevalence of disaster themed video games, little research has been conducted upon this genre, with almost no research regarding the effectiveness of these games for DRR. However, the pathways identified in this chapter suggest that video games could result in sustainable DRR awareness. Constructivist learning theory reveals that players have the ability to be self-engaged in the learning process through participation and play. The ability of players to take control over their own learning can enable a sense of empowerment. As identified by Petal (2007), top-down efforts toward education during the IDNDR failed to achieve the translation of knowledge into practice. Prensky (2002) suggests that video games provide players with five levels of learning: how, what, why, where and when. At the first level players learn how to do something and, more importantly, practice the skills they have learnt. Players learn what to do and equally learn what not to do on the second level by utilising the skills learnt on the first level. By the third level, players understand the consequences of their actions by learning why something is happening. By understanding the cause and effects of particular actions, players can formulate a game strategy to overcome a problem and achieve the winning state. The fourth or where level, relates to the context of the game world, players must learn about the cultural and environmental components of the game world. The final level explores the when, where players make value-based and moral decisions about what they are doing and whether it is right or wrong. Disaster-based video games could therefore provide a useful entry point into a more bottom-up learning approach. Players can explore ideas related to DRR rather than being directed systematically from a top-down approach on what they should or should not learn. Table 2.3 depicts the levels of learning indicated by Prensky (2002) and the potential learning outcomes that could be achieved in the context of a disaster video game. How a player approaches the game will be dependent upon their previous knowledge and experiences of disaster and DRR. However, the constructivism mechanisms present within a video game can enable all players to build upon their existing knowledge and provoke interest and engagement in DRR. Therefore, disaster video games could be important and effective tools to generate sustainable DRR awareness in players.

Table 2.3: Five levels of learning for a DRR video game adapted from Prensky (2002)

Level	Potential learning outcome
How	Players learn about disasters and the actions necessary for successful DRR.
What	Players learn what can and cannot be realistically achieved in terms of DRR and any potential constraints.
Why	Players formulate a strategy to achieve a successful DRR outcome.
Where	Players are introduced to a various environments and cultural considerations.
When	The choices made by the player throughout the game which have impacted upon the outcome following a disaster.

2.6 Conclusion

This chapter has reviewed concepts associated with disaster and disaster risk such as vulnerability and capacity. The overview of DRR presents a foundation for understanding the aims that DRR attempts to achieve, which ultimately forms the basis for DRR education. Since teachers often have no formal training in understanding fundamental ideas of disaster, it is necessary for teaching material to be created for the purpose of increasing disaster awareness to ensure the effectiveness of teaching DRR messages. Teachers are not required to partake in any training courses during higher education;

however, this is an area worthy of attention. A dialogue needs to be created with not only teachers but also students to help better address this crucial gap. This chapter has also examined, present game theory and has looked to elaborate two fundamental gaming components, participation and play. The core idea that games require active participation by players reflects the ability of games, specifically video games, to encourage active engagement with the material constructing the specific game. The acknowledgement of play as an important mediator for learning is also a core critical component of gaming. Players have the ability to experiment within the gaming environment. The connection between play and participation, therefore, reflects the concept that, if a player is making an effort to actively engage and participate then the player is additionally making the conscious effort to experiment, learn and engage with the material presented to them. The learning theory of constructivism demonstrates the potential of video games to be learning tools. As players self-regulate their behaviour, they additionally are taking control over their personal experiences and the potential for learning, not only in regards to game content, but also skills, motivations and social interactions. Furthermore, as players move through five levels of learning, their understanding of a particular topic and visualising the consequences of their actions, help players to formulate problem-solving strategies. This chapter has presented a framework from which future disaster video game research can expand from. The ideas presented here will be used to formulate a diverse array of methodologies to begin the next stage in disaster video game research: testing and assessing both 'serious' and mainstream video games with participants. Such an approach will present evidence that may either support the concept that video games can be utilised as learning tools for sustainable DRR awareness or that video games are in fact ineffective in building sustainable disaster DRR awareness.

Chapter 3 On the use of participatory methodologies for video game research: Exploring disaster risk reduction in video games

3.1 Introduction

Video game research largely focuses on examining the effects of video gameplay on cognition and behaviour (Buelow et al., 2015). Numerous studies explore the negative aspects of violent video games surrounding aggression (Anderson, 2004; Anderson et al., 2010; Hasan et al., 2013), with a smaller number of studies highlighting the benefits of playing video games (de Freitas & Neumann, 2009; Prensky, 2002). Video game studies consider the possibilities for video games to be used as learning tools. However, such studies chiefly focus on the different components of a video game like game development, video game content and/or player motivations (see Rebolledo-Mendez et al., 2009; Tsai et al., 2015). While these studies seek to investigate the effectiveness of the gameplay on players' learning, the methodological approaches that are frequently employed by researchers often do not match up with the central tenets of learning theory (specifically constructivism) that underpin such research. Therefore, a gap exists in current scholarship surrounding what are the most appropriate research methodologies to employ, and how to ensure research methodologies are in alignment with learning.

At present, researchers use a variety of methodologies to conduct their particular area of video game research as no standardised approach exists. Lankoski and Björk (2015) and Mäyrä (2015) observe that new areas of game research, like disaster video game research, are often void of previous successful research frameworks to provide systematic guidance. The methodological implications of how to undertake such specific enquiries are therefore lacking. This means innovation is required by video game researchers when looking to explore new research dimensions (Mäyrä, 2015). However, in order to generate paradigm shifts within scholarship, researchers require intimate knowledge of previous research, including of their strengths and shortcomings (Mäyrä, 2015). This is especially important within disaster video game research, as the researcher requires knowledge of not only the methodological approaches within disaster studies but also how to ensure such approaches are also appropriate for video game research.

The utilisation of diverse methodologies is of critical significance within such transdisciplinary research that incorporates different disciplinary traditions and the perspectives of users and practitioners (Popa & Guillermin, 2015). This chapter is therefore directed at drawing connections between a diversity of methodological approaches and demonstrating how such methods can be brought together within a methodological framework. This framework provides an innovative approach to video game research focused on learning.

Video games hold a significant role and influence in society as popular culture products. Video games frequently feature disaster scenarios, with disasters defined as events involving natural/human-made hazards that inflict harmful consequences upon infrastructure, livelihood and/or lives, due to resulting human actions which affect the social, political, environmental and economic sectors (Gaillard, 2015; Mercer, 2010; United Nations International Strategy for Disaster Reduction [UNISDR], 2017; Wisner et al., 2012). Video games like *Frostpunk*, the *Fallout* or *Metro* series or 'serious' disaster games like *Earth Girl 2* or *Sai Fah – The Flood Fighter*, offer insights into different conceptualisations of disaster that exist within society, as well as what those differences mean in terms of how people learn about and potentially respond to disaster events (Gampell & Gaillard, 2016; Quarantelli & Davis, 2011; Wachtendorf, 1999; Webb, 1998, 2007). The ever-increasing popularity of both 'serious' and mainstream disaster video games from various international NGOs, governments, researchers and global game development studios necessitates a critical examination of how such games can be used as disaster learning tools. Previous disaster video game research indicates that disaster video games can instil disaster awareness through their portrayals of concepts such as hazards, vulnerability and capacities as well as actions for disaster risk reduction (DRR) (Chapter 2; Gampell & Gaillard, 2016). However, limited understanding exists surrounding how such disaster video games actually contribute towards learning beyond trying to raise risk awareness.

The growing importance of researching video games for DRR is situated within the context of wider social change. Digital and technological advancements over the last three decades have resulted in information being available at the touch of a button. The changing availability and consumption of information, in combination with the persistent need for DRR, requires reconsideration of traditional education and learning methods. As young people grow up in an ever-increasing digital world, their familiarity of information technologies requires their learning space to transcend the limitations of the physical space (Chau et al., 2013). Hence, the immersive environments presented by video games provide players opportunities for personalised learning experiences and higher learning autonomy (Chau et al., 2013). This evolution involves a shift away from traditional deductive learning strategies (involving a concept being given to a learner to use on examples) (Amory & Seagram, 2003) towards more inductive learning strategies (focused upon learner discovery) (de Freitas & Neumann, 2009). Taking such an approach allows for engaged learning experiences and opportunities to construct concepts and rules based upon the learner's personal interpretations (Amory & Seagram, 2003), which in the case of this chapter, learner refers to the video game player and/ or playing companion.

This chapter commences by reviewing the broad methodological approaches currently utilised in video game research. Following this review, a rationale for using participatory methods for video game research is presented and connected to constructivist learning theory. Based upon the researchers' own disaster video game research a case is presented for how participatory approaches could be used by other video game researchers investigating the ability of video games to be used as learning tools. The participatory tools used in the research process are detailed while simultaneously examining the strengths and challenges of each tool. In conclusion, an innovative and novel methodological framework for disaster video game research is presented, with a critical engagement and reflection upon the discussed methodologies and broader scholarship regarding research practices.

3.2 Conventional video game research methodologies

Video game research can draw upon a broad selection of research methods and approaches of both a quantitative and qualitative nature, where deemed appropriate for the specific research investigation. The methodological diversity employed, reflects both the different researchers' disciplinary backgrounds (Lankoski & Björk, 2015), as well as the emergent nature of video game research which often requires scholars to develop original methods to proceed with their research into relatively uncharted territories. Mäyrä (2015) argues that an understanding of previous research and its shortcomings are necessary for video game researchers to suggest innovative methodologies to investigate new research areas. While the field of disaster studies documents numerous methodological approaches for researching disasters and DRR (e.g. Phillips, 2014), the specific field of disaster video game research is relatively undefined (in terms of methodological approaches). This position supports Mäyrä's (2015) notion that video game researchers need to be innovative to explore new areas of video game research. However, having intimate knowledge of previous research and its shortcomings is not as straightforward. Limited disaster video game research explores the strengths and limitations of different methods and assess a player's learning. This chapter investigates how researchers may overcome this challenge and limitation. It is argued that by exploring the commonly utilised methodologies within disaster research, alongside those of video game studies with a learning focus, can enable the generation of a reflexive and appropriate methodology that can align with and facilitate opportunities for constructivist-based learning. By addressing both the current research approaches and the gaps within the current literature enables the formulation of an appropriate methodological framework to conduct, not only disaster video game research but also potentially any form of video game research with a focus upon education and learning.

However, video game scholars find the concept of methodological and conceptual diversity problematic, as no one conceptual and methodological video game framework exists to allow for the interpretation and comparison of results and effects (Rebetez & Betrancourt, 2007). Scholars like Aarseth (2001) argue that video games should be given their own branch of theory, however in itself this is also highly contested, due to differing research focuses ranging from narratology, ludology (Aarseth, 2001) or interdisciplinary approaches (Wolf & Perron, 2003). Due to the expansive collection of potential methodologies and research topics, elaboration of all possible methods in specific detail is nearly impossible. Therefore, this chapter examines common conventional approaches utilised in video game research as a contextual foundation to introduce a participatory methodological framework for the conduct of video game research, informed by the researchers own disaster video game research process.

Most video game research concerned with the examination and exploration into the effectiveness of, or potential for, video games to be positive learning tools utilises quantitative approaches. Quantitative methods of data collection aim to collect data, objective in nature, limiting the ability for subjectivity and finding based upon the interpretations of patterns revealed in the data (Landers & Bauer, 2015). Studies from Buelow et al. (2015), Chau et al. (2013), Miller et al. (2011), Pilegard and Mayer (2016), Shute et al. (2015) and Yang (2012) collect or generate quantitative data to run various statistical analyses and generate conclusions. These studies employ a range of quantitative tools, including but not limited to, questionnaires (Buelow et al., 2015; Chau et al., 2013; Miller et al., 2011; Pilegard & Mayer, 2016) and knowledge tests (Chau et al., 2013; Miller et al., 2011; Pilegard & Mayer, 2016; Shute et al., 2015; Yang 2012). A control group is often arranged to allow a comparison between the use of a video game and other teaching tools. For example, Chau et al. (2013) had the control group watch a video of the *Second life* game environment compared to the video game group who interacted with the *Second life* game environment. The primary advantage of such quantitative research is the ability for future researchers to replicate the research and compare results to generate a scientific consensus.

Winchester and Rofe (2016) review the perceived dualistic relationship between quantitative and qualitative research, suggesting qualitative research methods as defining the research problem, hypotheses development, research design, data collection and deriving meaning through analysis. However, acknowledging the subjectivity and value-based nature of all research methods, in line with Popa and Guillermin's (2015) call for reflexivity, in turn reduces the gap between quantitative and qualitative methods

(Winchester & Rofe, 2016). In the context of video game research, qualitative research focuses upon two main areas, understanding the video game and understanding players and their gameplay experiences. Interviews (Pitkänen, 2015) and focus group activities (Eklund, 2015) aimed at narrative extraction from players regarding gameplay experiences, can also fall under the broader ethnographic research approach (Creswell, 2007). Qualitative research was employed by Nilsson and Jakobsson (2011) to explore the ways in which real worlds provided by *SimCity 4* could be a potential facilitator for science learning contexts. Nilsson and Jakobsson (2011) utilised focus groups, alongside video recordings of both participants' explanations and interactions with their respective group's future city model, to encourage participants to discuss different experiences and views with each other. Focus groups can be advantageous for observing everyday behaviour, jokes, arguments and discussions surrounding video games in a more social environment (Eklund, 2015), while simultaneously allowing for fact checking between respondents compared to results attained from one on one interviews (Nilsson and Jakobsson, 2011). Ultimately, the rich collection of information acquired from qualitative methods can be analysed to extract trends and broad themes from participant responses (Landers & Bauer, 2015) demonstrating how the material is conceptualised and perceived by people.

3.3 Connecting participatory approaches to DRR and constructivism

Video game research often utilises quantitative approaches or quantifies qualitative data to generate statistically analysed conclusions to derive a scientific consensus. Mayoux and Chambers (2005) review of research approaches for the consideration of participatory approaches found quantitative research is generally considered more credible and superior to both qualitative and participatory methods. Qualitative data are often depicted as explanations for research findings (Mayoux & Chambers, 2005), though these data are often focused and reflective of the researcher's research agenda. While quantitative and qualitative methodologies have their respective strengths, opportunities for more accurate quantitative and qualitative data may be possible from using participatory methodologies (Chambers, 2007; Mayoux & Chambers, 2005).

DRR aims to reduce disaster risk and increase people's awareness, especially among the vulnerable, by preventing hazards, reducing vulnerability and enhancing capacities to reduce the impacts of a disaster (Solecki et al., 2011; UNISDR, 2017). A hazard refers to a natural or anthropogenic phenomenon that may cause loss of life, injury, property damage and disruption to the functioning of society in a given location at a given time (UNISDR, 2017). Vulnerability mirrors the susceptibility to suffer from harm and damage in the event of a hazardous phenomenon or the condition of a society which makes it possible for a hazard to become a disaster (Cannon, 1994), while the term 'capacities' refers to the combination of knowledge, skills and resources a group of people or individuals resort to in managing and reducing the potential impacts of a hazard (Gaillard et al., 2019).

Given the complexities and structure of daily life in different environments for individuals, means successful DRR requires the actions, approaches and knowledge transfer to build upon and complement the other (Gaillard & Mercer, 2013). DRR cannot just address the hazard, respond to disaster, focus solely upon vulnerability, or be only top-down or bottom-up (Wisner et al., 2012). While disaster research utilises the same conventional quantitative and qualitative methodologies, disaster research increasingly utilises participatory methodologies and approaches as an alternative to the top-down technocratic approaches that often dominate the process of DRR (Le De et al., 2015; Pelling, 2007). While top-down technocratic initiatives rely upon scientific knowledge (Hewitt, 1983), bottom-up participatory actions attempt to collaboratively foster knowledge, perceptions and priorities of a large collection of stakeholders across all scales. Petal (2007) notes risk reduction education is frequently conducted from the top-down, without the inclusion of bottom-up perspectives from teachers and students. As such, participatory methodologies can concurrently empower those considered voiceless and provide a platform for top-down and bottom-up convergence (Chambers, 2008).

Research reinforces that video games have strong links to constructivist learning theory (Adams, 2007; Chau et al., 2013; Klopfer et al., 2018; Ray et al., 2014), though such research does not always take into consideration how the research methodologies may influence the research outcomes. Participation is not only a crucial element to participatory tools but is also fundamental to the nature of both video games and constructivist learning theory. Klopfer et al. (2018) adopt a constructivist approach towards resonant game development noting '*An idea central to our development of resonant games is that learners will best develop knowledge and skills by doing things in the world – knowledge is not delivered but constructed by the learner through and during activity and discovery*'. Constructivist learning theory considers learning to be an active process whereby learners actively construct, build and test new ideas or concepts against existing and past knowledge (Adams, 2007; Chau et al., 2013). Garrison and Anderson (2003) believe education has two purposes. First, the learner constructs meaning based on personal experience, supported by Amory and Seagram (2003), and second, the learners confirm ideas collaboratively within a community of learners, supported by Chau et al. (2013). Hence, constructivism is guided by two core pedagogical principles, the first suggests that the learning should be authentic, active and student-centred (Splan et al., 2011). Video games, by nature, require active player participation. Players are required to self-navigate and make active decisions, often reflective of the player's cultural, moral and behavioural understandings. Dede (1995) suggests virtual environments can provide such learning opportunities without real world repercussions, personalising individual learning experiences. However, when comparing the first pedagogical principle of constructivism to existing video game research (Buelow et al., 2015; Pilegard & Mayer, 2016; van Lankveld et al., 2017), participants are often provided with information, or requirements which removes the authenticity of any potential self-regulated learning.

The second pedagogical principle of constructivism suggests learning should also be simultaneously facilitated through social negotiation (Splan et al., 2011). Social negotiation allows learners to progressively test their constructed knowledge (Adams, 2007), and evaluate the viability of this constructed knowledge against alternative views, simultaneously enhancing the learning experience through collaborative learning and group activities (Chittaro & Ranon, 2007) or guided further by mentors and/or models, referred to as the more knowledgeable other and zone of proximal development (Meece & Daniels, 2008; Splan et al., 2011). Vygotsky emphasises the importance of social interactions upon learning, whereby knowledge is co-constructed between two people and not individually (Meece & Daniels, 2008). Chau et al. (2013) highlight the importance of knowledge sharing in constructivist learning. The interactions between the player and the video game, by performing various tasks, and the player with other players, through discussions among themselves, allow for learners to build personal knowledge while simultaneously sharing knowledge, experiences and activities. This knowledge sharing process enables the flow of new information or to build ideas during discussions to help enhance understandings of the material.

Klopfer et al. (2018) reflect upon the five-stage experiential learning model from Joplin (1981), whereby students are focused upon skills and information before a challenging activity, debriefing the experience of the activity as a group of learners with mentors providing feedback and support throughout the process. Klopfer et al. (2018) note that while games provide in-game feedback and support to players, their development of resonant games attempt to engage players with real life human support and interaction where possible. However, existing video game research at large, seemingly inhibits the potential possibility to foster the process of such learning to occur, as the learning process is studied from the outside. Hence, consideration of participatory approaches towards video game research could enable opportunities to foster authentic, active and player-centred learning while facilitating collaborative discussions and a space for social negotiation.

3.4 Outlining a participatory methodological framework for video game research

The majority of existing video game research focuses on player exposure to game content, specifically negative or violent content, and its potential impacts of behaviour (Ivory, 2013; Schuurman et al., 2008). However, limited research exists that examines the possible behavioural impacts of game mechanisms, player motivations, skill building and social interactions from the perspective of the research participants also known as video game players. This gap in knowledge is particularly noticeable in the context of scholars' understandings of how video games directly foster learning. Evidently, not all research initiatives are aimed at directly fostering the learning process, but instead choose to explore the possible learning instilled by video games. Hence, this thesis aims to address how disaster video games, both 'serious' and mainstream, can foster participation in learning about disaster and DRR.

Various international NGOs, governments and researchers are producing 'serious' disaster video games alongside mainstream disaster video games. However, despite the growing prevalence of disaster-themed video games, little research has been specifically conducted upon disaster video games for learning and almost no research considering the effectiveness for such games to build disaster and DRR awareness. Such disaster video games are utilised throughout various situations and settings, ranging from museums, schools and for personal use. Table 3.1 presents a condensed version adapted from the larger disaster video game typology by Gampell and Gaillard (2016). The disaster video game typology by Gampell and Gaillard (2016) works to confirm the intended goals of each game, like a focus upon preventive actions, by aligning the games content to DRR actions included within prevention (the actions taken on hazards to avoid potentially adverse impacts through advance action (Cuny, 1983; UNISDR, 2017)), mitigation (the actions on vulnerability to limit the adverse impacts of hazards (Cuny, 1983; UNISDR, 2017)) and preparedness (the actions on capacity to effectively anticipate, respond to, and recover from, the impacts of hazard events or conditions (Cuny, 1983; UNISDR, 2017)). Like Gampell and Gaillard (2016), Klopfer et al. (2018) note game content alone cannot inform whether a game resonates with the target audience for the chosen context, more appropriate data are required to measure the learning outcomes (Klopfer et al., 2018). Therefore, Table 3.1 serves a greater purpose than simply acknowledging what a disaster video game achieves in terms of DRR content and whether the intended game development goals of incorporating specific DRR actions are satisfied. Table 3.1 allows disaster video game researchers to consider the potential learning outcomes from such disaster video games and then select appropriate participatory tools through which to explore whether the disaster and DRR material resonates with participants. This methodological approach extends beyond simple acknowledgment of disaster content and instead reveals how participants/players connect the virtual and their surrounding environment. The approach ultimately presents an opportunity to consider whether such games could indeed foster participation in learning about disaster and DRR.

This thesis worked to incorporate participants from various educational institutions including New Zealand schools (intermediate to high school), secondary school social science teachers and museums. This thesis selected several 'serious' disaster-based video games from the disaster video game typology including *Earth Girl 2*, *Stop Disasters!*, *Sai Fah – The Flood Fighter* and *Quake Safe House*. The range of participants involved, alongside the utilisation of participatory tools, generated an opportunity to investigate the use of video games in various situations, locations and whether such video games could be used to foster participation in learning about disaster.

As video game scholarship previously emphasised, understanding the research material including clarity around the research question is a significant requirement to determine methodological approach. Therefore, to adequately address the main research aim of this thesis, Table 3.2 outlines the four research objectives and associated methodological approaches, which have informed the construction of a participatory methodological framework for video game research.

Table 3.1: Abridged version of previous disaster video game research connecting games to a DRR framework

			Disaster Video Games								
			DRR				Post-Apocalyptic		X	City Management Simulation	
			Earth Girl 2	Quake Safe House	Sai Fah - The Flood Fighter	Stop Disasters!	Fallout Series	Metro Series	Frostpunk	SimCity 4	Tropico 5
DRR	Prevention	Use of human made structures	X	X	X	X	X	X	X		
		Landuse regulations				X	X			X	X
		Basic need and services provision			X	X	X	X	X	X	X
		Engineering design	X	X	X	X	X		X		
	Mitigation	Engineering techniques/ hazards resistant construction	X	X	X	X	X		X	X	X
		Environmental policies							X		X
		Public awareness	X		X	X	X				
	Preparedness	Disaster risk analysis	X	X		X	X		X		
		Early warning systems	X			X	X		X	X	
		Stockpiling equipment and supplies			X		X	X	X		X
		Coordinated evacuation	X		X	X	X		X		
		Emergency operations			X	X	X	X	X		
		Public information	X		X	X	X			X	X
		Training and field exercises	X			X			X		

Source: Adapted from Gampell and Gaillard (2016)

Table 3.2: The four research objectives of this thesis with associated methods[10]

Research objective	Research method
To build a typology of disaster video games demonstrating the connections to DRR	• Disaster video game identification • Gathering basic information about each video game • Gamecade • Disaster risk reduction framework
To assess the impacts of existing disaster video games with a targeted audience to determine whether insightful knowledge is gained, with the potential to improve disaster awareness.	• Content analysis • Video game trials • Gameplay recording • Interviews (semi-structured/informal) • Pre/post-game questionnaires • Participatory focus group carousel activity
To carry out an analysis of disaster video games in collaboration with a targeted audience to understand how each game scores in terms of game content, player motivation, skill-building and social interaction.	• Interviews (semi-structured/informal) • Pre/post-game questionnaires • Participatory focus group carousel activity
To understand how video games may be used as tools for DRR.	• Review literature surrounding video games, popular culture and education including constructivist learning theory • Interviews (semi-structured/informal) • Content analysis • Video game trials • Gameplay recording • Pre/post-game questionnaires • Participatory focus group carousel activity

[10] This table has been revised from the published version to maintain thesis consistency.

3.5 Participatory methodological framework for video game research

A significant omission from the existing video game literature is a critical examination of participatory methods to investigate learning. In contrast, participatory methodologies, which are increasingly utilised in disaster research (Le De et al., 2015; Pelling, 2007), were naturally incorporated into the methodological framework for this thesis, supporting the sentiment by Lankoski and Björk (2015) that methodological approaches reflect the researchers' disciplinary backgrounds. However, the variation in study locations and situations like schools or museums, mean not all participatory methodologies are suitable, requiring more conventional approaches. This section briefly details the processes behind each of the methodologies utilised within these locations, with reference to the researchers own research process to demonstrate how the tools can be used. Table 3.3 concludes this section by outlining a participatory methodological framework for conducting video game research alongside the identified strengths and challenges to these methods.

3.5.1 Pre/post-game questionnaires

Questionnaires are commonly used for both quantitative and qualitative video game research. This thesis still included questionnaires in video game trials to observe how the questionnaire answers collected, compared to those collected through participatory tools. Pre-game questionnaires were identical and used to gather individual perspectives and information relating to the participants existing gaming and educational habits, along with determining their understanding of disaster and DRR. Post-game questionnaires were specific to the video game played and gathered game results, alongside a second opportunity for participants to revisit and reflect on any new disaster knowledge. Social science teachers attending the New Zealand Social Sciences Conference (SocCon) 2017 were given one questionnaire of 12 questions that focused upon their past video game experiences, their perspectives on using video games in the classroom and identifying any pre-existing experience with disaster or DRR education. Teachers who supervised video game trials within the classroom were presented the same set of questions as semi-structured interviews. All questionnaires were designed by the researcher based upon assumptions made from existing literature or information provided by the video game developers.

3.5.2 Playing the game

Video game research (see Chow et al., 2011; Yang, 2012) often provides participants with set tasks to carry out or gives participants information regarding game controls among other material. Unlike the research of other scholars, participants involved in this thesis research were not provided with any information regarding how to play the game, a list of controls or specific researcher-based objectives to achieve. The overarching rationale was to create a moment in time where participants could play the video game as authentically and organically as the participants wanted. This meant that a participant could play through a tutorial, skip the tutorial and play the game, try to win a game level or alternatively they could just experiment and explore. Hence, gameplay was defined by the player rather than the researcher, reflective of constructivist principles.

3.5.3 Carousel activity – collecting participant generated information

In the case of school video game trials, the carousel method involved six self-formed groups of participants along with six flipcharts each titled with a specific topic (game content, mechanics, skills/motivations, social interactions, hazards and vulnerabilities in the study area and capacities and DRR for the study area). The flipcharts were placed upon walls or on the floor, with each group allocated one of the six flipcharts. Participants were asked to provide written or picture feedback upon the titled flip chart. After 5 minutes, the groups rotated clockwise to a new flipchart providing an opportunity to discuss, add or alter to the previous group's comments. Participants discussed their experiences, as well as the previous group's flipchart contributions with their fellow group members before they themselves contributed to the flip chart.

This carousel exercise served two main purposes. First, to gather participants' ideas, enjoyments, frustrations or improvements to each of the four video game components rather than focusing solely upon content. Second, to generate discussion and connections between the video game and the participant's local area. Participants listed, as earlier defined, the potential hazards, individual, family or 'community' vulnerability, capacities and any possible DRR methods for preventing a hazard, mitigating a hazard or preparing for a hazard, in their local area. The approach also allows a comparison between the individual questionnaire responses gathered surrounding knowledge of disaster and DRR and the group-based carousel activity, reflecting the importance of social interactions and knowledge sharing in constructivist learning (Chau et al., 2013; Meece & Daniels, 2008).

The SocCon 2017 teachers' carousel process was identical to the previous carousel, with minor changes being that the carousel involved four self-formed groups of participants along with four flipcharts focused upon game content, mechanics, skills/motivations and social interactions. Unlike the previous carousel activity, the teachers were asked to reflect upon their needs and requirements for video games to become a part of the education and learning process, especially within a classroom environment. This approach emphasises the lack of bottom-up perspectives from those on the frontlines of education, like teachers and students in risk reduction education (Petal, 2007) and video game development. The carousel therefore teased out perspectives on what is required to better integrate video games into the teaching curriculum and to make video games a successful learning tool. Such information gathered directly from participants can directly inform future video game development.

3.5.4 One-word activity – identifying participant expectations

One-word activities are short and engaging activities, where participants are provided post-it notes and asked to write one word or sentence about a given topic. One-word activities were used when participant numbers were too low to conduct a carousel, resulting in responses from each of the participants involved and gathering a similar sized data set to that of other conducted carousels. SocCon 2017 teachers generated one-word perspectives and expectations of what a video game should be before playing a disaster-based video game.

3.5.5 Scoring activity – quantifying the carousel data

To continue building upon the teachers existing perspectives and knowledge, on completion of the SocCon 2017 carousel, the teachers involved carried out a scoring activity upon their completed flipcharts. Within their same four groups, participants were given sticky dots and asked as a group to review the answers provided and place dots next to the comments and perspectives which most highly resonated with them and their views for video games in the classroom. Participants were told two dots translated as most important, one dot was important, and no dots meant not as important. After 5 minutes, the groups moved clockwise until they had visited each of the flipcharts and placed their sticky dots onto the flipcharts. Following the activity, participants were involved in a debrief activity, reflecting upon their original ideas of the carousel and explore their rationale for scoring certain ideas over the others. The complete process allowed participant-based quantification of their own qualitative answers, rather than the researchers placing their own values upon qualitative data.

3.5.6 Debrief – reflective focus group activity

Reflecting Joplin's (1981) final step of the five-stage experiential learning model, a debrief activity is necessary following each of the participatory activities, in this case carousel, carousel and scoring, one-word activity, to allow participants to reflect upon not only the overall process but also the information that they have provided. Debriefing not only allows the researcher/facilitator to gather insightful information or seek further clarifications regarding the participants' ideas, but also provides participants with opportunities to discuss with one another and the researcher/facilitator regarding their experiences. The debrief activity is run by participants reading out aloud their opinions and comments from the flipcharts, post-it notes or tally the number of sticky dots with the facilitator or researcher guiding the participants in their discussions. The debrief design provides participants an opportunity to critically reflect on the process, often empowering participants to take control of the activity. Therefore, participants could critically reflect upon the information they provided and interact with or question each other, creating participant-regulated discussion and limiting facilitator directed conversation.

Table 3.3: Participatory methodological framework for video game research, outlining approaches including purpose, strengths/ challenges and research group[11]

Method	Purpose	Strengths/Challenges	Research group
Video game identification	To identify both 'serious' and mainstream video games in order to build a video game typology (see Gampell & Gaillard, 2016 for preliminary disaster video game typology examples)	• Can compare different video games • Can track origins of each game and their evolutions • Games are numerous with varying degrees of relevance, difficult to compile and classify all games • Technical requirements, geographical restrictions and costs associated with the hardware/ software	• Researcher based (participant influenced)
Interviews (Semi-structured/ informal)	To gather information regarding: 1. The rationales for game design, chosen content and game mechanics 2. Intention for content depiction 3. Teacher feedback upon the process and use of video games for educational purposes	• Can create a dialogue about the learning process and thought processes of participants • May not necessarily relate to their actual gameplay behaviours or answers provided in the questionnaires • Challenges in setting up interviews with people involved in the video game development	• Teachers (semi-structured/informal) • Students (informal) • Museum visitors (informal) • Game developers (informal)
Pre-game questionnaire	To attain a sense of existing gaming and educational habits, including a pre-game understandings of chosen research content	• Can collect a large sample of data from participants which can be compared and analysed • Questionnaire answers do not necessarily reflect gameplay behaviours	• Schools • Teachers (targeted) • Museum visitors (semi-structured interview)
Playing the video game	To provide participants an unrestricted opportunity to play, experiment and explore	• Self-regulated learning • Active participation • Connect experiences and knowledge to content and mechanics	• Schools • Teachers (targeted) • Museum visitors

[11] This table has been revised from the published version to maintain thesis consistency.

		• Cooperation to overcome challenges/ problem solve • Technical issues can occur • Different levels of technological skill and can impact the gameplay experience	
Post-game questionnaire	To gather game results and readdress understandings of chosen research content	• Can collect a large sample of data from participants which can be compared and analysed • Can present targeted questions about the specific video game to participants • Questionnaire answers do not necessarily reflect gameplay behaviours	• Schools • Museum visitors (semi-structured interview)
Carousel	To generate a collaborative activity to facilitate discussion between participants regarding their perspectives upon: 1. game content, mechanics, skills and motivations, social interactions 2. Reflect upon their understanding of chosen research content. This thesis explored disaster and DRR by identifying local hazards, vulnerability, capacities and DRR opportunities (prevention, mitigation, preparedness) after playing a disaster video game	• Generates discussion • Cross reference ideas • Attain better response on specific themes, unachievable from questionnaires • Requires participant movement • Can be used for subsequent activities, that is scoring • Momentum can be difficult to gather if participants are unfamiliar with the tool or unmotivated group dynamic • Power relations in the group may not necessarily result in certain ideas being relayed (especially if only a few writers) • Trying to find appropriate locations to place the flipcharts so all can access them and the writing upon the flipcharts is unhindered by the behind surface.	• Schools • Teachers
One-word activity	To generate responses from each participant in order to generate discussion before or	• Can be used when participant numbers are low to gather sufficient data and opinion	• Teachers

	following the playing of a video game	• Can instigate thinking upon a particular topic • Facilitator can refer back to these original ideas • Participants can get hung up on thinking of one word, or that their answer is not the same as the rest of the group	• One class of high school students
Scoring	To rank the views of participants collected within the carousel to derive what is most important to them	• Enables quantification of the most important aspects regarding video games in the classroom • Builds upon participant carousel data therefore authentic and genuine responses • Participants can have difficulty in finding the middle ground when attempting to score within the group setting	• Teachers
Debrief – Reflective focus group activity	To debrief the perspectives of the participants following the participatory activity. Providing an opportunity to go further with their explanations and enable debate, follow up questions and clarifications regarding their responses	• Facilitator can discuss and debrief the answers presented through the activities with the participants, which in turn can create a dialogue between facilitator and participants and participant to participant • Facilitator can gather further insight and thoughts directly from the participants upon what they have written • Opportunity for participants to critically reflect upon the process • Participants can be empowered to take control of the discussion • Participants can lack the confidence to read/ speak out in front of their peers • Time consuming	• Schools • Teachers

3.6 Methodological strengths of participatory tools for video game research

This section aims to detail the main strengths associated with each of the participatory tools used to conduct disaster video game research, as shown in Table 3.3. As suggested earlier, participatory tools align closely to the underlying foundations of constructivism, that learning is an active process and facilitated through social negotiation, with learners actively constructing, building and testing new ideas against their existing knowledge, while progressively testing their constructed knowledge through social negotiation (Adams, 2007; Chau et al., 2013; Splan et al., 2011). Therefore, the participatory tools and approach utilised in the research process generated an opportunity for participants to self-regulate their learning through active knowledge and skill building.

While most participants throughout the research process were comfortable with how to navigate through the game environments and use the technology, some participants including school students, teachers and museum visitors struggled. The frustrations around gameplay and usability often filtered into the corresponding game content and mechanics flipcharts or featured in questionnaire answers and informal discussions. However, nearby participants or bystanders often provided help to those who required it. These individuals offered suggestions towards how others could complete various in-game tasks, understandings of the game rules or even suggestions towards how to use in-game tools, acting as the more knowledgeable other. In some cases, those students who offered help were not necessarily those who, within the everyday classroom environment, would be referred to as experts. However, through this process these participants were empowered, providing their knowledge and experiences to help their classmates and were given a sense of achievement as their classmates turned to them for advice. Some participants, decided to work co-operatively upon one device to better utilise their knowledge and attain a high score, connecting to the second principle of constructivism. Thereby, the process not only facilitated an opportunity for social negotiation but also allowed participants to actively construct, build and test new ideas within the game environment.

Importantly, gameplay using the outlined approach contrasts common gameplay methods in video game research (Buelow et al., 2015; Pilegard & Mayer, 2016; van Lankveld et al., 2017), where participants are provided with information or requirements, removing the authenticity of any potential self-regulated learning. Informed by the first principle of constructivism, that the learning should be authentic, active and student-centred (Splan et al., 2011), the approach allows participants to play without restrictions, fostering active player participation requiring players to self-navigate and make active decisions. While providing participants with information may minimise issues around usability, the gameplay approach outlined also provides greater opportunity to observe the second principle of constructivism, as detailed in the preceding paragraph.

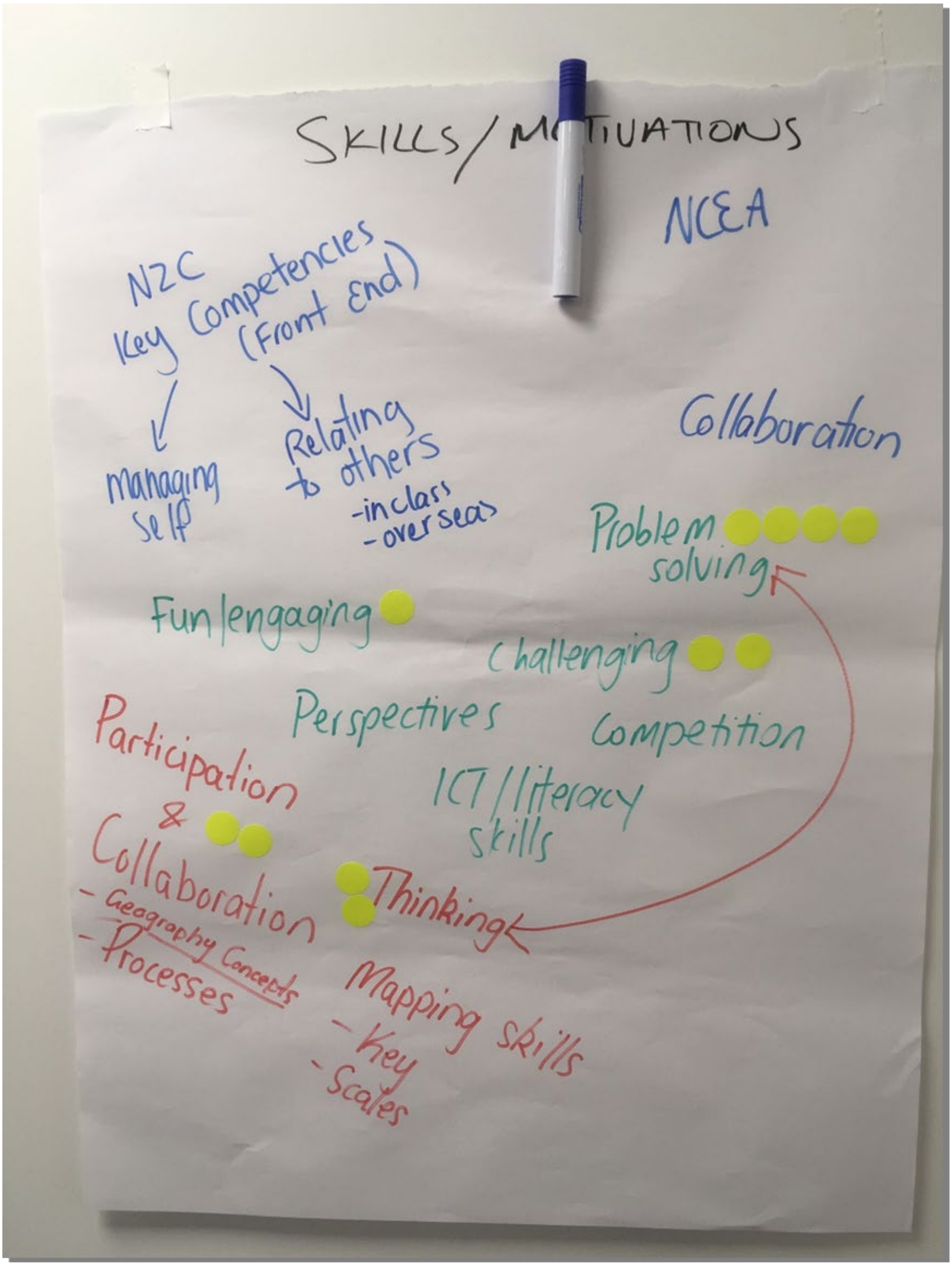
Petal (2007) acknowledged that risk reduction education was generally conducted by scientific, academic and technical experts, emergency managers and NGOs, with minimal teacher, student and player engagement in this process. While the vast range of stakeholders may have good intentions at heart, ultimately these parties also have an agenda they want to achieve. An issue arises here as often this agenda does not correspond to that of the users, in this case the teachers and students/players. Therefore, the scoring activity enabled the participating social science teachers, to quantify what was most important to them to enable the use video games within the classroom. By building upon the answers generated in the carousel activity and ranking the most important concepts results in authentic and genuine responses from those who are on the frontlines of education, versus researchers placing values upon what they believe to be most important.

The main strength of the carousel was the ability to generate discussion around particular topics/concepts. Such discussions involved the participants cross-referencing ideas with each other within their group before adding the information to the flipchart. Subsequent groups could assess the previous information, either agree with the statements or disagree before presenting their personal insights, shown in Figure 3.1. The carousel also asked important questions regarding local hazards, vulnerabilities and capacities (Figure

3.2 and Figure 3.3), reflecting a section of the pre and post-game questionnaire. Often, through their discussion, participants would generate answers to these topics along with further thought and insights associated to their social and cultural beliefs, not seen within the questionnaire responses. As Klopfer et al. (2018) suggest, applying knowledge learnt in one context is difficult to transfer to another context. However, the socially interactive dimension of the carousel suggests with peer feedback and support from people participating in the carousel, can draw out ideas which can enable a pathway for better transfer of knowledge and applications to other contexts. Additional benefits of the carousel include movement to help keep participants engaged, and the ability to be continued upon with another activity, like scoring to generate quantifiable information.

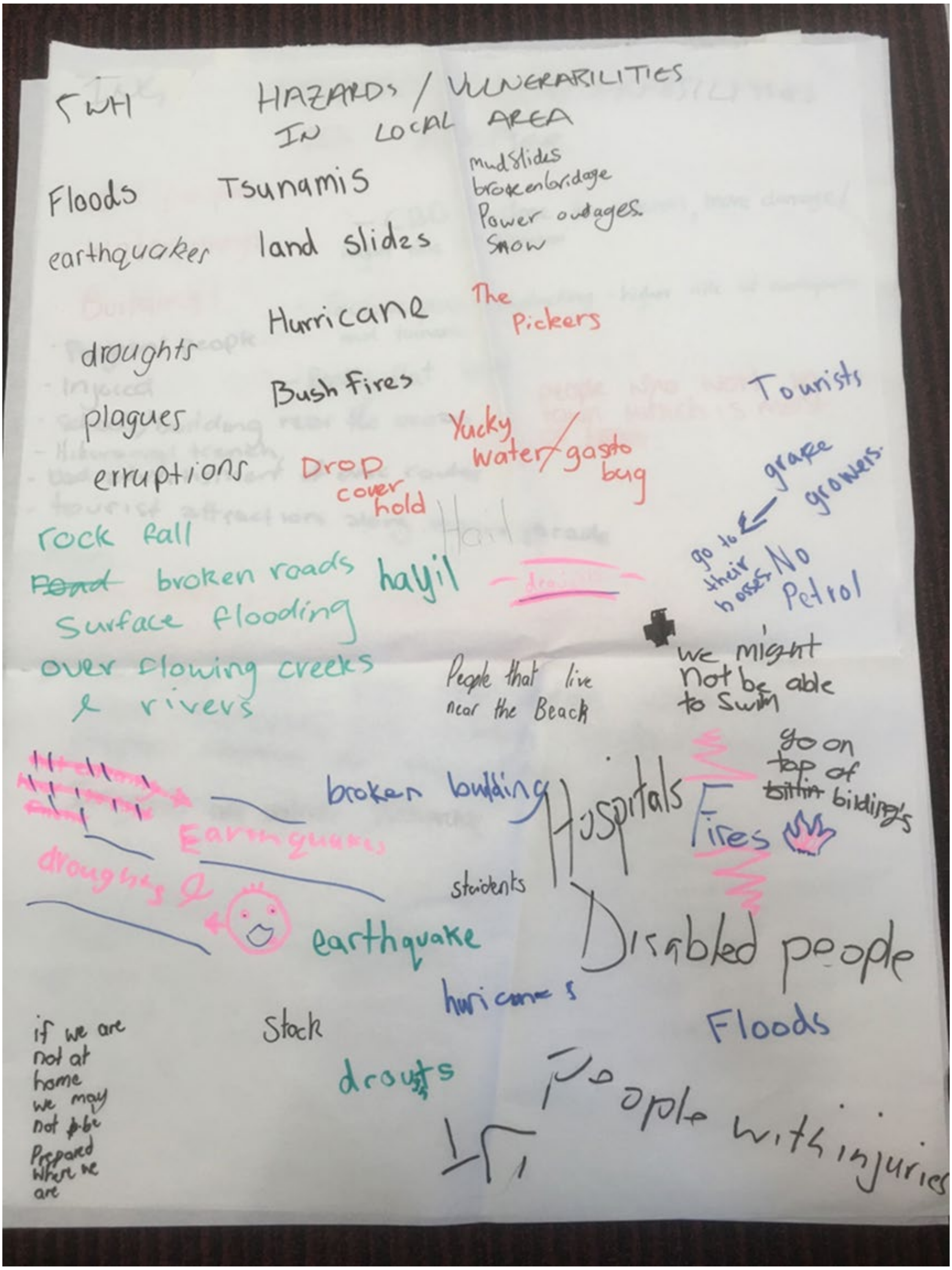
The one-word activity had two purposes in the research process. Primarily, the activity was used in the case that participant numbers were too low to operate the usual carousel activity. In this case, every participant placed a post-it note with their contribution to each of the six flipcharts. In doing so, the flipcharts had numerous and varied responses from each participant, an outcome that may not have been otherwise possible. The responses given were also by nature those which resonated most strongly with the participants, reflecting Klopfer et al. (2018). The debrief activity gave participants a chance to discuss their responses and further reflect upon the answers given. Second, the activity helped initiate the discussion of expectations for video games in the classroom with social science teachers during SocCon 2017. The strength of the one-word activity in this capacity was to provide a short and punchy introduction utilising the teachers' own expectations of video games in the classroom/for learning. By having these one-word responses, the workshop facilitator could refer back to the teachers' original expectations throughout the duration of the workshop and demonstrate the possibilities of video games in a learning setting through the teachers' own expectations. In addition, such one-word activities generated, in a simplified format, information of teacher expectations, which could be delivered to video game developers working within the space of video games for learning.

Figure 3.1: Skills and motivation flipchart identified by social science teachers



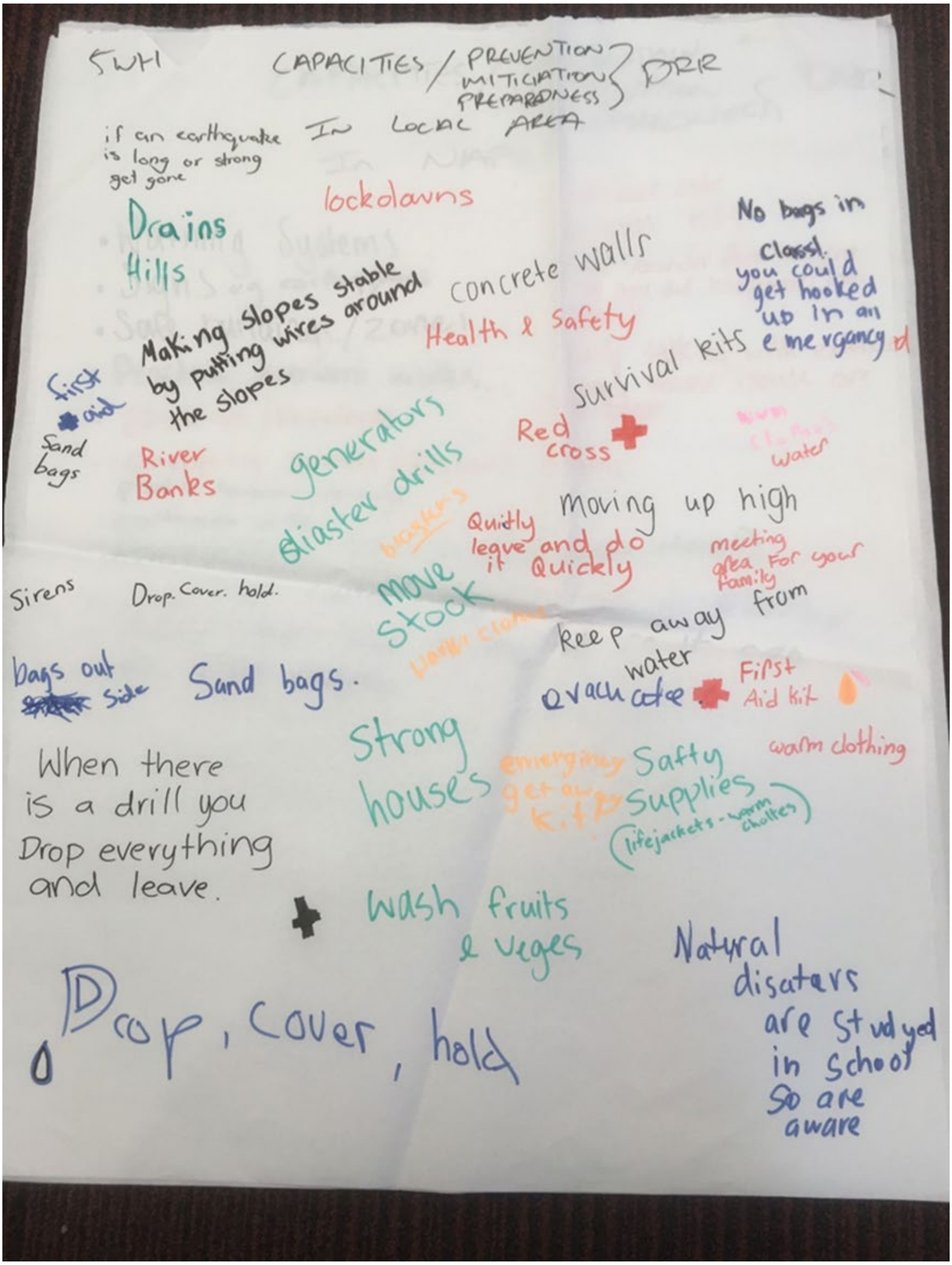
Source: Author's own (2017)

Figure 3.2: Hazard and vulnerabilities in local area identified by intermediate school students



Source: Author’s own (2017)

Figure 3.3: Capacities and DRR actions in the local area identified by intermediate school students



Source: Author’s own (2017)

3.7 Methodological challenges of participatory tools for video game research

While participatory tools demonstrate genuine strengths for conducting video game research, Table 3.3 demonstrates methodological challenges still exist which require researcher reflection and consideration. This section considers some of the practical challenges and epistemological issues to conducting video game research with participatory tools, though further reflection upon the methodological limitations is warranted. However, to our knowledge a near complete participatory approach towards video game research has not been conducted. Therefore, focusing upon the practical challenges allows future researchers to reflect upon these challenges when integrating such participatory approaches, and with further utilisation of these tools, a better-informed discussion around the methodological limitations may be possible.

While participatory tools can work in parallel with the aims of constructivist learning, the process is not genuinely participatory due to the researcher's requirement to gather information for the completion of their own research and thereby shaping the research direction (Madsen & O'Mullan, 2018; Weaver et al., 2009). Allowing research participants to design their own questions and focus, could better serve the principles of constructivism surrounding authentic and self-regulated learning. However, one needs to be mindful that the participants would need to learn how this process works, and through their learning, experiences and knowledge to create their own research questions and focus could lead participants in a biased direction (Allan, 2012; de Block & Buckingham, 2008).

Power issues can also become apparent during the participatory process. The facilitator needs to be aware of participant social/class positions and the possible impacts of such relationships, not just between researcher and participant but also participant to participant. Power through the participatory process can reflect hierarchical positions, whereby the more privileged may be in a better position to control access to the process and be deemed more knowledgeable (Allan, 2012) which may result in one individual influencing the overall discussion (Weaver et al., 2009). The facilitator may need to encourage the 'passing of the stick' and help empower those with less dominant personalities within the participatory process. The facilitator can make use of the debrief activity to support the ideas of those who may be marginalised within the process. For example, a teacher crossed out the ideas of an international student with limited written English on the flipchart. The debrief activity allowed the student to elaborate further, revealing their idea to be of both importance and relevance, especially surrounding gender perceptions. Hence, an important reminder of power positions when using participatory research methodologies and the position of human supports/ facilitators when engaging with participants.

Issues of confidentiality can arise as activities are of a group-based nature and can compromise confidentiality. Such challenges are not only limited to focus group discussions, carousels or interviews but are also valid concerns for questionnaire surveys. Such activities therefore require careful consideration by the researcher and/or facilitator on the appropriateness of conducting such activities (Petrova et al., 2016). Concerns may be related to interviewer/moderator relationships with participants, confidentiality issues, ethical considerations, participant selection and level of participant ability. Petrova et al. (2016) suggest that researchers have a responsibility to engage with appropriate research methodologies, to minimise any possible detrimental effects upon the research participants and strengthen the overall trust of the research process. The researcher may potentially determine a particular research method inappropriate and therefore could employ a different research method to better serve and protect sensitive or confidential participant information.

The majority of video game research utilises conventional research methods for the basis of providing statistically significant results. Often such conventional methods require participants to think through questions and provide either verbal or written answers. However, for participants with oral, visual or written communication difficulties, including people taking part in research in their non-native language, as well as people with physical and/or learning disabilities, such approaches limit their ability to contribute. Participatory tools can offer a solution to this challenge as such tools can require less dependency on participant literacy and language skills (Allan, 2012). While such an approach may demonstrate participant knowledge and experience in an alternative way, the challenge for studies taking a participatory approach is the fact statistically significant data sets may not be achievable. Mayoux and Chambers (2005) defend such participatory data sets by suggesting that larger sample sizes do not necessarily correlate to better information but could instead reflect bad data. However, as previously mentioned, participatory methods have an ability to also generate quantitative information, referred to as participatory numbers or participatory statistics. Participatory numbers can be generated for numerous purposes through various participatory activities (Chambers, 2007). Chambers (2003) notes the process of generating participatory numbers can allow participants to define their own indicators, analysing and monitoring these indicators themselves, thereby generating numbers that most likely reflect their realities. The visual element of such activities can transcend language, cultural and literacy barriers (Chambers, 2010). Therefore, while participatory methodologies may struggle to gather statistically significant data, they can have strengths, as outlined in the preceding section, with regard to providing more accurately detailed information and help to empower participants, among other strengths.

3.8 Conclusion

Despite the growing prevalence of disaster-themed video games, little research explores this genre of video games and even less that examines the effectiveness for such games to build disaster and DRR awareness. This chapter highlights that in order for video game research that assesses the contribution of video games for building awareness, it is critical that an appropriate methodology (which fits within the parameters of video games and context of the research outcomes) is selected. In this context, video games are deemed an activity requiring active participation and play, which correlates to the defining principles of constructivism learning theory, namely that learning is authentic, active and student-centred, while simultaneously facilitated by social negotiation. Understanding the broader contextual information strengthens the appropriateness for utilising participatory tools to collect research data, when the research outcomes are for assessment of learning outcomes in participants.

This chapter provides an overview of some of the participatory tools currently used to assess to what extent disaster video games foster learning about DRR. In addition, the associated strengths and challenges with using these participatory tools for disaster video game research are also outlined. While participatory tools can provide an opportunity for participants to self-regulate their learning experience and provide more authentic responses towards the pre-defined research questions, statistically significant data for scientific validity is not necessarily collected, though participatory numbers may be an option to overcome this challenge. It is critical that researchers consider potential power dynamics within the research process and consider the appropriateness of both conventional and participatory methods. Participatory methods provide pathways that enable direct communication with frontline individuals, for example addressing the needs and concerns of teachers regarding video games in the classroom, or empowering marginalised individuals in the case of school students. Participatory approaches are not always suitable, and therefore reinforce researcher responsibility to determine the most appropriate methodological frameworks, dependent upon context and reflection of appropriateness of more conventional approaches. The need to bridge different methodological approaches, which are contextually appropriate, can provide a more robust, authentic, and complete analysis, not only for disaster video games but also for questions about the learning outcomes of video games at large. Therefore, the participatory approaches explored in this chapter present a novel approach for conducting video game research and a methodological framework that could present a more meaningful research option for investigating video games as learning tools.

Chapter 4 Exploring the use of the *Quake Safe House* video game to foster disaster and disaster risk reduction awareness in museum visitors

4.1 Introduction

Disasters, associated with both natural and anthropogenic hazards, are increasingly popular themes for video games, which reflects the cultural dimensions of disasters in society (Webb, 2007). However, while disaster video games can provide researchers with valuable insights into how people conceptualise disasters in their daily lives, there is limited research into portrayals of disasters within popular culture (Gampell & Gaillard, 2016; Quarentelli & Davis, 2011). Previous disaster video game research indicates that disaster video games have the potential to instil disaster awareness through the portrayal of hazards, vulnerabilities, capacities and disaster risk reduction (DRR), with constructivist learning theory supporting the use of video games (Chapter 2; Gampell & Gaillard, 2016). Gampell and Gaillard (2016) connected game content for several disaster video games, both 'serious' and mainstream, to a DRR framework (prevention, mitigation and preparedness), identifying that further research into how game content, game mechanics, player skills, motivations and social interactions all contribute towards possible learning outcomes is required. Solinska-Nowak et al. (2018) support the findings of Gampell and Gaillard (2016) with their overview of 'serious' or educational (rather than mainstream) games for DRR, finding that several scholars prove 'serious' games and/or simulations have the potential to raise awareness and develop skills though quantitative and qualitative research is scarce surrounding the effectiveness of these games. Similarly, there is an identifiable gap in the effectiveness of conveying disaster preparedness education through museums (MacDonald et al., 2017) and in understanding how 'serious' disaster video games may contribute toward fostering the participation of museum visitors in learning about disaster and DRR. Accordingly, this chapter provides valuable insights into the use of disaster video games in museums, while contributing not only towards a better understanding of disasters within popular culture but also in fostering greater museum visitor participation in learning about disaster and DRR.

4.2 Video games, constructivism and museums

Video games are increasingly popular amongst people of all ages, genders and ethnicity. Hence it is of no surprise that video games have globally become a fully integrated and vital part of contemporary culture, society and everyday life for millions of people (de Aguilera & Mendiz, 2003; Gampell & Gaillard, 2016). As such, video games and games at large, have become powerful influencers not only for other video games but also movies, music and other forms of popular culture. The influential power video games have upon multiple dimensions of daily life demonstrates their ability to capture the attention of society, influencing culture but moreover their innate ability for active learning. Like the rapidly ever-changing technological future, people require twenty-first-century skills and competencies to be a twenty-first-century citizen (Xanthoudaki, 2015). Video games can be easily connected to constructivism and theoretically, seem to be advantageous in the attainment of building a player's awareness of various issues and skills (Adams, 2007; Chau et al., 2013; Klopfer et al., 2018; Ray et al., 2014). However, while video-game theory fits with the principles of constructivism, game content, game mechanics, skills and motivations along with social interactions as a result of gameplay, can have a significant impact upon the learning experience. Similarly, Brabazon (2006) suggests the use of digital media for strategic educational purposes in museums, often has poor deployment and is rarely considered a reflexive loop between teaching and learning, display and visitor, which again impacts upon visitor learning experiences.

Technology has a strong influence on education and learning practice (Xanthoudaki, 2015). Paliokas and Sylaiou (2016) claim that broad adoption of ‘serious’ games into museums and cultural settings suggest ‘serious’ games can directly link target user groups to museum content to fulfil their educational needs. Such games draw upon the museum’s characteristics and exhibitions, designed to complement, enhance or augment the museum experience (Paliokas & Sylaiou, 2016) and can come in a variety of formats not limited to digital, physical, mobile, virtual and multi-player. As such, museums use such games to support constructivist learning through exhibit interaction (Yiannoutsou & Avouris, 2012). However, Paliokas and Sylaiou (2016) suggest visitor gaming experiences and museum impact is the core focus in a modern ‘serious’ game approach for museums, instead of positive learning outcomes, believing learning outcomes could be achieved through traditional approaches. However, MacDonald et al. (2017) emphasise that scholars stress in order to increase students' motivation and engagement with material, both formal and informal instructional methods suitable for different learning abilities is required.

Naskali et al. (2013) comment that while the collective significance of video games and their history have emerged from 'the below' via everyday experiences and gamers, a growing trend demonstrates the institutionalisation of video games coming from the bottom-up. Hence, the complexity of modern-day requires museums to be reflexive and capable of repositioning cultural references (Delgado, 2009). For museums to facilitate learning, museums must provide consideration toward their audiences and the creation of spaces within the museum that can foster educational experiences for visitors (Demski, 2009). Elwick (2015) argues, in the context of implicit learning, that understanding the learning process when visitors enter the museum likely contributes to greater understandings of visitor experiences. In turn, such understanding can better cater for the learning needs of visitors (Elwick, 2015). Museums have therefore seen a shift from exhibiting and interpreting objects toward encouraging visitor interpretation, providing visitors with opportunities to observe, handle, interact and experiment with various objects (Jeffery-Clay, 1998), an approach strongly aligned with constructivist learning theory.

Constructivist learning theory asserts that learners with minimal instruction, construct knowledge including both individual and social meanings, based upon their own experiences and their reflection upon these experiences, through active engagement and self-regulation, challenging their current thinking and existing beliefs (Chow et al., 2011; Cohen, 2011; Hein, 1991; al Mahmud, 2013; Ray et al., 2014; Schunk, 2012). Constructivism assumes individuals are active learners who develop knowledge for themselves, either via exogenous, endogenous or dialectical constructivism (Schunk, 2012) with Table 4.1 outlining guiding constructivist principles suggested by Hein (1991). Vygotsky's theory, a form of dialectical constructivism, considers the social environment as critical for learning while social interaction transforms the learning experience (Schunk, 2012). Vygotsky, compared to Piaget, emphasises the importance of social interactions upon learning, whereby knowledge is not constructed individually but co-constructed between two people (Meece & Daniels, 2008). Vygotsky also suggests the difference between achieving independent problem-solving compared to the potential problem-solving achievement with assistance from the more knowledgeable other is the zone of proximal development (Cicconi, 2014; Meece & Daniels, 2008; Schunk, 2012). With appropriate instructional conditions, support and guidance, students can achieve higher learning potential and mental functioning (Meece & Daniels, 2008; Schunk, 2012). Knowledge is not gained passively during such interactions, but rather learners bring personal understanding to the social interaction, constructing meaning via the integration of these understandings with their experience (Schunk, 2012). While not formally part of Vygotsky's theory, instructional scaffolding as termed by Wood et al. (1976) fits within the zone of proximal development as an appropriate application to help increase the learner's competence, whereby the more knowledgeable other provides verbal or physical assistance and support to help the learner master a task or problem outside of their capabilities (Meece & Daniels, 2008; Schunk, 2012). Such an application becomes an important consideration when considering the potential learning experiences by using a video game.

Table 4.1: Guiding principles of constructivism

Principle	Explanation
Learning is an active process	Learner uses sensory input, engaging with the world to construct meaning. Learner is active, not passive.
People learn to learn while they learn	Learning by both constructing meaning and constructing systems of meaning.
Meaning construction is mental	Activities need to engage both the mind and physical action/ hands-on experience. Reflective activity.
Learning involves language	Language and learning are intertwined, with the language used influencing how people learn. People talk to themselves while learning.
Learning is a social activity	Learning is associated with connections with other people, teachers, peers, family. Learning uses conversation, interaction with others and knowledge application.
Learning is contextual	Learning based upon existing knowledge, beliefs and experiences. Learning is not through facts and theories processed separately in the mind.
Knowledge is required to learn	Cannot assimilate new knowledge without a structure formed from previous knowledge to build on.
Learning takes time	Learning requires reflection, revisiting ideas, trying ideas and using ideas. Learning is a product of repetition and exposure.
Motivation is key	Motivation is essential for learning, which includes understanding the ways knowledge can be used. Without knowing the reasons why one can be less involved in using the knowledge instilled.

Source: Adapted from Hein (1991)

4.3 A case study of Quake Safe House in the context of New Zealand

Quake Safe House (QSH) was an Earthquake Commission (EQC)[12] branded 'serious' disaster video game tasking players with preparing a Wellington hillside home for an earthquake. During the 2016-2017 period of this research, QSH was only available to the public as a physically installed interactive display located in two museums, Te Papa, i.e.

[12] A New Zealand Crown entity providing insurance to residential property owners alongside investment into disaster research and education (Earthquake Commission, 2018).

the Museum of New Zealand in Wellington, as part of the Awesome Forces exhibit (Gampell & Gaillard, 2016) and the Canterbury museum exhibit Quake City in Christchurch. Awesome Forces was an EQC sponsored free exhibit highlighting disaster risk and preparedness information with a walk-through shake house simulator (MacDonald et al., 2017). Quake City charges an admission to explore the aftermath of the September 4, 2010 and February 22, 2011 Christchurch earthquakes, majorly sponsored by EQC (Canterbury Museum, 2019). Selby and Kagawa (2012) indicate that disaster prevention education directly relating to local hazard risks and culture is most relevant to learners (MacDonald et al., 2017). Given New Zealand's location upon the Pacific Plate boundary and the Australian Plate, tens of thousands of earthquakes occur annually (MacDonald et al., 2017). This made QSH an appropriate game to explore how standalone video games, featured as part of a larger museum exhibit, may foster museum visitor engagement in building their awareness of disaster and DRR.

Documentation provided by EQC for the EQ-IQ/Quakehouse project[13], which preceded the development of QSH, provides some potential context for the development intentions of QSH. An interactive graphic called Quakehouse, on the now unavailable EQC EQ-IQ website, aimed to engage New Zealanders (the audience/readers of the website) with EQC's prevention messages. Quakehouse enabled players to create earthquakes, with various intensities, with and without precautions to limit damage to their home and contents. Quakehouse provided players with clear instructions and feedback after the earthquake simulation about how to take preventative actions within their own home, linking players to areas of the EQ-IQ website (refer to Figure 4.1). Quakehouse aimed to convert awareness into engagement and encourage action from New Zealanders to prepare for damage-causing earthquakes by providing information for them before, during and after an earthquake (Selby & Kagawa, 2012).

[13] EQ-IQ/ Quakehouse was a website/ interactive graphic designed as a place for New Zealander's to engage with EQC's messages around DRR action. This website is no longer available.

Figure 4.1: Side by side comparison of Quakehouse interactive graphic. Left: Instructions on how to use. Right: Results of unsecured home after a magnitude 8-9 earthquake.

Source: Etties (2007)

QSH locates the player in New Zealand, with a rugby ball on the roof of the house and Wellington city landscape in the windows. Using a touch screen, players drag and drop a range of preventative earthquake measures designed to reduce the damage to their home and contents. Players are provided with basic gameplay rules and the overall goal of QSH, but they are not provided with any specific instructions about the purpose of each preventative tool. Instead, players are required to work this out for themselves through gameplay. Gameplay lasts a total of 2 minutes and 20 seconds with players working through three scenarios with a set time limit: kitchen (50 s), lounge (50 s) and house exterior (40 s). Players drag the tools supplied on the sides of the game screen and drop them on specific objects like the bookcase or fish tank. At time-up the player observes the impacts of the earthquake with the suitability of tool placement indicated by being sequentially checked off with a tick or cross. A feedback screen is shown to players, providing overall scores for correctly securing each object in each scenario and an overall final percentage score (refer to Figure 4.2).

Figure 4.2: Images of *Quake Safe House* game. Top left: Wellington hillside home location. Top right: *Quake Safe House* game rules. Bottom left: *Quake Safe House* game instructions and gameplay demonstration. Bottom right: Consequence of player's actions and feedback.

Source: Author's own (2016)

No definite information was found to suggest the intended target audience for QSH, though the game could be played by both children and adults as demonstrated by the demographic of the research sample. Gampell and Gaillard (2016) connected QSH to a disaster video game typology intended to reflect DRR content found in different disaster video games in terms of prevention, mitigation and preparedness. Gampell and Gaillard (2016) found QSH connected to four aspects of DRR including prevention (use of manmade structures, engineering design), mitigation (engineering techniques/hazard resistant construction) and preparedness (disaster risk analysis).

4.4 Methodological approach

This chapter primarily explores how the 'serious' disaster video game QSH, could foster museum visitor's learning about disaster and DRR. Data collection was conducted in Te Papa on 15–16 October 2016 and Quake City on 18–19 March 2017. The study took a qualitative approach, focusing upon understanding QSH and the gameplay experiences of museum visitors. Findings do not aim for statistical representativity but rather demonstrate patterns for how museum visitors think about and respond to a video game like QSH. In this chapter, the research participants' perspectives of their interactions with QSH are used to examine the ability for 'serious' disaster video games to be utilised as a learning tool within the museum space.

The research drew upon semi-structured interviews (combining structured pre/post-game interview questions with informal post-game debrief conversations), playing QSH and researcher observations (Table 4.2). The research methods allowed participants to share their perspectives of QSH based on game content, game mechanics, player motivation, skill-building and social interaction and allowed researchers to derive insights into if and how playing 'serious' video games within a museum environment can build disaster awareness and knowledge.

Table 4.2: Summarised methodological framework for the video game trial research process

Method	Detail	Outcome
Structured pre-game interview questions	- 13 short answer questions informed by pre and post-game questionnaires from 2007 RiskRed report on *Stop Disasters: Fire scenario* and *Darfur is dying* survey reasoning document (RiskRed, 2007) - Approx. three minutes	- Attain existing video game habits and pre-game understandings of DRR strategies. - Provision of relevant hazard safety measure examples from their knowledge relating to earthquakes.
Play *Quake Safe House*	- Unassisted gameplay in line with constructivism - Gameplay lasts two minutes and twenty seconds - QSH played at least once, sometimes twice.	- To provide participants with material to answer the post-game questions and replicate typical play experiences. - Assumes learners with minimal instruction can construct knowledge, based upon their own experiences and their reflection upon these experiences, through active engagement and self-regulation, challenging their current thinking and existing beliefs (al Mahmud, 2013; Chow et al., 2011; Cohen, 2011; Hein, 1991; Ray et al., 2014; Schunk, 2012).
Structured post-game interview questions	- 16 short answer questions informed by preliminary content analysis of QSH by Gampell and Gaillard (2016) and EQ-IQ website/ Quakehouse information. - Approx. five minutes	- Participant perspectives of QSH (scores, game content, mechanics, skills, motivations, social interactions) and readdress understandings of DRR strategies post-game. - Provision of new DRR strategies from QSH not known previously for pre and post-game comparison. - Provision of DRR strategies not featured in-game for any natural hazard more relevant to everyday life.
Post-game debrief	- Instigated by the participants post-game. - Timeframe and questions dependent upon the participants.	- Informal post-game debrief conversations. - Allowed those on ethical limitations like being too young to formally participate due to parental consent then personal assent requirements to informally discuss gameplay experiences and insights into QSH.

Rather than asking every passer-by at the museum to participate for the sake of collecting data, participants were purposefully selected based upon whether they showed an interest in and approached the QSH display. If a museum visitor approached QSH, the researcher would approach the visitor and ask whether they would be interested in taking part in the research. The participants had no interaction with the actual QSH game other than approaching the game display prior to their participation in the study.

Twenty-two (22) people participated in the study, with 11 participants recorded at each museum. Most participants belonged to the 22 to 25 age group (n=7, six males and one female) followed by 26 to 30 (n=4, equal split male and female). Collectively, the 41 to 50 (n=3, one male and two female), 51 to 59 (n=2, two female) and over 60 (n=3, 1 male and two female) age groups totalled eight participants, with 11 to 12 (n=1) and 13 to 18 (n=2) totalling three female participants. Participants were mostly from Europe, commonly France, Germany and the United Kingdom alongside a few Australians who had recently immigrated to New Zealand. Notably, the total sample size for this research is small, especially given the high number of yearly visitors to Te Papa and Quake City for the 2016/2017 period (1,578,292 and 53,481[14] people respectively (Canterbury Museum, 2018; Museum of New Zealand Te Papa Tongarewa, 2017)).

4.5 Evaluating the potential of *Quake Safe House* to foster participation in learning

QSH was a standalone interactive video game display, located within a larger exhibit, competing with several other displays for the attention of museum visitors. In order to convey the intended messages of disaster prevention, QSH needed to attract and then subsequently engage the visitor through gameplay. The small sample size seemingly indicates that QSH was not succeeding in attracting museum visitors. However, it is apparent from the qualitative data collected that several patterns emerge from the research findings. Collectively, the participants' perspectives upon QSH in terms of game content, game mechanics, skills and motivations, alongside their social interactions as a

[14] This number is based upon available information that more than 190,000 visited Quake City over a period of three and a half years from opening in 2013 to the move to the new premises in 2017.

result of gameplay reflect that these areas can have significant impacts upon the learning experiences of players. Therefore, in order to consider how QSH would foster participation in learning about disaster and DRR within the museum space, several variables require attention including the location of the QSH display, the space surrounding the display, the museum audience themselves and a focus upon the game content, mechanics, skills and motivations and social interactions of QSH.

Museums Aotearoa (2005) asserts that the educational role of a museum lies at the core of their public service. Pre-game interview questions indicated participants would primarily access new information on earthquakes, the video game's hazard scenario, from the internet (n=18), television (n=6) and then school (n=3). An 11-12-year-old female was the only participant to include books as a place to access new information about earthquakes, while a woman in her 50's indicated that her hotel in Christchurch had provided her with information surrounding earthquake safety measures. However, while no participants expressed they would use video games or the museum for learning new information. Yet, several participants did reference in their post-game interviews that their decision to play QSH was to learn more about earthquakes, what to do and also test their skills.

Nevertheless, the post-game debrief indicated that their principal purpose for visiting their respective museum was for learning, either to learn more about New Zealand in general or in particular, the 2011 Christchurch earthquake. One participant from Western Australia, now residing in Christchurch, commented that they were visiting Quake City to learn more about earthquakes should they experience an earthquake while living in Christchurch. The post-game debrief conversations indicated that the QSH display and game was not interacted with by New Zealanders over four days in two different cities/ museums but instead primarily foreign tourists or people who had recently migrated to New Zealand. This could suggest why the participants did not specifically include museums as places to learn new information for educational purposes but instead considered the museum as a tourist destination. Therefore, while education may be at the core of a museums public service, one cannot dissociate that the museum is also primarily a tourist attraction.

The assumed goal of QSH, as derived from the EQ/IQ website and Quakehouse, was to build greater public engagement with strategies that individuals can employ to reduce damage to their homes and contents from a specific hazard (earthquakes) rather than DRR more broadly (Etties, 2007). The preliminary content analysis of QSH suggested that two of the possible four actions of prevention were demonstrated within the game, namely the use of human-made structures and engineering design. Pre-game, three Te Papa participants and nine Quake City participants gave variations of drop, cover and hold, like '*Get under a table. Run outside into an open space if possible*.' and '*[Hide under] the table. Protect [your] head. If time keep phone close to head.*' seemingly indicating that participants had potentially more exposure to preparedness strategies versus engagement with prevention messages (refer to Table 4.3). Only two participants from Te Papa referenced preventative measures pre-game including one female participant in her 40s commenting '*Attaching heavy objects to walls or floors, making sure [the] house is attached to foundations*' and one male over 60 noted '*Secure anything that can fall over*'.

Table 4.3: Knowledge of DRR strategies indicated by participants

DRR strategies	Pre-game	Post-game
Drop, cover, hold	12	0
Secure objects	2	10
Go to an open area/ evacuation point	5	0
Don't know/ no answer	5	11

The pre/post-game comparisons show questionable awareness improvements. Post-game, participants indicated increased prevention awareness, often realising the gaps within their existing knowledge and interest in learning more about the tools used within the game. The findings show an increase of responses relating to prevention and securing objects. However, only seven participants (one Te Papa and six Quake City) could specify objects to be secured, preventative measures or tools used in the game or objects. While 17 participants provided relevant DRR strategies pre-game, only nine participants could recall new strategies obtained from playing QSH. Yet, some individuals pre-game claimed to have a basic understanding of earthquake preventative measures and post-game a complete understanding, or very little to basic understanding but did not provide definite examples of prevention strategies.

In terms of game content, QSH was generally well-received. Participants believed the game content was relevant and appropriate in terms of raising their awareness about the type of household actions to prevent earthquake-induced damage. However, eight participants felt that the game needed to provide players with more in-game information or instructions specifically regarding each tool and its use within the game (how it should be employed by the player to achieve the goal of the game). One 51–59 year old female participant from Quake City commented an improvement to the game would be *'Explanations about how the solutions would work.'* This comment is a crucial consideration for the development of a video game intended for the museum environment, especially in situations where games (like QSH) are used in more than one location. The walls at Te Papa surrounding QSH did provide information regarding the in-game tools and what players could use them on. However, participants rarely read the surrounding display information. Often the Te Papa participants only realised the information about QSH and earthquake damage prevention strategies were available to them on the walls post-game with direction by the researcher. In contrast, the walls surrounding QSH at Quake City were bare and did not provide visitors with any QSH related signage or any information relating to the game (refer to Figure 4.3). Considering most participants were foreign tourists, a fundamental flaw exists surrounding the language and vocabulary for those interacting with QSH. Six participants commented upon the necessity for the game to have alternative languages other than English. During a post-game debrief, the researcher directed one participant to the information at Te Papa. The participant attempted to translate the information, however there was no equivalent translation to some of the words used. As one participant notes '*Easy to understand [the game] but vocabulary [is not].*' Thereby, presenting another level of confusion to the game content for foreign visitors. Although, this could equally impact New Zealand residents should English be a second language and therefore may work against the intended goals of QSH.

Figure 4.3: Location of *Quake Safe House* display and surrounding area. Left: Te Papa. Right: Quake City.

Source: Author's own (2016, 2017)

The game mechanics of QSH brought some level of frustration to all participants demonstrated in gameplay observations and post-game debrief, though not always recorded in the structured interviews. With the vast improvements to touch screen technology and the daily usage of smartphones with more intuitive control, participants initially struggled with moving the game screen. The drag and drop mechanics of the game felt clunky and the lag often resulted in participants accidently locking a tool onto an incorrect object due to moving their finger too fast across the screen. As such, the game mechanics played a significant role in the initial scores of participants unable to work out how to move the screen via the two arrows at the bottom. One 22–25 year old male participant commented '*[QSH] was quite poorly designed. You [can't] reverse a safety tool once [you] put [it] on an item. The camera is slow which makes the time limit [go] even faster. You can't scout the room before pressing the start button.*' Participants thought the game's objectives were easy to figure out (n=16). Collectively, instructions were clear to understand with an average of 3.6, on a scale of 1–5 where 1 is very unclear and 5 very clear. The feedback at the end of each scenario was appropriate (n=17). However, several participants wanted more detailed information and the ability to learn more about the correct tools or why their chosen tool was inappropriate. Participants were frustrated with the short time limits placed upon each level, as they struggled to find the specific objects to interact with, moving the screen was not quick enough, and the lack of in-game information about each tool meant participants were unable to rationalise and understand what the specific tool they were selecting could achieve. Participants were also uncertain as to which objects within the game environment needed to be secured, often becoming stuck on the initial screen and not realising or having difficulty to move the screen using the arrows in the appropriate direction before the time ran out. An improvement suggested by an over 60 female was '*No time limits, [need] time to think and understand.*' Similarly, a 22–25 year old female suggested '*Dark out the arrow which way you can't move. Not so fast to think about [what to do] before you act. Show what [object] is important.*' These mechanics potentially contributed to the participant's limited learning outcomes.

Participants demonstrated some improved skills post-game, including physical skills, like being able to interact with the game screen, but also having attained new knowledge around various prevention measures. One 22–25 year old male participant noted '*Need to fix [the] oven [and] fridge if I had a house here.*' suggesting a conversion of awareness toward an engagement with prevention messages and potential to use this knowledge to act accordingly. 16 participants felt that after playing QSH, they had an increased understanding of preventative actions to take for an earthquake. Though in some cases, following gameplay, three participants felt they knew less than they initially thought and three were unchanged. In general, participants only played QSH once and were unmotivated to play the game a second time to improve upon or utilise their newly developed knowledge or skills. 19 participants finished their first playthrough of QSH with a score of 52% or below. Six participants, two males 22–25, one male and female 26–30, one female 41–50 and one female over 60, were motivated to play a second time and generally improved upon their original score by approximately 20–30% due to their increased understanding of the game's mechanics and knowledge of the in-game tools. The reason for the lack of participant motivation and hesitance to play QSH a second time stemmed from several issues surrounding game design and mechanics as elaborated in the previous paragraph. One participant expressed that '*Something need[s] to be put in to encourage players to replay the game.*' Participant further revealed they did not necessarily intend to interact with QSH. Instead, QSH was mistaken as either an internet access point, the earthquake house simulator at Te Papa or the GNS interactive display at Quake City (identical display unit housing a screen positioned immediately next to QSH).

Participants gave interesting insights to their perspectives regarding social interaction. Out of 10 male participants, seven preferred playing games cooperatively generally within the 22–30 age group. In contrast, from a total of 12 females, only one female participant from the 13–18 age group preferred to play games cooperatively. While these findings suggest participants prefer not to play games cooperatively, researcher gameplay observations were noticeably different. All participants who were accompanied by family or friends, immediately upon starting QSH called to these people to play with them and help them play the game. Conversing with different participants about this observation revealed, having prior experience with other video games was considered valuable. Hence, individuals commanding such knowledge became the more knowledgeable other providing support and guidance. Participants did mention the enjoyment of competitive games, which while QSH does not have a competitive function, some of the more competitive participants wanted to try improving upon their original scores and when accompanied by family and friends encouraged them to try to beat their scores.

One participant's perspective seems reflective of the outcomes for the research on QSH suggesting '*Personally it was raising my awareness of what objects in the house are dangerous in [the] event of earthquake. While the game did inform me of what tools could be used for prevention, I do feel that information will be forgotten quickly. One bad thing is that I will be taking in a lot of information in a museum visit.*' Table 4.4 summarises the collection of participants' perspectives and learning experiences, reflective of constructivist principles. Table 4.4 mirrors this participant's response to principles of constructivism, demonstrating that QSH, like the participant denotes, has potential to impart relevant information, specifically for the intended purpose of drawing attention to messages of prevention. However, greater attention is required to ensure the museum environment can help facilitate the possible learning experience a video game can provide museum visitors.

Table 4.4: The influence of *Quake Safe House* upon the learning experience of museum visitors with consideration to constructivist principles

Constructivist principle	*Quake Safe House* influence upon learning experience
Learning is an active process	- Active participation by playing - Interaction with different prevention tools in-game - Interaction and control of in-game camera
People learn to learn while they learn	- QSH bound by rules, rules influence player decision making and actions - Time limit requires player decisions upon appropriate prevention tool to minimise damage during an earthquake - Rules learnt through initial tutorial and gameplay of three different scenarios
Meaning construction is mental	- Hands-on activity requires active participation - Decisions made based upon player understanding and subsequent actions
Learning involves language	- English language and New Zealand context - Requirement to read and understand English - Specific vocabulary related to disaster prevention - Cooperative situations can encourage dialogue with partners, family members, talk to themselves or translation software to guide through thought process
Learning is a social activity	- Mainly a single-player game - Can be played cooperatively, players discuss, express ideas based upon past experiences with shared control or one controls while the other instructs
Learning is contextual	- Utilise past knowledge and experience from various situations – other video games, technology, disaster awareness

Knowledge is required to learn	- Real world/ game world governed by rules, understood by players - Knowledge of rules used to build further knowledge and understanding
Learning takes time	- Experiment with ideas surrounding disaster prevention - Repetitive gameplay allows better understanding, build confidence, ability and knowledge to improve scores
Motivation is key	- Attain high score motivated players - Game did not motivate repetition of gameplay - Repetitive players motivated to play again demonstrated improved scores and understanding, compared to original play through – suggests players learnt something.

4.6 Learning about disasters through video games in New Zealand museums

The research findings demonstrate that QSH does connect to constructivist principles (Table 4.4), acknowledging previous scholars' connections between video games and learning theory. However, while a video game like QSH can potentially foster the participation of museum visitors in learning about disaster and DRR, the research findings allude to a significant setback. Interestingly, the findings in Table 4.3 indicate improved awareness of prevention measures rising from two participants pre-game to 10 new participants post-game (3 Te Papa and 7 Quake City). However, uncertainty still surrounds whether a video game installed within a typical museum environment is effective at converting the intended messages to the museum visitor. Participant perspectives seem to indicate more information and instruction is required to fully understand the preventative strategies and measures. A significant benefit of this research is an ability to utilise the perspectives of participants to give greater insight toward the design of video games for a museum environment.

QSH was designed to reflect a Wellington hillside home, and most probably with the New Zealand public in mind. However, the intended QSH target audience does not reflect the audience visiting the museum. This research revealed New Zealanders did not interact with QSH over four days in two different cities/museum but primarily foreign tourists. The annual reports of both Te Papa and Canterbury Museum support these observations. The annual 2016/17 annual report for Te Papa indicates 43% of the total 1,578,292 visitors to the museum were international visitors (Museum of New Zealand Te Papa Tongarewa, 2017). Likewise, the majority of Quake City's visitors in the 2016/17 period were tourists (who comprised 73% of all visitors to the Canterbury Museum and Quake City) (Canterbury Mueseum, 2018). Several participants commented that where they reside overseas, earthquakes are not a major hazard. However, the Quake City museum dedicated to the 2011 Christchurch earthquake receives paying visitors interested in learning more about earthquakes and the events of 2011. Four participants from Quake City referenced their reason for playing QSH was to learn about earthquakes with one 22–25 male participant commenting he was '*Curious and never had [experienced an] earthquake and what to do [it was the] best way to imagine what happens*'. With 11 participants having paid to visit Quake City for the purpose of learning about earthquakes, seven of these participants post-game recalled earthquake prevention strategies not previously known. Therefore, a lack of improved awareness levels about earthquake prevention does not appear to stem from being a tourist. Ultimately, regardless of how the video game visually connects with New Zealand, the underlying constructivist process as outlined in Table 4.4 should be occurring.

Noticeably, participants often struggled to make sense of QSH's purpose, which no doubt impacted the ability of participants to demonstrate an improvement of their earthquake prevention understanding as seen in the findings. As a process instructional scaffolding, a component of the zone of proximal development, enables the learner to solve a problem or achieve a goal beyond their unassisted efforts (Loparev & Egert, 2015; Wood et al., 1976), therefore increasing the learner's competence. Effective scaffolding incorporates the concept of fading (Loparev & Egert, 2015). The learner with a grasp of a target skill, continues practicing by successfully executing the skill with limited hints and feedback from the master (fades) (Loparev & Egert, 2015). Participant perspectives indicate QSH was unable to provide effective scaffolding for visitors to learn about earthquakes and how to reduce the damage earthquakes may cause within a household setting. Issues with the game mechanics including time limit, moving the screen, the drag-drop feature, uncertainty about what objects are to be interacted with and needing further instructions about the content all work against ability of QSH to provide participants with the preliminary skills to apply to subsequent game challenges. Participants were unable to practice the skills necessary for gameplay or learn how to use each tool in the game before they played the game, impacting not only the older generations but also younger participants. Without this learning process or scaffolding, the purpose and potential to build awareness of earthquake prevention measures and understandings were not fully realised through playing QSH. Given that QSH represents the zone of proximal development, implementing an effective instructional scaffolding system would give participants the guidance to learn new information (Klopfer et al., 2018) and strengthen connections with the constructivist learning process.

Constructivism suggests that learning takes time and motivation is key. Significantly, the three sections of gameplay in QSH last a total of 2 minutes and 20 seconds. Several participants commented upon the short time frames indicating that more time was needed to digest the information and think about their actions. Therefore, the timeframe could be a factor in participants building a complete understanding of the content and more importantly understanding what they were attempting to achieve. An observation of a younger museum visitor playing QSH demonstrated a clear understanding of bracing the house, something several older participants got incorrect. The visitor suggested they knew what to do as they played a bridge building game at home. A bridge designed with triangles is stronger than one without triangles. Therefore, the young visitor applied their prior knowledge and experience from the bridge building game (a form of zone of proximal development that provided the initial instructional scaffolding) into making the correct tool decision to brace the house. Thereby, experimenting with existing knowledge to confirm the accuracy of their understanding. Klopfer et al. (2018) suggest that the application of knowledge learnt in one context is difficult to transfer to another context. Although, the visitors response suggests this knowledge and understanding had been built over a period of time with repetitive gameplay experiences. However, only six participants were motivated to play QSH a second time. All repeat participants increased their overall game scores implying they had 'learnt' something from their previous gameplay. Notably, the remaining 16 participants were unwilling to reengage with QSH for another 3 minutes to try improve their scores. As such, it is questionable whether learning can actually occur from playing a video game if the video game is only played once rather than through repetitive gameplay as constructivism outlines.

Evidently, the research findings seem to indicate that the QSH display was somewhat ineffective at not only capturing visitor attention, and the game design may have also contributed to low interaction levels. A significant difference between a 'serious' video game in a classroom versus a museum environment is the fact there is no teacher or facilitator to help foster the learning process in a museum. Instead, the video game must capture the visitor's attention and motivate the visitor to continually reengage with the display. In contrast, a video game can be a set classroom task with repetitive gameplay sessions. A video game like QSH is surrounded by several other displays and is continually competing for the attention of the museum visitor. While several participants liked the graphics of QSH, one 26–30 year old female participant commented '*If clipart could make a game this is what it would look like*' indicating the graphics were unappealing, needing improvements to both the graphics and user interface.

One should refer back to the everyday usage of a video game. Video games are ultimately a fun activity, often played socially, which are not explicitly designed for an educational purpose (Young et al., 2012), yet can often satisfy the nine principles of constructivism as outlined in Table 4.4. Such video games, no matter whether they are designed with the casual player in mind or an AAA video game title (analogous to a blockbuster film) for a more experienced player, capture the players' attention, motivating the players to continually return to the game over a period of time. In respect of popular culture, classic and retro video games and consoles are experiencing a resurgence by not only nostalgic generations but also new generations (Schmidt, 2018; Sega Nerds, 2019). Yet, it is unlikely 'serious' video games would achieve similar standings. Significantly, affinity groups can emerge from mainstream video games which may involve metagaming (Young et al., 2012). Such social interactions, social learning and metagame learning of frequent gamers, reflect the connections to constructivist principles and may therefore lead to improved learning experiences and motivations for repetitive play. The Digital

New Zealand Report 2016 (DNZ16) suggests New Zealand males in 2016 had been playing games for five years longer than females, 15 years versus 10 years (Brand & Todhunter, 2015). Commenting that 75% of people would prefer to play alone; however, 38% of people will play games with their partners while in the same room (Brand & Todhunter, 2015). Observations during this research often saw female participants calling to their male partners to advise and play QSH with them, even though females were noted as not preferring to play games cooperatively. Importantly, such interactions and experiences were of immense value to those participants who worked cooperatively with a partner or group. Observations saw participants have discussions about the tools, how to move them around the game and attempts to apply personal past experiences and knowledge to the situation at hand.

The construction of knowledge occurs, as Meece and Daniels (2008) argue, through a process of co-construction; by interacting with others, people create knowledge (rather than doing it individually). Participants drew upon their partners, friends and family members (more knowledgeable other) when playing QSH to provide them with verbal or physical assistance that helped them complete the game, another component of the zone of proximal development. Without the more knowledgeable other, it was likely that some participants would not have understood how to play the game (as it was outside their current capabilities) (Meece & Daniels, 2008; Schunk, 2012), and the available instructional scaffolding within QSH was inadequate to support these participants. These observations support Vygotsky's theory that the social environment is critical for learning and social interaction transforms the learning experience (Schunk, 2012). However, QSH was not designed to adequately support social learning in the museum environment. Therefore, video games within a museum environment may require reconceptualising.

For museums to facilitate the learning process and foster educational experiences inclusive of all visitors, consideration toward the museum audience and the creation of spaces within the museum is required (Demski, 2009). It is this gap highlighted by Demski (2009) that may hold true for the findings of this research upon QSH within the museum space. Unlike a museum-based disaster education program which could be specifically directed toward New Zealand-based students, teachers and parents (MacDonald et al., 2017), QSH is situated among numerous other exhibits and displays. Brabazon (2006) comments that digital media can be used for strategic educational purposes, except deployment is poor and rarely considered a reflexive loop. This aligns with the participant's perspective about the amount of information a visitor confronts during a museum visit and new information may be forgotten quickly. Therefore, a standalone 'serious' video game within a museum environment needs to be memorable, engaging and connected to the surrounding displays. Reflecting upon the connections of metagaming and constructivist principles, the research observations reflect the disconnect in deployment, where developers in collaboration with museum curators missed an opportunity, to better direct museum visitors interacting with QSH toward the information and messages engaged with in-game that were displayed at Te Papa, while there was no information available at Quake City. The participant's comment regarding loss of knowledge inadvertently reflects the positions of Brabazon (2006), Demski (2009) and Hein (2006), and the research findings. Therefore, a necessary improvement to how museums present and use video games would be to ensure there is a connection of the video game to the surrounding exhibit.

It is crucial for QSH, as a standalone interactive video game display, to not only foster interaction between QSH and museum visitors but also direct the visitor back to information in the wider exhibit. Importantly, QSH should not be a disconnected activity from the wider exhibit, but in the absence of a teacher or facilitator, the wider exhibit may be required to guide the museum visitor. Notably, the final feedback screen of QSH referred visitors back to the non-operational EQ-IQ website. Evidently, participants were unaware of the information associated to QSH on the walls at Te Papa, though QSH also did not refer back to this information in the feedback screens. Given the interest and motivation to learn about earthquake risk reduction activities by Quake City visitors, they had no method to seek further information. Furthermore, there needs to be a level of consistency toward how video games are curated within the museum space. Video games cannot just be added in as an interactive activity, but rather need to be installed in a way that is clear and easily replicated in subsequent museum exhibits. Such video games need to be well supported by information that provides clarity for museum visitors about the games purpose and where they can gain further information to enhance their learning experience. The provision of such supporting material, in line with the constructivist learning framework discussed earlier in this chapter, would allow museum visitors to extend their learning about DRR, with individual's learning about a subject built step by step, with allowances for social learning, and subsequently putting this learning into practice through gameplay.

4.7 Concluding thoughts on learning through disaster video games in museums

This chapter draws attention toward the prospect of museum visitors, improving their awareness of disaster and DRR using a 'serious' disaster video game Quake Safe House. The connection of 'serious' disaster video games like QSH to constructivist learning theory suggest an ability to foster the participation of museum visitors in learning about disaster and DRR. However, further improvements especially surrounding the game design and presentation of the museum exhibition is required to better connect museum visitors who engage with 'serious' disaster video games with accessible information upon leaving the museum.

While the intentions of QSH may have been to increase engagement and awareness of preventative measures, the overall QSH display was not adequately positioned to ensure the museum visitor could engage with messages of disaster, DRR and specifically in the case of QSH prevention. While some participants demonstrated an improved level of earthquake prevention awareness, there were no opportunities for further engagement and reflection after leaving the museum. It is questionable as to whether museum visitors who engaged with QSH would be able to recall and translate their engagement with preventative strategies into action once outside of the museum environment. Parallel to the suggestions put forward by Macdonald et al. (2017), further research into methods which extend the video game players engagement with disasters and DRR following their interaction with a disaster video game museum exhibit would be beneficial. With consideration to constructivism, the provision of a pathway for continued reflection and actions once back home would allow an extension of learning time and connection to a relatable context.

This chapter highlights several factors which require careful consideration to avoid future 'serious' disaster video games intended for the museum environment falling into similar pitfalls. More attention toward the mechanics of the game and increasing player motivations to use the game are essential aspects to consider to further visitor engagement. More attention should be given toward how a video game, like QSH, could be best incorporated into an exhibition space, and potentially in other museum spaces. Focusing upon how the video game and display collaboratively best contribute to the learning opportunities of museum visitors is required, ensuring that associated information in-game is also reflected outside of the game. Provisions should also be made to consider the museum audience versus the target audience, including alternative languages, to create a more inclusive experience.

An opportunity therefore exists to engage a range of stakeholders, including representatives of the potential museum audience, in a collaborative process toward creating a video game with attention to game design in terms of game content, mechanics, skills and motivations and social interaction. In addition, exploring the location of the video game within an exhibition and the space surrounding the video game display. Importantly, this process cannot be undertaken solely by external stakeholders but must include the representatives of the everyday museum visitors. As Brabazon (2006) and Hein (2006) note people enter the museum space with preconceived ideas of what is popular and appealing, like the participant commenting about the graphics of QSH. Such perceptions can differ between individuals and social groups and may be challenging to cater to all. However, by bringing together a diverse set of stakeholders to develop more attractive and engaging 'serious' video games and displays for the purpose of the museum environment can lead to potentially improved uptake of the intended learning objectives reflective of constructivist learning principles.

Chapter 5 'Serious' disaster video games: An innovative approach to teaching and learning about disasters and DRR

5.1 Introduction

The New Zealand Curriculum sets out the scope and progressive scale of achievement objectives from integrative social science learning in primary schools (level 1-5) to individual disciplines like geography in secondary school (level 6-8) (Aitken & Sinnema, 2012). To understand the achievement objectives, students are to be engaged in a learning process that draws on and evaluates multiple sources of information; considers multiple, competing values and perspectives; develops deep understandings; and reflects on the learning and responses required of them. To inform the design of future geography teaching, Aitken and Sinnema (2012) propose a pedagogical model underpinned by four mechanisms to facilitate learning for all social sciences: 1) connection – make connections to students' lives, 2) alignment – align experiences to important outcomes, 3) community – build and sustain a learning community and 4) interest – design experiences that interest students.

Teachers must continually cogitate about how their students can be best equipped with the knowledge and skills necessary to allow them to respond to the dynamically transforming and uncertain future (Svoboda, 2019). Geography teachers and educators may therefore seek innovative teaching methods, like video games, to capture their students' attention and connect to broader learning objectives. Video games can assist in the development of geographic knowledge, creativity and spatial awareness representing a crucial bridge between play and practice for geography (Bereitschaft, 2016). However, limited research is available, that explores the effectiveness of video games with respect to curriculum requirements (Brysch et al., 2012; Papastergiou, 2009; Young et al., 2012).

Using a case study from New Zealand, this chapter examines how 'serious' disaster video games can foster student's participation in learning about disaster and disaster risk reduction (DRR) within the classroom. Firstly, a broad overview constructivist learning theory forms the theoretical foundation to examine video games. Secondly, the chapter provides greater context for the case study, including a review of disasters in the subject of geography. Thirdly, an outline of the methodological process details the approach used to conduct video game research with four New Zealand schools and six teachers. Lastly, the empirical results and subsequent analysis explore how 'serious' disaster video games can potentially be utilised as classroom learning tools.

5.2 Framing video games as constructivist learning tools

Constructivism, inspired by the theories of Piaget and Vygotsky in the 1930s, considers learning as an active, experiential and socially driven learning process (Piaget, 1952; Vygotsky, 1978). The first pedagogical principle of constructivism considers learning as authentic, active and student-centred (Splan et al., 2011; Rehmat et al., 2020). The second pedagogical principle emphasises the importance of social interaction in transforming the learning experience. Social negotiation facilitates learning by allowing learners to test their constructed knowledge and evaluate this construction against a broader body of perspectives, enhanced by collaborative learning and group activities (Adams, 2007; Chittaro & Ranon, 2007; Joplin, 1981; Splan et al., 2011). Therefore, learners are actively constructing, building and testing new ideas or concepts against existing and prior knowledge, collaboratively confirming these ideas within a community of learners (Adams, 2007; Chau et al., 2013; Garrison & Andrew, 2003; Meece & Daniels, 2008; Piaget, 1952; Rehmat et al., 2020; Schunk, 2012; Vygotsky, 1978). To support video game integration into the classroom, the alignment of video games to learning theory is necessary to recognise their potential as learning tools (Turkay et al., 2014; Young et al., 2012).

Scholarship demonstrates the connections of video games to constructivist learning theory (Adams, 2007; Chau et al., 2013; Klopfer et al., 2018; Obikwelu & Read, 2012; Ray et al., 2014). Naturally, video games require active player participation, where players must self-navigate and make effective decisions, often reflective of the player's cultural, moral and behavioural understandings (Chapter 2; Chapter 3). Klopfer et al. (2018) note that learners best develop knowledge and skills by doing; therefore, the learner constructs knowledge through action rather than inaction. Research suggests that students have a 75% retention level when they interact, see and hear, compared to only 20% what they hear and 40% what they see (DeKanter, 2005). Importantly, social interaction and negotiation occur both within and outside the video game environment. Young et al. (2012) emphasise that much of the learning from video games comes from affinity groups and metagame sources like blogs and discussion pages, surrounding game content or other gameplay aspects like modding, hints or cheats. Such interactions influence the building of personal knowledge as players share their experiences, actions and understandings with others. Young et al. (2012) suggest learning outside of the video game environment can be as powerful as direct learning from gameplay within the video game environment. Dezuanni and O'Mara (2017) illustrate the potential power of *Minecraft* fandom in primary school students learning. Dezuanni and O'Mara (2017) comment present the students reflections upon extended durations of *Minecraft* gameplay outside of school hours, which involves research, problem-solving and creative practices influenced through sources like Youtube and other online communities. The students could translate these experiences into the Serious Play project that involved the use of *Minecraft* (Dezuanni & O'Mara, 2017).

Research shows the enhancement of student learning in geography through video games (Bereitschaft, 2016; Brysch et al., 2012). Scholarship demonstrates the potential of video games to raise player's awareness of global issues and development of geographic skills (Bereitschaft, 2016; Brysch et al., 2012; Chapter 2; Davis, 2020; Gampell & Gaillard, 2016; Girgin, 2017; Solinska-Nowak et al., 2018). Video games like *SimCity*, *Spore* and *Minecraft*, among numerous other examples, can engage players from all walks of life in developing geographic knowledge, creativity, spatial awareness and problem-solving surrounding environmental issues, including climate change, urban planning, and other geographical concepts and processes (Bereitschaft, 2016; Brysch et al., 2012; Chapter 2; Davis, 2020). Further, some video games like *Mafia III* can confront gamers with the realities of racism, injustice, and segregation with players required to navigate their game protagonist through a virtual game environment that reflects lived realities in society (Leonard, 2020). However, greater attention toward teachers' usage of video games is required (Brysch et al., 2012; Young et al., 2012).

5.3 Teaching disasters in New Zealand using 'serious' disaster video games

Achievement standard AS91007, part of the level one National Certificate of Educational Achievement for senior secondary geography students (Year 11, approximately 16 years old), aims to understand the shaping of environments by extreme natural event(s). Students must fully explain a selection of five aspects toward how extreme natural events shape natural and cultural environments (NZQA, 2019). A geography teacher will aim to connect a locally relevant case study to the following five aspects of AS91007:

1) Natural and cultural characteristics (features) of the environments that make them vulnerable to the extreme natural event(s)

2) Natural processes that operate to produce the extreme natural event(s)

3) Effects of the extreme natural event(s) on the natural environments

4) Effects of the extreme natural event(s) on the cultural environments

5) How different groups of people have responded to the effects of the extreme natural event(s)

Hawke's Bay is a region on the east coast of New Zealand, exposed to earthquakes, tsunami, volcanic ash fall, flooding and fires (Hawke's Bay Emergency Management, 2020b). In 1931, Hawke's Bay experienced a 7.8 earthquake with 256 people losing their lives and extensive damage to housing and infrastructure, further exacerbated by fire damage. The earthquake transformed the surrounding natural landscape, in particular the city of Napier, raising the seabed by two meters, and had economic, political, cultural and social influences (Hill & Gaillard, 2013). As such, the 1931 earthquake is a relevant localised case study for AS91007 and significant part of Hawke's Bay's identity While the New Zealand Curriculum does not explicitly define or outline disasters nor DRR especially for levels 1-5 (Chapter 7; MacDonald et al., 2017), all Hawke' Bay students should have some awareness about disaster and DRR.

5.4 Methodological approach for video game research

This research set about to determine whether 'serious' disaster video games could foster student participation in learning about disaster and DRR in the classroom. Four Hawke's Bay schools with a total of nine classes (one co-education intermediate school class, one all boy's high school geography class, two geography classes at an all girl's high school and an all girl's boarding school involving one intermediate class and four high school classes including one geography class and social science class) participated in the research. One hundred and seventy one (171) students ranging from Year 8-13 (age 12-18), participated in the video game sessions. Notably, the intermediate classes (Year 8) and high school classes (between Years 9-10) have social sciences included as part of their curriculum rather than undertaking these classes by choice. For high school classes, between Years 11-13, students have specifically chosen to take geography as an examinable subject toward their qualifications. The students involved were not part of accelerant classroom streaming. The researcher conducted the research from June 20 to 23rd 2017 at the school during class time, where each session lasted approximately an hour. Six teachers who supervised the video game sessions participated in semi-structured interviews via email to gather their perspectives upon the use of video games within the classroom.

The researcher identified three free and easily accessible 'serious' disaster video games: *Earth Girl 2*, *Sai Fah – The Flood Fighter* and *Stop Disasters!*, featuring hazard scenarios and DRR content relatable to Hawke's Bay. Preliminary information was collected upon the three 'serious' disaster video games including development, game mechanics and intended learning outcomes (Table 5.1). The three video games were then subject to a content analysis through researcher gameplay and connected to a DRR framework reflecting prevention, mitigation and preparedness actions to confirm the intended learning outcomes and possible influences of game content (Table 5.2).

Table 5.1: Basic information and gameplay mechanics for identified 'serious' disaster video games

Game	Information	Gameplay Mechanics
Earth Girl 2 (Earth Girl Tsunami) (https://earthgirl2.com/earth-girl-tsunami/)	• Casual strategy game. • Developed by game artists and scientists at the Earth Observatory of Singapore in 2014. • Target audience ranges from 10 to 30+. • The intention is to save people living in seaside communities – earthquake and tsunami by using different DRR tools.	• Played on touch screen with drag and drop mechanics. • Number of seaside locations with different contexts – cities, villages etc. Various NPCs including pregnant women, babies, elderly etc. Various difficulty levels are available. • Information is given in game by the 'locals' with feedback also provided at the end of the level
Sai Fah – The Flood Fighter (https://bangkok.unesco.org/content/sai-fah-flood-fighter)	• Side scrolling arcade adventure game with a Thai context. • Developed by Opendream for UNESCO in 2014. • Target audience are children aged 5 – 18. • Intention to raise awareness around flood safety and flood preparedness.	• Played on touch screen with drag and drop mechanics • Story driven gameplay with three different stages comprising of several levels, before, during and after the flood. • Information and feedback is given in game and at the end of the level
Stop Disasters! (https://www.stopdisastersgame.org/)	• City Management simulation game. • Developed by ProjectThree for the UNISDR in 2009. • Target audience are children aged 9-16 or secondary level education. • Intention is to learn about disaster prevention for a range of natural hazards including earthquake, flood, tsunami, hurricane and fire.	• Flash game played in web browser • Players can choose from five different natural hazard scenarios including earthquake, flood, tsunami, hurricane and fire. Ability to choose various difficulty levels. • High amounts of information is provided in game and feedback is also provided at the end of the scenario.

Table 5.2: Connecting the identified 'serious' disaster video games to a DRR framework

			Educational Disaster Video Games		
			Earth Girl 2	Sai Fah - The Flood Fighter	Stop Disasters!
DRR	Prevention	Use of human made structures	X	X	X
		Landuse regulations			X
		Basic need and services provision		X	X
		Engineering design	X	X	X
	Mitigation	Engineering techniques/ hazards resistant construction	X	X	X
		Environmental policies			
		Public awareness	X	X	X
	Preparedness	Disaster risk analysis	X		X
		Early warning systems	X		X
		Stockpiling equipment and supplies		X	
		Coordinated evacuation	X	X	X
		Emergency operations		X	X
		Public information	X	X	X
		Training and field exercises	X		X

Source: Adapted from Gampell and Gaillard (2016)

The researcher conversed with the classroom teacher to determine the video game for the session. This ensured the video game was appropriate and aligned with the teachers' teaching plan and curriculum requirements. Two intermediate classes (ages 10-13) played *Sai Fah – The Flood Fighter*, two high school classes (ages 13-18) played *Stop Disasters!* with the remaining five high school classes playing *Earth Girl 2*. Gameplay lasted approximately 15-20 minutes dependent upon the game played and number of students. Student gameplay was unrestricted meaning the students did not have set tasks, instructions or game control diagrams. Instead, students discussed with their classmates or instigated an interaction with the teacher for advice or minor demonstrations.

Therefore, the participant, not the researcher, defined the gameplay experience, an approach that was reflective of constructivist principles (Chapter 3).

The video game sessions drew upon pre/post-game questionnaires, playing one of the three 'serious' disaster video games, a carousel activity and debrief activity during class time. The data collected from the pre and post-game questionnaire responses are only inclusive of the 116 participants who correctly recorded their non-identifying participant numbers to allow comparison (Table 5.3). The data collected from the carousel activities are inclusive of all 171 students.

Table 5.3: Summary of video game sessions with participating schools

School	Number of classes	Number of recorded participants (116)	Diversity	Video game
A	1 High school (Senior)	11	Boys only	Stop Disasters!
B	2 High school (Senior)	27	Girls only	Earth Girl 2
C	1 Intermediate	24	Mixed	Sai Fah
D	5 High school (1 Intermediate, 1 Junior and 3 Senior)	54	Girls only	Earth Girl 2 (n=36) Stop Disasters! (n=5) Sai Fah (n=13)

Pre-game questionnaires captured the existing gaming habits and understandings of DRR strategies for the specific in-game hazard scenario (Table 5.4). The post-game questionnaire sought any new DRR strategies learnt post-game, outcomes of gameplay and students' perspectives upon game content, mechanic, skills/motivations and social interactions (Table 5.5). Each student undertook the pre/post-game questionnaires individually. A non-identifying participant number organized the collected data in Microsoft Excel. The data primarily compared pre/post-game responses regarding the students understanding of DRR in respect of the intended learning outcome of the video game and DRR content analysis (refer to Table 5.1 and Table 5.2). Additionally, a comparison of the students' perspectives about the designated video game, their gameplay experiences and results was achieved to inform the connections to constructivism.

Table 5.4: Pre-game questionnaire template

Question	Pre-defined responses if applicable
What game are you trialling?	Earth Girl 2/ Sai Fah – The Flood Fighter/ Stop Disasters!
What is your designated number?	
Where do you have access to a computer?	Home/ School/ Other – write in
Where do you access to the internet?	Home/ School/ Phone/ Other – write in
On average, how many hours a week do you play video games? (Including Facebook games or smartphone apps)	0 hours/ 1-3 hours/ 4-6 hours/ 7 or more hours
Why do you play games?	Fun/ Learning/ Other – write in
Do you usually play a video game until you have beaten the game?	Yes/ No
Do you prefer to play video games with others? (e.g. playing with someone sitting next to you or by playing with someone online)	Yes/ No
What gaming platforms do you prefer to play games on? (Circle all that apply)	Playstation 3/ Playstation 4/ Xbox 360/ Xbox One/ PC/ Smartphone/ tablet/ Nintendo DS/ Wii/ Other – write in
What are some examples of games you would usually choose to play?	
How much do you know about the prevention of this video games hazard scenario?	1 (Very little)/ 2 (A little)/ 3 (Neutral)/4 (Basic Understanding)/ 5 (Complete Understanding)
Could you provide examples from your knowledge of any relevant hazard safety measures regarding your hazard scenario?	
How would you usually access information regarding the video games hazard scenario?	Books/ Internet/ Television/ School/ Other – write in
What is your gender?	Male/ Female/ Other
To which age range do you belong?	0-4/ 5-10/ 11-13/ 14-18/ 19-21/ 22-25/26-30/31-40/41-50/51-59/ Over 60/ Rather not say

Table 5.5: Post-game questionnaire template with interchangeable video game specific questions for *Earth Girl 2, Sai Fah – The Flood Fighter* and *Stop Disasters!*

Questionnaire	Question	Pre-defined responses if applicable
All	What is your designated number?	
Earth Girl 2	How many people were saved at the end of the scenario?	0-40/41-80/81-120/121-160/161 and over
	Select all the tools you chose for the scenario:	Education/ Warning Siren/ Roads/ Bridges/ Ramps/ Reinforced buildings/ Other – write in
	Did you select the tools suggested by the villagers?	Yes/ No/ I did not know the villagers suggested tools
Sai Fah – The Flood Fighter	How many levels did you play?	1/2/3/4/5/6/7/8/9/Other – write in
	How many stars did you score overall?	1/2/3/4/5/6/7/8/9/10/11/12/ Other – write in
	Did you try to achieve all objectives?	Yes/ No
Stop Disasters!	What scenario did you play?	Tsunami/ Earthquake/ Hurricane/ Wild Fire/ Flood
	What was the cost of damage in Dollars at the end of the scenario?	Under $3000, $3000-$4000/ Over $4000
	How many people were injured at the end of the scenario?	0-10/11-20/21-30/31-40/41 and over
	How many people died at the end of the scenario?	1/2/3/4/5/6/ Other – write in
	Did you pass all the mission objectives?	Yes/ No/ I did not know there were objectives
All	Did you feel that the feedback at the end of the game scenario was sufficient enough to help you better your score the next time you would play?	Yes/ No
	If you played a level more than once, did your score:	Increase/ Decrease/ Didn't change/ I only played once
	Were the game objectives easy to figure out? (e.g. what was expected of you during the game?)	1 (Unclear)/ 2/ 3 (Neutral)/4/ 5 (Clear)

	How would you rate the (video game name) in terms of difficulty?	1 (Easy)/ 2/ 3 (Neutral)/4/ 5 (Hard)
	After playing (video game name) how much do you know about the prevention of (hazard scenario)?	1 (Very little)/ 2 (A little)/ 3 (Neutral)/4 (Basic Understanding)/ 5 (Complete Understanding)
	How effective was (video game name) in teaching you about the safety measures associated with (hazard scenario)?	1 (Very ineffective)/ 2/ 3 (Neutral)/4/ 5 (Very effective)
	Would you say that (video game name) was a better method of learning about the dangers and safety measures of (hazard scenario) than a teacher alone?	1 (Disagree)/ 2 (Slightly disagree)/ 3 (Neutral)/4 (Slightly agree)/ 5 (Agree)
	Would you say that (video game name) was a better method of learning about the dangers and safety measures of (hazard scenario) than a television program?	1 (Disagree)/ 2 (Slightly disagree)/ 3 (Neutral)/4 (Slightly agree)/ 5 (Agree)
	Would you say that (video game name) was a better method of learning about the dangers and safety measures of (hazard scenario) than other media such as the internet or books?	1 (Disagree)/ 2 (Slightly disagree)/ 3 (Neutral)/4 (Slightly agree)/ 5 (Agree)
	Could you provide any new examples of relevant hazard safety measures regarding (hazard scenario) after (video game name)?	

Unlike the questionnaires, the carousel and subsequent debrief were group-based activities to facilitate social interaction between the students. Students self-formed into six groups, equalling the number of flipchart stations around the room. Each group started at one flipchart, discussing amongst themselves upon a specific topic (game content, mechanics, skills/motivations, social interaction, hazards/vulnerability for the local area and capacities/DRR for the local area), providing written or picture feedback.

After 3-5 minutes, groups rotated clockwise to the next station. Figure 5.1 demonstrates how the carousel activity was set up and Figure 5.2 provides an example of a completed flipchart. The carousel activity generated greater levels of response than the questionnaires with examples influenced by the game scenario played. The researcher transcribed each flipchart into Microsoft Word for easier analysis. This enabled a comparison between the individual questionnaire responses and group-based carousel responses regarding the students' understandings toward different components of disaster and DRR post-gameplay. Coding the carousel responses around the five aspects of AS91007 in level one geography and constructivist principles demonstrates the ability of video games as potential learning tools for geography.

Figure 5.1: Diagram of the carousel activity, indicating clockwise rotation of groups around six flipcharts titled with topics for students to provide responses

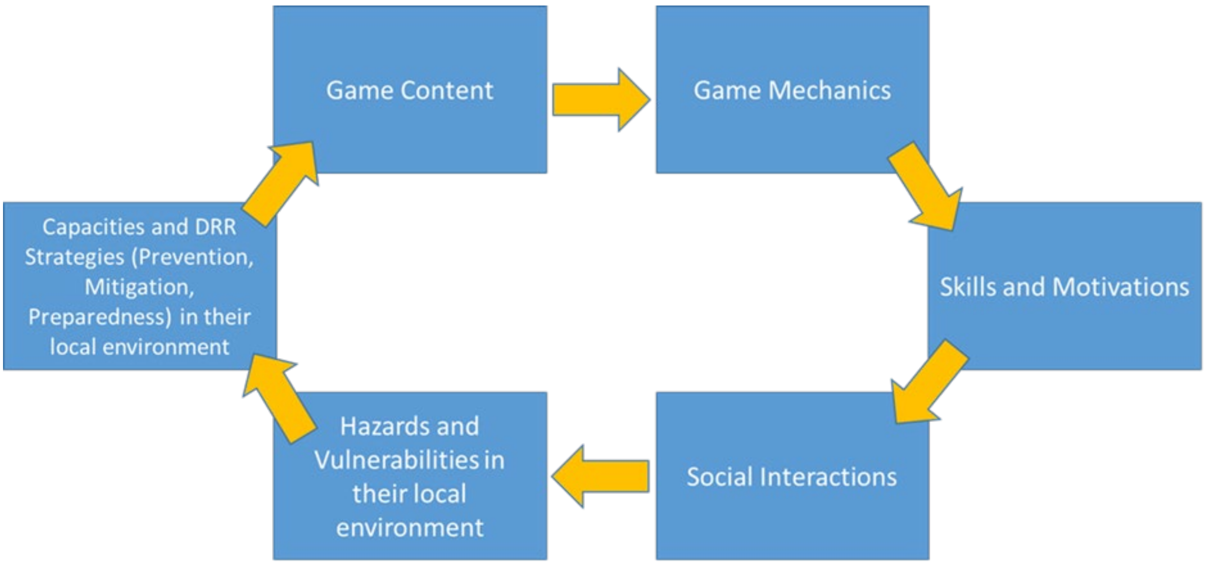
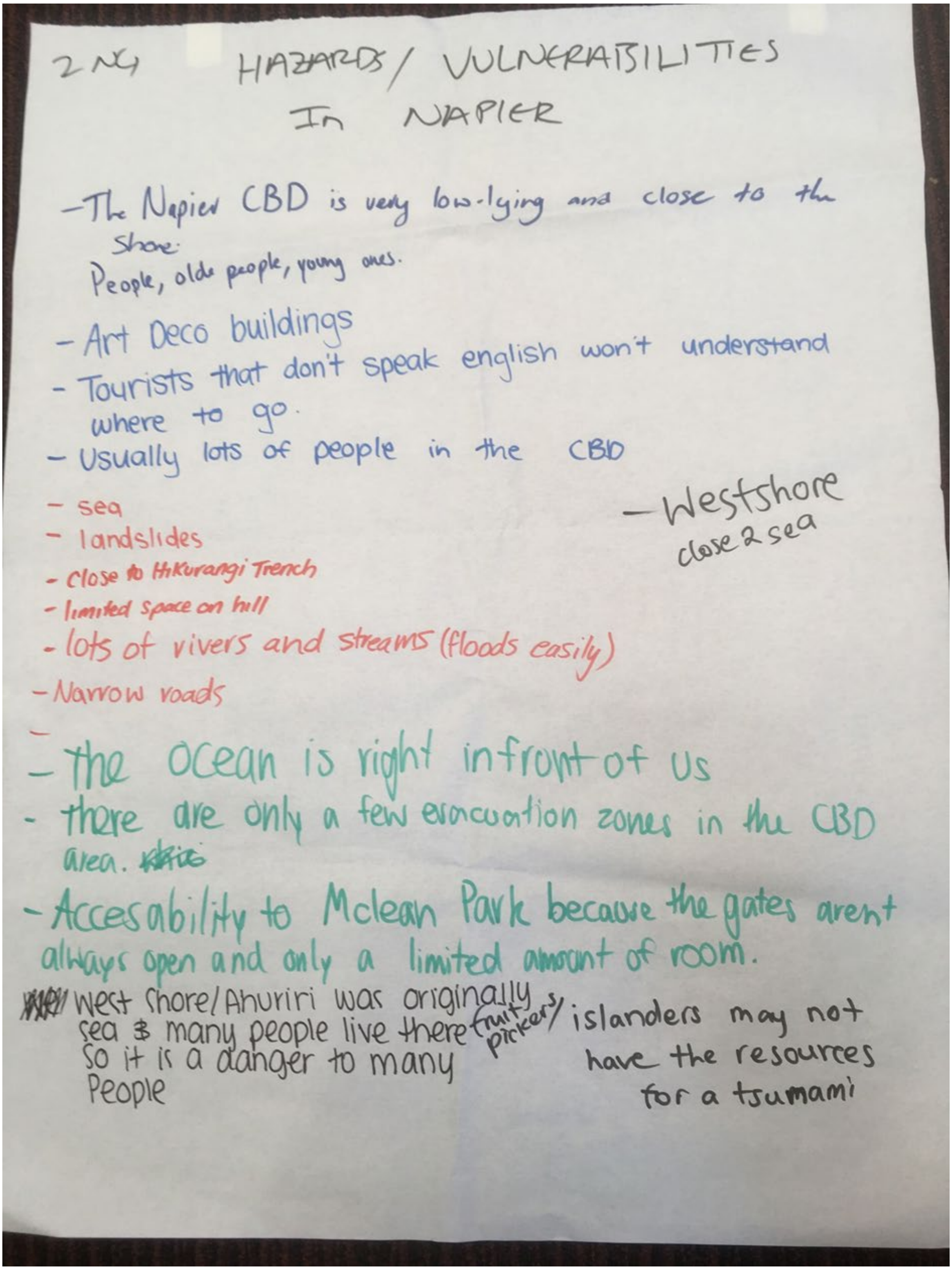


Figure 5.2: Example of a completed flipchart



Source: Author's own (2017)

A participant-regulated debrief activity occurred within the remaining class time. Students had an opportunity to reflect critically upon the overall process, conversing with each other to test their new knowledge and draw valid conclusions (Joplin, 1981). The debrief activity provides greater context and understanding directly from the students around the carousel responses.

Overall, the research methodology aims to be active, experiential and socially driven, aligning with constructivist learning principles. Apart from the designated classroom video game being selected between the researcher and teacher, students were free to engage with the video game without external interference or rules. The gameplay aimed to be student-centred to ensure the experience was authentic and experiential, aligning with the first pedagogical principle. To facilitate students' learning through social negotiation, students interacted with each other through conversation and/or demonstrations during gameplay, the social group-based carousel activity and finally a whole class debrief aiming to align with the second pedagogical principle of constructivism. The carousel and debrief activities also aimed to be student-centred determining what was important to the students in terms of the overarching topics rather than the researcher or teacher driving the discussion. Instead, the teacher and/ or researcher could build upon the students' curiosity, knowledge and understanding to promote a deeper learning experience.

The teachers provided their perspectives upon the use of video games for teaching within the classroom through semi-structured interviews, combining structured interview questions via email (as their preference) with informal post-class debrief conversations. The structured teacher interviews were thematically analysed for common themes relating to teaching strategies surrounding video games and classroom observations. Emerging themes included engagement (boys, girls and concerns), learning (tools, outcomes, and the process), previous experiences (video games in the classroom, teachers having been taught about disasters in their personal education, and teacher's personal usage of video games) and teaching pedagogy (implementation guidelines, video game impact, and support for teachers to integrate video games into the classroom).

The data generated insights, from both students and teachers, to inform how 'serious' disaster video games can contribute toward classroom learning as teaching and learning tools. Although there are several limitations of the research methods. Primarily constraints of class time meant the activities were shorter than the preferred duration. Additionally, the incorrect recording of pre/post-game questionnaires results in 65 missing individual perspectives. The pre and post-game questionnaires were only accessible upon the tablet device supplied by the researcher. Students were asked to complete the pre-game questionnaire first then the specific post-game questionnaire following their gameplay. However, some students only completed either the pre-game or the post-game questionnaire. Additionally, some students completed the same questionnaire multiple times, for example completing the pre-game questionnaire two to three times. Another issue related to students incorrectly recording their designated number that meant their pre and post-game responses could not be connected to each other. Further, in the case of one class there were not enough students to conduct the carousel using the method prescribed in the previous paragraph. To overcome this challenge, a one-word activity was used to help facilitate the carousel. Starting at one flip chart, students wrote one word or sentence upon a sticky note associated with that flip chart topic. Students would place their completed sticky notes upon the corresponding flipchart for the other students to read. Students conversed with each other while writing their responses to maintain social interaction. As a result, the students produced a similar sized data set though the social dynamic was slightly different. Notably, the research method does not aim to achieve statistical representativity but instead aims to demonstrate the patterns for how students think and respond to a video game in the classroom environment.

5.5 Evaluating 'serious' disaster video games for classroom learning

Since 2009, the Digital New Zealand Report has documented game audiences in New Zealand. The Digital New Zealand Report 2018 (DNZ18) found 74% of video game players are under the age of 18 (Brand et al., 2017). Their study surmised that by gender, 72% of males play video games compared to 62% of females. For young adults, passing time and having fun were the main reasons to play a video game, with 85% of all players surveyed indicating they play games cooperatively with another person from time to time (Brand et al., 2017). DNZ18 found casual gameplay time per day is nearly identical between male and females at 20 and 21 minutes respectively (Brand et al., 2017). In comparison with the research findings from this case study, 81% of the participating students indicated they played video games, with 100% of male participants and 76% of female participants. The participants gave fun as the main reason for playing games (n=105), followed by learning (n=4) and passing time (n=3), with only 68% of the research participants indicating a preference for playing games cooperatively, either in-person or online. The majority of female participants provided several examples of casual games they would usually choose to play, with males providing examples of more mainstream video games. With the three 'serious' disaster video games displaying similarities to a casual game in design, the students maintained gameplay engagement for approximately 20 minutes. Overall, researcher observations did not capture any definite evidence of increased performance in gameplay based on age or gender.

Theoretically, students post-game answers should reflect the intended learning outcomes of the played 'serious' disaster video game (Table 5.1). Students (116) self-assessed their level of knowledge surrounding strategies to reduce disaster risks featured in their designated video game via pre/post-game questionnaires. Pre-game, 56% of students (n=65) gave examples of their DRR understanding (Sai Fah n=34, Earth Girl 2 n=27 and Stop Disasters! n=4). The pre-game examples indicated prior engagement with preparedness messaging like '*Earthquake, if it's long or strong get gone, curl up like a turtle under a strong desk or table, drop cover hold Fire, leave the building calmly Tsunami, get to high ground if an earthquake is long or strong*'. Post-game, 77% of students (n=89) felt they had an increased understanding of DRR actions relating to their video game hazard scenario. Yet, only 22% of students (n=25) in the post-game questionnaire could provide examples of their new understanding around DRR for their hazard scenario (Sai Fah n=14, Earth Girl 2 n=11 and Stop Disasters! n=0). Post-Sai Fah questionnaires reflected flood safety and preparedness measures including comments around learning to move electrical items before a flood, using sandbags and having emergency supplies. While post-Earth Girl 2 questionnaires reflected building public awareness of hazards and evacuation processes like '*You need safety places for everybody of all age and state. You need sign posts and education so that everyone knows where to go.*' One Earth Girl 2 student who gave no pre-game example of DRR understanding noted post-game '*That a good evacuation plan in place will help when there is a real emergency.*' Such post-game answers demonstrate some students did gather insightful information that resonated from their gameplay experience. However, results were more prevalent through group-based tools rather than individual questionnaires.

School A and D students who played *Stop Disasters!* personally decided which hazard scenario they wanted to play. As a result, ten students from School A played the Stop Disasters! earthquake scenario, while three School D participants played the tsunami scenario. Both debrief activities revealed students chose the hazard scenario based upon the localized case study they were learning in their geography class or the relevance of the hazard scenario to their everyday life. However, Stop Disasters! students were unable to provide any new knowledge learnt from their game scenario in the post-game questionnaire. Yet, analysing their carousel responses some students included responses reflective of their game hazard scenario. In the case of School D, carousel responses focused on tsunami influenced examples like '*Build sea walls and have access to resources in disaster*' with School A referencing in relation to the earthquake scenario 'Reinforcing buildings'.

Similarly, both School B and D students included several DRR actions reflective of the tsunami and earthquake scenario in *Earth Girl 2*. Students recorded that evacuation routes and information signs need to be '*in multiple languages*' in connection to their local environment. During one debrief in School D, students elaborated that their rationale behind the inclusion of multiple languages upon their hazard/ vulnerability flipchart was surrounding the potential vulnerability of the significant number of seasonal workers in Hawke's Bay. Students indicated that '*Fruit pickers/ islanders may not have the resources for a tsunami*'. In turn, this led to a discussion regarding the high number of tourists visiting Hawke's Bay and the importance of having appropriate and accessible disaster and DRR information available to non-native English speakers. The inclusion of a diverse range of non-playable characters in *Earth Girl 2* like pregnant women, babies, people in wheelchairs and the elderly also resonated with another group of students in another class at School D who wrote *'hospital patients*' upon their hazard/ vulnerability flipchart. This became a focal point of conversation in the debrief which evolved into considering what procedures are in place for hospital patients should a hazard strike while undergoing a major operation. In turn, this sparked greater discussion surrounding other marginalised groups like prisoners, older people living in rest homes or those hosted in mental health care facilities where physical access is controlled.

The carousel activity for students in both Schools C and D elaborated upon preparedness measures, generally flooding strategies, found in *Sai Fah – The Flood Fighter*. The most persuasive resonating message from the game revolved around emergency kits with a flavour of the students own beliefs like '*Survival kit: food, water (filtered), torch, blankets, pillows, family (MOST IMPORTANT!), pray for everyone that they stay alive!*' In the subsequent debrief the students commonly referenced the importance of emergency kits and what they should contain. Seemingly, each of the three games led to different learning outcomes dependent upon the game played reflective of the game content and intended learning outcomes (Table 5.1 and Table 5.2). Although, it is possible games like *Sai Fah – The Flood Fighter* with simple, clear and repetitive messaging can resonate stronger with students than several messages as in the case of *Stop Disasters!.*

5.6 'Serious' disaster video games for classroom teaching and learning

Prestridge (2017) suggests the success of a video game as a learning tool is dependent upon the teaching beliefs and pedagogies of the teacher. In fact, Young et al. (2012) argue that further pedagogical attention is required around the social dynamics of the classroom and instructional facilitation. Teachers are likely to use the same pedagogical practices and usual teaching approaches rather than adapt their teaching strategy (Kim et al., 2013; Prestridge, 2017). This can constrain the strengths of a video game to generate deeper understanding over time, reflection and active engagement in favour of efficiently covering the required sections of curriculum for an assessment (Squire, 2003; Young et al., 2012).

Teachers were mostly positive about the potential opportunities offered by video games for classroom teaching and developing student-learning experiences. There was an even split between the interviewed teachers who had used video games in the classroom previously versus those who had not. Nonetheless, their perspectives of video games for the purposes of learning were quite similar. Evidently, the teachers interviewed strongly indicated that video games are only one tool contributing to the overall learning process rather than a panacea. Teachers emphasised that video games and technology are '*tools to facilitate learning*' and not '*a default teaching strategy*' but are instead '*one of many*' tools that can be used for classroom learning. Teachers commented that such video games needed to be '*appropriate for students*' with '*purpose, links to the curriculum, key skills being targeted and developed, cultural and language considerations*' though importantly, '*some rules or framework to ensure that the video games were not being used as gimmicks but rather be given the time to use them as powerful learning opportunities.*' Additionally, consideration is needed toward classroom timeframes to ensure debriefs of the learning outcomes could follow gameplay. A teacher familiar with using video games in the classroom summarised that '*I think in today's world using technology is essential in the classroom to allow students to show their learning and gain access to more information. I think it is also important that students don't just use technology as a substitution for workbooks but start to create outcomes with technology*'. With a second teacher concluding, '*I think that this idea should be pursued. There is a lot of scope to include ICT games in our programmes. To me Geography is an ideal subject for this to happen. Also, with the increasing use of ICT in today's classroom the time is right to support teachers with this type of platform.*' As such, teachers may require some professional development to move beyond video games as simply an activity toward understanding and using video games for learning (Kim et al., 2013).

The research findings support the sociality of learning and a shift away from the video game as the sole focus of learning. The case study research approach aimed to not only connect the 'serious' disaster video games to principles of constructivist learning theory but also worked to facilitate a conducive environment for learning to occur, in accordance to constructivism. Collating the students perspectives and gameplay experiences indicate that the three 'serious' disaster video games: *Earth Girl 2*, *Sai Fah – The Flood Fighter* and *Stop Disasters!* all have explicit linkages to learning theory and under the right conditions; learning should occur (Table 5.6). However, the interviewed teachers and the research findings indicate that the students' required further facilitation of their learning through social negotiation. Therefore, the integration of social learning, metagaming and gameplay are crucial for classroom teaching strategies with video games (Girgin, 2017; Young et al., 2012).

Table 5.6: The influence of *Earth Girl 2*, *Sai Fah – The Flood Fighter* and *Stop Disasters!* upon the students' learning experience with consideration to constructivist principles

<table>
<tr><th>Constructivist Principle</th><th>Influence of Earth Girl 2 upon student learning experience</th><th>Influence of Sai Fah – The Flood Fighter upon student learning experience</th><th>Influence of Stop Disasters! upon student learning experience</th></tr>
<tr><td rowspan="3">Learning is active process</td><td colspan="3">• Student's active participation by playing</td></tr>
<tr><td colspan="3">• Interaction with different tools/ items in-game</td></tr>
<tr><td>• Interaction and control of moving the game environment</td><td>• Interaction and control of game character Sai Fah</td><td>• Interaction and control of moving the game environment</td></tr>
<tr><td rowspan="3">People learn to learn while they learn</td><td colspan="3">• Game is bound by rules, rules influence player decision making and actions</td></tr>
<tr><td>• Time limit, budgets requires player decisions upon appropriate tools to minimise damage during the games hazard scenario</td><td>• No time limit, story unfolds by completing levels and problem-solving challenges to avoid Sai Fah getting injured</td><td>• Time limit, budgets requires player decisions upon appropriate tools to minimise damage during the games hazard scenario</td></tr>
<tr><td colspan="3">• Rules learnt through tutorials and/ or gameplay</td></tr>
<tr><td>Meaning construction is mental</td><td colspan="3">• Hands-on activity requires active participation
• Decisions made based upon player understanding and subsequent actions</td></tr>
</table>

<table>
<tr><td rowspan="3">Learning involves language</td><td colspan="3">• Multiple languages available</td></tr>
<tr><td>• South East Asian context</td><td>• South East Asian context</td><td>• Various global contexts</td></tr>
<tr><td colspan="3">• Requirement to read and understand one of the available languages
• Specific understanding of vocabulary related to disaster and DRR
• Cooperative in-person situations can encourage dialogue with peers or talking to themselves guide through thought process</td></tr>
<tr><td>Learning is a social activity</td><td colspan="3">• Single player game
• Can be played cooperatively, players discuss, express and experiment ideas based upon past experiences with shared device control or controls while the other instructs</td></tr>
<tr><td>Learning is contextual</td><td colspan="3">• Utilise past knowledge and experience from various situations – other video games, technology, disaster awareness</td></tr>
<tr><td>Knowledge is required to learn</td><td colspan="3">• Real world/ game world governed by rules, understood by players
• Knowledge of rules used to build further knowledge and understanding</td></tr>
<tr><td>Learning takes time</td><td colspan="3">• Experiment with ideas surrounding disaster and DRR
• Repetitive gameplay allows better understanding, build confidence, ability and knowledge to improve scores</td></tr>
<tr><td rowspan="3">Motivation is key</td><td colspan="3">• Attain high score motivated players</td></tr>
<tr><td>• Motivated to improve upon number of people saved</td><td>• Motivated to complete the story</td><td>• Motivation to get less deaths and save more people using upgrades to reduce the risk</td></tr>
<tr><td colspan="3">• Repetitive players motivated to play again demonstrated improved scores and understanding, compared to original play through – suggests players learnt something.</td></tr>
</table>

The active, experiential, experimental and playful dimension of gameplay allowed students the time to engage with various DRR tools or concepts and observe the possible impacts that a natural hazard or the consequences of their decision-making could have on natural and cultural features. Students were able to test their prior understandings of disaster and DRR, either individually or collaboratively via gameplay. Teachers observed different classroom dynamics like '*There were students who perhaps would not normally work together doing so. They were totally focused on the game and not giving as much thought to who they were working with*' supported by another teaching commenting '*the main difference was that everybody was engaged in the whole lesson!*'. The research inferred that students preferred working cooperatively, leading to shared experiences and approaches to problem solving. However, while the students were able to converse, demonstrate and observe each other during gameplay, their experiences and knowledge of post-game disaster and DRR understandings were not transferred to the individually completed questionnaire. The carousel gave students a platform to test, discuss and evaluate their knowledge amongst the broader perspectives of their classmates. Therefore, educators alongside researchers, administrators, policy-makers and game development companies should aim to rethink and reshape traditional teaching and learning activities which expand the social dimension and metagaming elements to foster student participation in learning (Brysch et al., 2012; Papastergiou, 2009; Young et al., 2012).

Uniquely, the research findings signify an opportunity for geography teachers to engage their students in a meaningful engagement with the curriculum. While not all classes were specifically geography or social science specific, the reflective and evaluative process of the research approach demonstrates that the carousel responses for each video game from various classes can connect to the five aspects required by AS91007 (Table 5.7). Notably, all three video games were not specifically designed for the New Zealand context. However, the underlying fundamental learning outcomes found within the designated 'serious' disaster video game could still engage students in learning content as determined by the curriculum. While this case study was centred on disaster and DRR, the research methodology employed can be applied to any other realm of geography education in association with a relevant video game. For example, *SimCity* could be used to engage students in urban planning, migrations, environmental issues and disasters, among many other topics, with carousel flipcharts or other social group-based tools further facilitating the students learning with discussions toward addressing particular curriculum requirements, focus topics, questions or connecting back to the students' local environment.

Table 5.7: Connecting examples from the carousel activities to the five aspects of AS91007

Aspect	Earth Girl 2	Sai Fah – The Flood Fighter	Stop Disasters!
Natural and cultural characteristics (features) of the environments that make them vulnerable to the extreme natural event(s)	• Houses too close to the sea: Clive, Waimarama, Napier, Te Awanga - campsite, café, winery --> people tourists	• We might not be able to swim • If we are not home we might not be prepared where we are	• Not enough housing • Sick, ill, disabled and elderly can't move fast
Natural processes that operate to produce the extreme natural event(s)	• Tectonic plates subducting – higher risk of earthquakes and tsunamis	• Global warming • Heavy rain	• Fault line
Effects of the extreme natural event(s) on the natural environments	• West shore/ Ahuriri was originally sea	• Over flowing creeks and rivers	• Slips/ land erosion • Tsunami
Effects of the extreme natural event(s) on the cultural environments	• CBD is close to ocean, more damage, higher risk in tsunami • Access to resources	• Yucky water/ gastro bug	• Budgeting too small • High buildings fall down
How different groups of people have responded to the effects of the extreme natural event(s)	• Practice tsunami walks • The safety walls by Marine Parade and Bay View • Visible evacuation route signs • Stop banks to stop floods	• Survival kit: food, water (filtered), torch, blankets, pillows, family (MOST IMPORTANT!), pray for everyone that they stay alive! <3	• Reinforcing buildings • Build sea walls and have access to resources in disaster

The learning area of the social sciences in New Zealand is structured around identity, culture and organisation; place and environment; continuity and change; and the economic world. Ultimately, video games can provide geography teachers with various environments and situations where players can access experiences otherwise unattainable with traditional teaching methods. Students commented through the carousel activities that '*it's good to see the outcome on a screen instead of real life so you know what to do*' and that using video games was '*a different way of learning and a fun* *way*'. However, to facilitate learning, video games cannot be standalone activities but instead need integration around social group-based activities. The pedagogical framing of the research process enables its conversion to an appropriate teaching strategy in alignment with the four mechanisms of the pedagogical model for social sciences outlined by Aitken and Sinnema (2012) (Table 5.8). Evidently, such a teaching strategy can deepen a student's engagement in a learning process in attainment of the geography achievement objectives. Unlike other areas of the curriculum, geography, as a subject, and the social sciences can further foster students learning surrounding concepts which resonant with the individual and encourage deeper student understanding of the curriculum.

Table 5.8: Connecting the research process to the mechanisms explaining effective teaching in social science

Mechanism	Research process
Connection - Connections made to students' lives	• Hazard scenarios reflective of their local environment • Carousel flipcharts connecting thinking back to the local area • Visual components can be more inclusive of students understanding
Alignment – Align experiences to important outcomes	• Pre-game identification of prior student knowledge • Video game aligned to the teaching plan and curriculum requirements • Multiple opportunities to revisit concepts through different activities which can attend different learning needs of the students
Community – Build and sustain a learning community	• Students build trust with their teacher to advise and guide their learning • Promotion of dialogue through gameplay, carousel and debrief activity. • Learning process shares the power between students and teacher
Interest – Design experiences that interest students'	• Students have freedom around their own learning and how that occurs – cooperative partnership, one person plays the game while the other guides • Not all activities motivate students therefore need to understand what does and does not motivate them • Video game scenarios can give students first-hand experience of long term processes surrounding different contextual situations • Variety of activities helps students recall of the content embedded within their experiences.

5.7 Conclusion

The pedagogical model and associated mechanisms to teaching geography can provide a foundation for the effective integration of video games into geography classes. This study set out to demonstrate the ability of 'serious' disaster video games to foster students' participation in learning about disaster and DRR. This research has shown that three 'serious' disaster video games – *Earth Girl 2*, *Sai Fah - The Flood Fighter* and *Stop Disasters!*, align with curriculum requirements for geography in New Zealand and also connects to the principles of constructivism. Even though such video games can bridge the gap between play and practice in geography, the appropriate and effective implementation of such 'serious' video games requires greater consideration of teaching strategies.

The use of 'serious' disaster video games within the classroom demonstrated that students did increase their understanding and knowledge related to disasters and DRR. However, further research is required to determine how significant the learning gains are for students. Particular emphasis and attention should be directed toward the cohesion and integration of video games into teaching pedagogy alongside other teaching tools to best foster student learning. Video games should not be used as one-off tokenistic activities but should serve a key purpose to allow students to experiment and test their understandings from taught content via the teacher and other classroom activities. If this process can be designed well, it should allow for a more definitive confirmation of whether students are or are not making significant learning gains. To a degree, the usage of video games in this case study were somehow tokenistic, as they were one-off activities and conducted at random intervals in the classroom. For example, students were not learning about disasters at this time in the school term. The students did demonstrate improved awareness of disaster contents through the carousel activities and debrief discussions, often reflecting material engaged with in the video game. However, it is unknown whether the video game sessions translated into meaningful action, like students using their new knowledge in their exams. Therefore, it is important to consider the long-term sequence of teaching activities to overcome the limitations of one-off activities. Future research could also investigate whether age and/ or gender influences gameplay performance. Such research could help in refining teaching strategies to determine the best approach for students of particular age groups or genders when using video games within the classroom.

Teachers are expressive of the positive benefits offered by video games. However, experienced users are wary that the usage of video games in the classroom must move beyond a tokenistic activity so that these games can have a meaningful contribution to the overall teaching and learning process. Student and teacher perspectives have shown video games are one tool that can facilitate the learning process in the classroom. Supporting video games with social group-based teaching tools enables students to engage in active, experiential, cooperative and collaborative learning reflective of constructivist learning. Ultimately, the alignment of video games to constructivism and the four pedagogical mechanisms: connection, alignment, community and interest, suggests the ability of geography to enable deeper discussions and engagement of the curriculum by both students and teachers. Future work should investigate a longitudinal progression of video games within a learning unit using a teaching strategy that continually builds upon the mechanisms of connection, alignment, community and interest. Geography is in a unique position to examine whether students with an increased exposure to the video game and social based learning strategies can actually facilitate a deeper engagement and understanding of geographic knowledge, creativity and spatial awareness.

Chapter 6 Participatory *Minecraft* mapping: Fostering students' participation in learning about disaster

6.1 Introduction

Scholarship suggests video games are one of several innovative tools to foster students' participation in learning (Gee, 2007; Schifter & Cipollone, 2015; Squire, 2005). However, research indicates that video games cannot be standalone tools for teaching and learning (Young et al., 2012). In order for video games to be used effectively and appropriately as learning tools, the teaching pedagogy requires more significant consideration (Schifter et al., 2013; Young et al., 2012). The integration of video games into a teaching pedagogy supported by other teaching tools may be the best approach to foster student learning upon a particular topic (Chapter 5).

International organisations, governments, non-government organisations and researchers are developing 'serious' disaster video games to raise player awareness of disaster and disaster risk reduction (DRR) (Chapter 7; Gampell & Gaillard, 2016). However, teachers and students are often absent from conversations surrounding the development and design of such 'serious' disaster video games. Additionally, such 'serious' disaster video games cannot attract and retain the attention of players required to engage them in repetitive gameplay. Alongside the difficulties to attain traction with students, teachers can also find the connection of the video game to the curriculum and integration into the classroom difficult (Chapter 7).

Unlike, 'serious' video games, mainstream video games like the multiplayer video game *Minecraft* are immensely popular with players worldwide. *Minecraft* is well established in popular culture, demonstrating a broad appeal to people of diverse backgrounds having featured in video games, television shows, numerous YouTube videos and LEGO (Garrelts, 2014). *Minecraft* has also become a popular tool in education, beginning to bridge the gap between video games and the classroom (Becker, 2017; Hewett, et al., 2020). However, teaching pedagogies on how to best integrate mainstream video games into the classroom is limited (Becker, 2017; Hewett et al., 2020; Qian & Clark, 2016).

In 2019, ten years since the initial release of *Minecraft*, its developer, Mojang, announced 176 million copies of *Minecraft* had been sold worldwide (Persson, 2019). Initially released in a developmental form in 2009 before an official release in 2011, *Minecraft* is a sandbox video game (Hewett et al., 2020; Mavoa et al., 2018), where the virtual open-world is made of LEGO-like blocks (Becker, 2017; Hewett et al., 2020; Schifter & Cipollone, 2015). The numerous iterations of the *Minecraft* blocks allows players to create various structures, settings and items within the game world (Becker, 2017; Mavoa et al., 2018). The creative and collaborative actions of players drive the gameplay versus having a structured narrative (Schifter & Cipollone, 2015). Therefore, *Minecraft* offers a learning environment that fosters the creative efforts of students in collaboration with other players (Schifter & Cipollone, 2015). Several versions of *Minecraft* are available, including *Minecraft Education Edition*, specially designed for educators (Becker, 2017; Hewett et al., 2020; Mavoa et al., 2018). Importantly, *Minecraft* reflects principles of constructivist learning theory, offering teachers a versatile platform across various curriculum subjects (Becker, 2017; Hewett et al., 2020; Mavoa et al., 2018; Scarlett, 2015; Schifter & Cipollone, 2015).

Clark et al.'s (2016) meta-analysis suggest games as a medium can support productive learning. However, they highlight the importance of the role of design beyond the game. Gee (2003) emphasised that neither gamers nor students can learn only by playing if the space in which to facilitate the learning process is poorly designed (Fanning & Mir, 2014). Clark et al. (2016) suggest a shift from proof-of-concept studies and medium analysis studies to cognitive-consequences and value-added studies to explore how theoretical design decisions influence learning outcomes within and beyond the classroom. Scholars suggest the integration of social learning, metagaming and gameplay are crucial for classroom teaching strategies with video games (Girgin, 2017; Young et al., 2012).

Using a case study from New Zealand, this chapter investigates how integrating a geo-referenced *Minecraft* world into a teaching pedagogy co-designed between academics, teachers, students and emergency management personnel can foster students' participation in learning about disaster and DRR. This research incorporates components of the student-centred methodological framework for video game research conceptualised in Chapter 3. The tools used enabled an opportunity for social learning beyond the video game environment.

6.2 Contextualising video games as disaster learning tools for the classroom

Chapter 3 conceptualised a student-centred methodological framework for video game research that informed the particular direction of the methodological approach underpinning this specific case study. Chapter 3 notes that video games require active participation and play, hence grounding the methodological framework to the defining principles of constructivism. Two core pedagogical principles guide constructivism: 1/ learning is authentic, active and student-centred (Rehmat et al., 2020; Splan et al., 2011), and 2/ the social environment and social interactions that facilitate the learning experience is crucial (Meece & Daniels, 2008; Vygotsky, 1978). Utilising this framework, Chapter 5 gathered the perspectives of 171 students, ranging from intermediate school (ages 10-13) and high school (ages 13-18), involved in classroom video game trials of 'serious' disaster video games. Additionally, the perspectives of the supervising classroom teachers and high school teachers attending the New Zealand Social Sciences Conference in 2017 and 2019 upon the use of disaster video games as classroom learning tools were also collected. Commonly, teachers and students are absent from discussions surrounding DRR, even though they should be considered primary stakeholders (Chapter 7; Luna, 2017; Petal, 2007, 2008). Significantly, this process collected direct insights from students and teachers regarding their personal perspectives and requirements that informed how a video game could be effectively utilised for learning about disaster and DRR.

In any case, the success of video games, 'serious' or mainstream, within the classroom is still reliant upon the teaching beliefs and pedagogies of the teacher (Prestridge, 2017).

The use of video games may require teachers to revise their style of teaching and learning (Prestridge, 2017; Schifter et al., 2013). Research suggests that teachers are likely to retain their usual pedagogical practices and approaches rather than adapt their teaching strategies (Kim et al., 2013; Kordaki, 2013; Prestridge, 2017). Such teaching approaches are often determined out of necessity to cover all components of the curriculum for assessment rather than enabling an immersive experience that works to the strengths of video games by generating deeper understanding over time, reflection and active student engagement (Gee, 2005b; Squire, 2003; Young et al., 2012).

6.3 Methodological approach

This chapter primarily uses a scoping study to explore how the use of a geo-referenced *Minecraft* world, alongside an appropriate teaching pedagogy, could foster student participation in learning about disaster and DRR within their local area. Scholars, practitioners and policymakers have advocated since the 1990s for the participation of children and youth in DRR (Peek, 2008). Maraekakaho (MKK) is a rural agricultural and wine-growing region situated in Hawke's Bay, New Zealand, which commonly experiences floods, drought and bush fires. In 2007, the area was subject to extensive flooding, which required the evacuation of the school and local fire department (Figure 6.1). Residents of MKK approached the local emergency management group to develop a disaster resilience plan for the area. Hence, the students of Maraekakaho School participated in learning about disaster and DRR within their local area. Ultimately, three co-education classrooms comprised of both male and female students (two years 5-6 classrooms -ages 9-10- and one year 7-8 class -ages 11-12-) involving approximately 90 students participated in the research.

Figure 6.1: Maraekakaho flood in 2007: A) Maraekakaho School, B) Original location of the fire station

Source: Hawke's Bay Emergency Management Group (2020a)

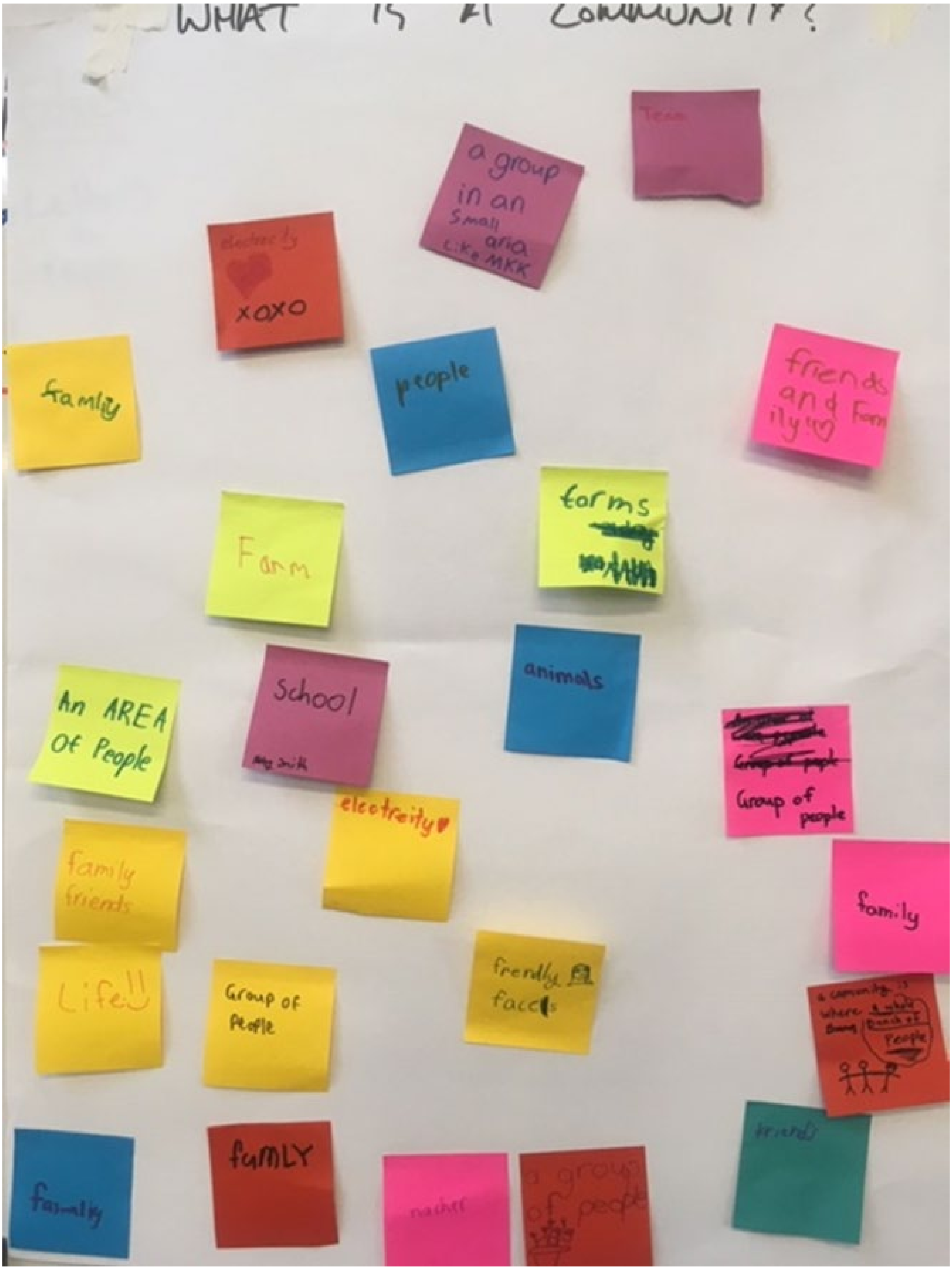
6.3.1 Co-designed teaching pedagogy/ research approach

Teachers, researchers, local emergency management personnel alongside input from the students, co-designed a teaching pedagogy that doubled as the research approach. Informed by the student-centred methodological framework put forward in Chapter 3, social group-based activities, commonly associated with participatory toolkits, supported students in learning about disaster and DRR. To avoid conducting one-off tokenistic activities without connection to the overall learning process, consideration of the long-term sequence of teaching activities is necessary. In this case, the teachers and researchers purposefully conducted activities to scaffold the students' engagement with learning about concepts of disaster and DRR. Students could re-engage with previously completed activities within subsequent classroom sessions. For example, by conducting a secondary activity after an initial activity (Activity A + Activity B) or using information from the initial activity to inform a new activity (Activity A => Activity B). This process demonstrated that the activities were not one-off but rather part of a continual teaching and learning process. Notably, a student-led debrief was conducted after each activity, aligning with the second pedagogical principle of constructivism. Hence, students could critically reflect upon each step of the process, conversing with each other to test their new knowledge and draw valid conclusions (Joplin, 1981). The debrief activities directly provided teachers and researchers greater context and awareness toward the students' understanding. Thereby helping inform subsequent teaching sessions by revisiting areas students' needed further engagement with or additional input from the teacher. The overall co-design process ensured that the activities conducted would fit with the school philosophy, teaching pedagogy and classroom schedules.

6.3.2 Procedure

The initial classroom activities aimed to introduce students to concepts of natural hazards and DRR. To commence, students wrote one-word they associated with the term 'community' on a post-it note and placed this upon a flipchart (Figure 6.2). Debriefing the collection of post-it notes helped students generate what they determined to be a 'community'; this was an essential step in the overall process, aligning with the first pedagogical principle of constructivism ensuring authentic student engagement. The researchers and teachers passed the decision-making to the students to define their 'community' rather than making assumptions as to what the students considered to be their 'community'.

Figure 6.2: One-word activity defining the student's 'community'



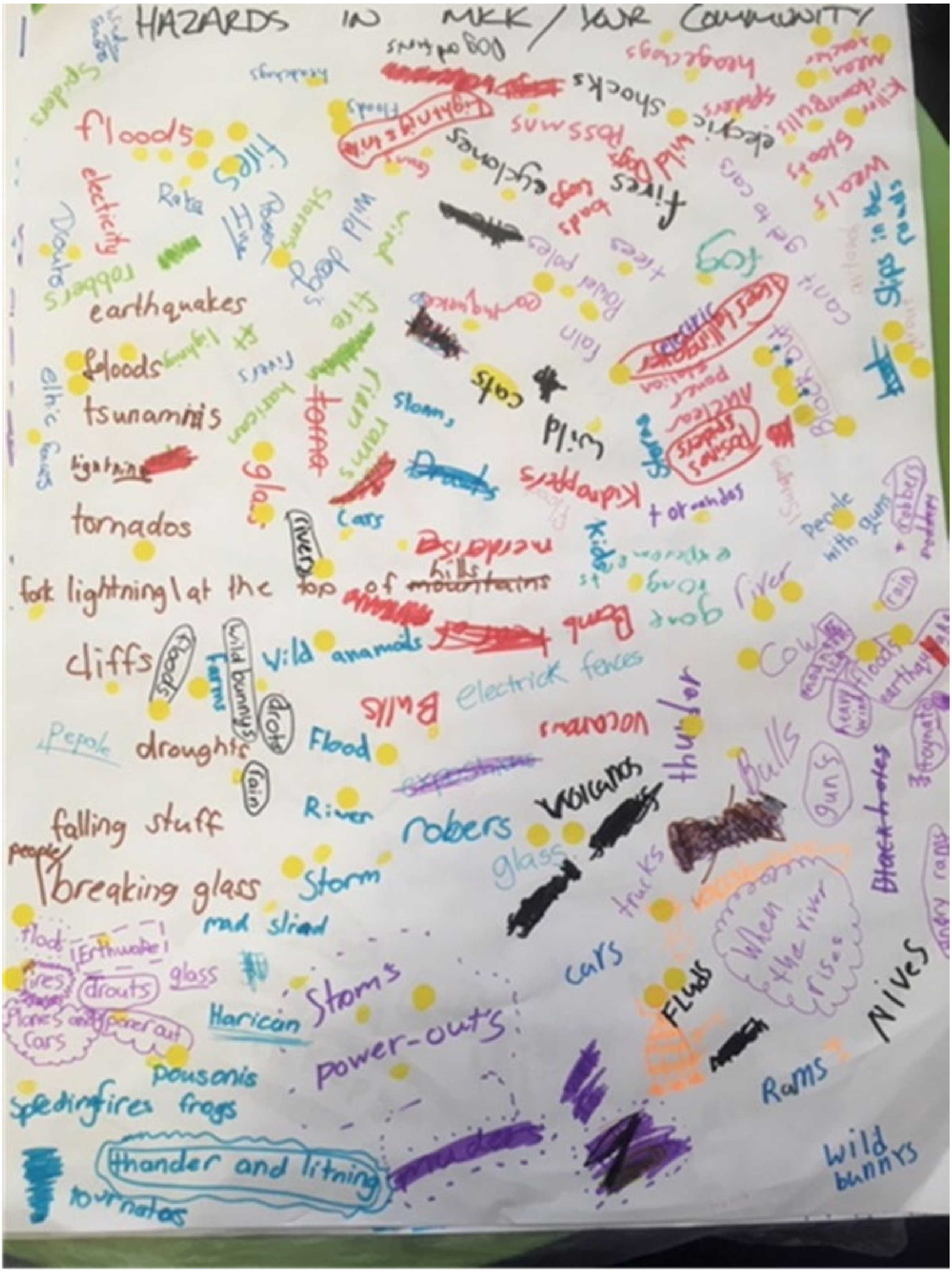
Source: Author’s own (2018)

Next, students engaged in a carousel activity to facilitate discussion around identifying the hazards, vulnerability and capacities found in their 'community'. Students self-formed into groups, starting at one of three flipchart topics ((Hazards/ Vulnerability/ Capacities) in your local community)), situated in a circle pattern around the classroom (Figure 6.3). Each group discussed amongst themselves ideas surrounding the specific flipchart topic concerning their local area and provided written or picture feedback upon the flipchart. As a group, students would rotate clockwise to the next station, building upon the previous groups' input. Following the completion of the carousel activity, students undertook a scoring activity to quantify their carousel responses. Run similar to the carousel, in their groups' students worked through the collection of responses putting three sticky dots next to a response they deemed most important, two sticky dots if of medium importance and one sticky dot if of minor importance. Through the scoring activity, students quantified the hazards, vulnerabilities and capacities they considered most significant in their 'community' (Figure 6.4).

Figure 6.3: Students engaged in the carousel activity

Source: Author's own (2018)

Figure 6.4: Example of carousel activity with the subsequent scoring activity



Source: Author’s own (2018)

Following the completion of the preceding activities, the students worked in groups to plot the scored information from the carousel activity upon an aerial photo of the MKK area. Students used yarn, stickers and pens to indicate not only the hazards, vulnerabilities and capacities previously identified but also the major infrastructure and natural landscape features around MKK like roads, river, school, woolshed, monument, restaurant, fire station and rubbish centre. The students also created a legend for their 2D maps. This activity introduced students to mapping conventions and familiarised students with the surrounding area from an aerial perspective. Ultimately, this activity gave students a tangible asset to support them when engaging with the geo-referenced *Minecraft* world, to locate particular features or working out their in-game locations. Researchers and teachers could eventually discuss and debrief the student's thoughts in connecting components of reality to the virtual *Minecraft* world.

Before commencing the *Minecraft* activity, students re-engaged with their carousel activity working to connect specific hazards, vulnerabilities and capacities with a reason, i.e. Hazards: swimming pool - if cannot swim, Vulnerability: gumboots (childcare centre)-young children, Capacity: swimming pool - water source, learning to swim. This activity reinforced the purpose for why students were engaging with *Minecraft* to plot this information.

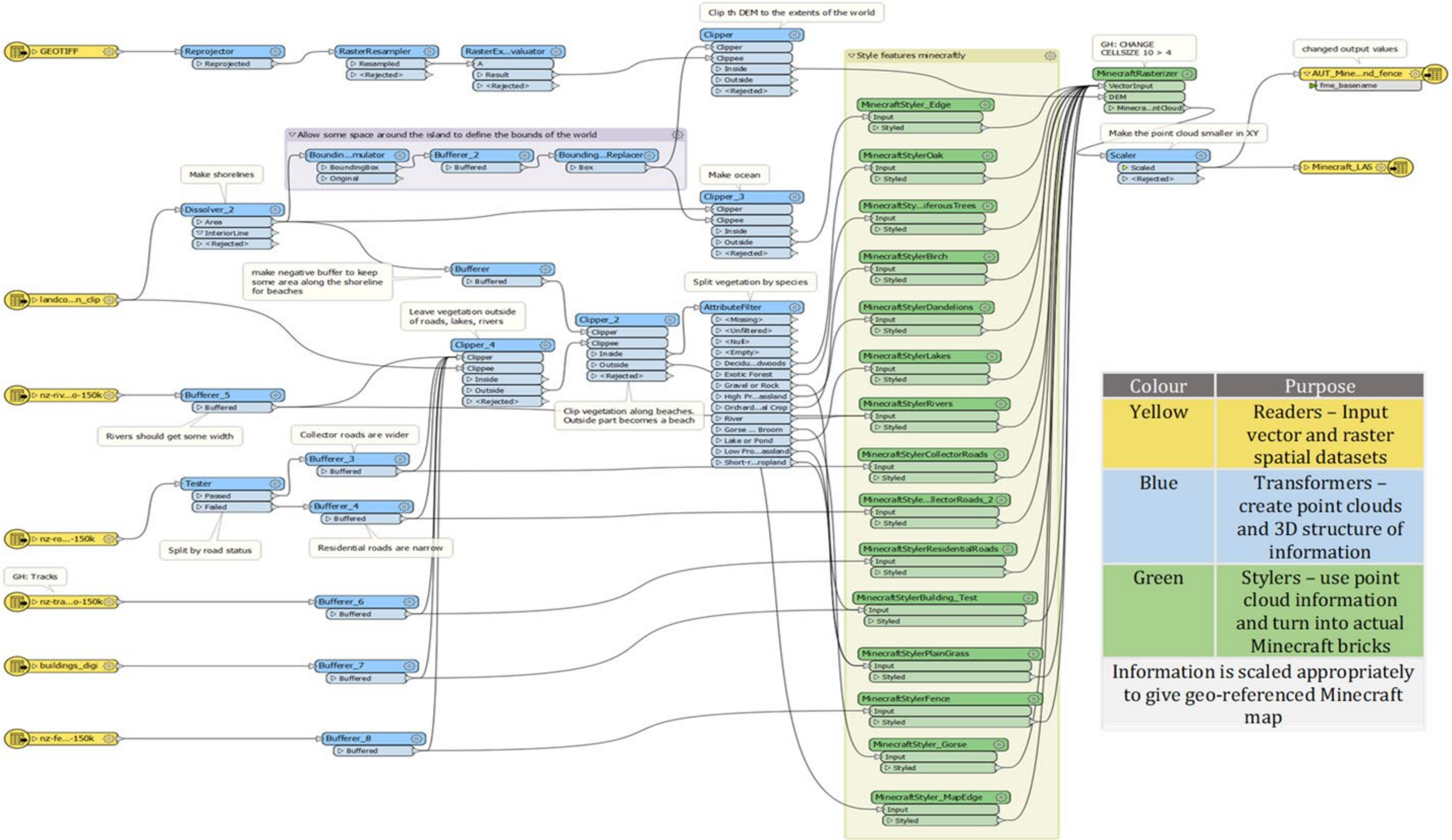
6.3.3 Minecraft: Free play, Break It Early Test and Geo-referenced Minecraft

As the school did not have access to laptops capable of running *Minecraft*, at the suggestion of some of the students, *Minecraft: Pocket Edition* was installed upon the school-owned iPads. Importantly, students were initially given free-play *Minecraft* sessions without any rules governing over their gameplay from teachers of the researchers. Such free-play sessions not only helped increase the competency of players and their familiarity the game controls and mechanics but also let students experiment, play and carry out any destructive or disengaged behaviour before engaging with the actual *Minecraft* activity. Through this process, teachers and researchers could identify student leaders who could help advise and guide their classmates within the geo-referenced Minecraft world and the students who were less confident.

To create the geo-referenced *Minecraft* base map, open-source spatial datasets (i.e. Land Information New Zealand) were processed through an FME Desktop 2019 workbench (see http://www.safe.com) to create *Minecraft* compatible world files (Figure 6.5). The workbench was developed from an initial example (Bagh & Ireland, 2015) and consists of a semi-automated geoprocessing workflow to manipulate and combine input spatial datasets. To overcome issues with the school firewall and network, a laptop running PocketMine (see http://www.pocketmine.net) hosted a *Minecraft* server via an offline local Wi-Fi network. Due to the restricted number of connections allowed by the modem, a maximum of 14 iPads could join the *Minecraft* server allowing multiplayer gameplay access to the geo-referenced *Minecraft* world. Students were vital in testing the geo-referenced *Minecraft* world in a 'break it early' test on-site. This process not only familiarised the students with the geo-referenced *Minecraft* environment but also identified any potential challenges. During operation, the researchers have full control over the world, able to change variables such as in-game weather or broadcast messages on class objectives and time-limits. Students identified navigation issues around spawn location and flower placement, restricting ease of building. Researchers resolved any difficulties identified to create the final base version of the geo-referenced *Minecraft* world of MKK (Figure 6.6).

Three classes of students spent 90 minutes mapping hazards, vulnerabilities and capacities, which involved the researcher using three different teaching approaches with the classes. The first class used the information from the other activities and 2D maps to plot information with limited guidance from the teachers and researchers. Class two, undertook the same activities as class one, but the teachers and researchers gave students more hands-on direction during the activities; the classroom teacher, for instance, distilled locations from the students' prior activities to target the students' building focus. The third class also had access to their previous activities and 2D maps, however, the students engaged with the *Minecraft* world without input or guidance from the teachers or researchers. Debrief discussions were held halfway through each session to review their progress and reflect upon details like location accuracy or missing features. Students would try to address these points before a final debrief to close the session and review their *Minecraft* worlds concerning the other activities.

Figure 6.5: FME workbench with a series of geoprocessing transformer operations to combine various spatial datasets into a *Minecraft* world file



Colour	Purpose
Yellow	Readers – Input vector and raster spatial datasets
Blue	Transformers – create point clouds and 3D structure of information
Green	Stylers – use point cloud information and turn into actual Minecraft bricks
Information is scaled appropriately to give geo-referenced Minecraft map	

Figure 6.6: In-game screenshot of the geo-referenced *Minecraft* base world of MKK

Source: Author's own (2020)

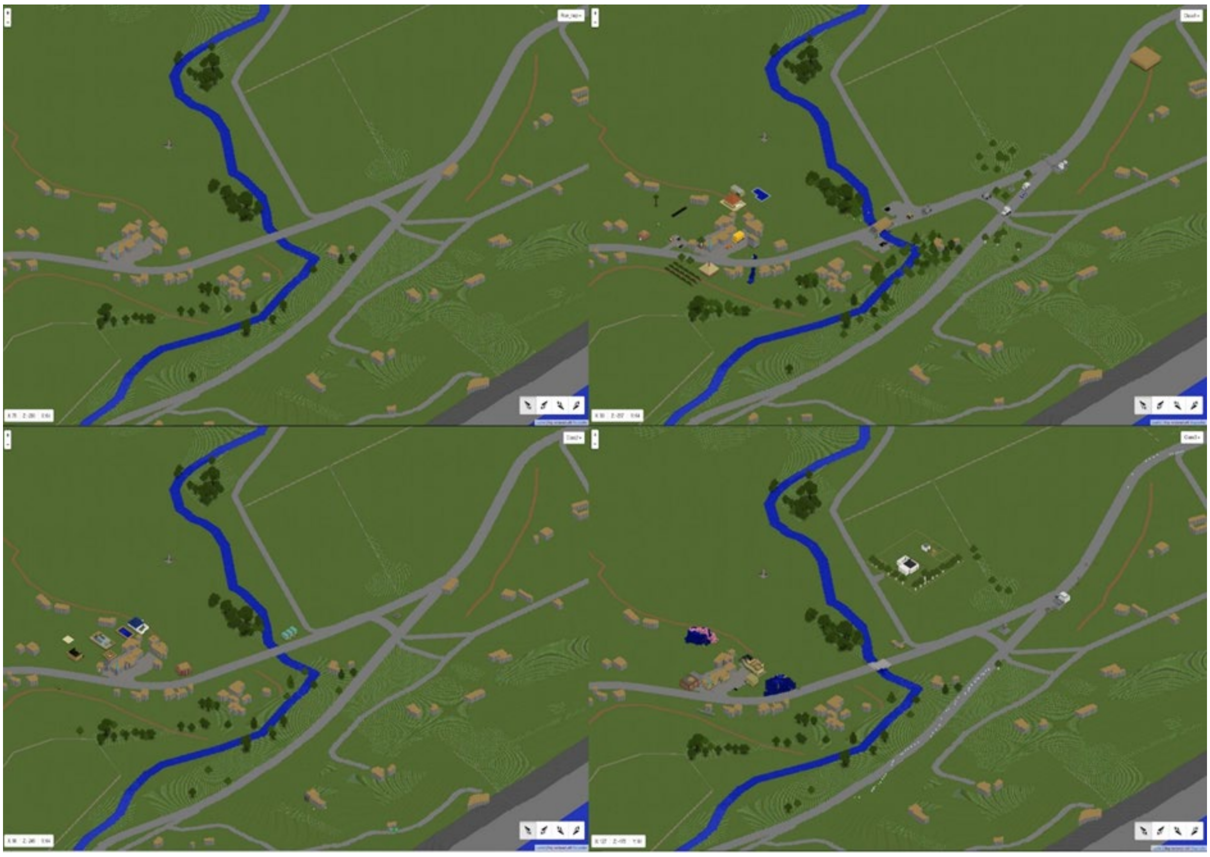
6.3.4 Data analysis

The three geo-referenced *Minecraft* worlds produced by the students were digitally saved and could subsequently be re-played by the researchers to explore the students' post-gameplay modifications. Gameplay video recordings captured the students' in-game conversations and building process. To reflect upon what components from the previous teaching activities transferred into their geo-referenced *Minecraft* worlds, the researcher transcribed the one-word post-it notes and carousel responses into Microsoft Excel. As the students provided numerous examples in the carousel, the researcher narrowed down the transcribed responses to those with an associated sticky dot from the scoring activity. The researcher used the students' quantified responses to determine the most significant hazards to MKK as perceived by the students. Further, the researcher categorised the students' defined and quantified vulnerabilities and capacities of MKK into physical, natural, political, economic, social and human.

6.4 Evaluating the Minecraft gameplay process

Scholars encourage video game research to go beyond game content and consider the influence and implications of game mechanics, skill-building, player motivations and social interactions (Gampell & Gaillard, 2016; Ivory, 2013; Schuurman et al., 2008). The findings presented in this chapter are based on researcher observations, debrief discussions with teachers and students, alongside the completed classroom activities and *Minecraft* gameplay. Figure 6.7 portrays the original geo-referenced *Minecraft* base world alongside images of the modifications made to this base world by each classroom.

Figure 6.7: Sections of the geo-referenced *Minecraft* worlds of MKK. Top left: The original base world. Top right: Class one. Bottom left: Class two. Bottom right: Class three.



Source: Author's own (2020)

6.4.1 Game content

In terms of game content, the students all accessed the same base geo-referenced *Minecraft* world. However, the content of each world was reflective of the creative input from the students. Table 6.1 presents the modifications made by each of the three classrooms. Class one had the most categorised modifications totalling 19, followed by class two with 16 and class three with 14. All three classes included flooding hazards, the fire station, the memorial, Gumboots (childcare centre) and the recycling station. Notably, class one was the only class to include fire hazards, an orchard, power lines, school bus and other vehicles along the roads and school car park.

In contrast, class two made modifications mostly within proximity to the school; this may have been the result of the random assignment of features designated to the students based upon the teacher's compilation of locations from the prior classroom activities. Class two were the only students to modify the church and include both the school playground and school sport shed. While the accuracy of the modifications were close to their real-life locations, the sizing and orientations were not always accurate for classes one and two. Class three generally exhibited better accuracy with their modifications, especially for the recycling station and bridge. Class three included the pony club and brewery which were unseen in the other worlds. Significantly, as all pre-existing structures on the geo-referenced *Minecraft* map are solid, students from classes two and three spent time hollowing out and redesigning the internal construction of buildings like their classroom and library alongside their exteriors.

Table 6.1: List of modifications made to the *Minecraft* world categorised by class

Modifications	Class1	Class2	Class3
Bridge	X		X
Chook and Filly restaurant		X	X
Church		X	
Fire hazards	X		
Fire station	X	X	X
Firetruck	X		
Flooding hazards	X	X	X
GodsOwn Brewery			X
Gumboots childcare	X	X	X
Houses	X	X	
Memorial	X	X	X
Orchard	X		
Pony club			X
Pool changing facilities	X	X	
Power lines	X		
Power station	X		X
Recycling station	X	X	X
School Bus	X		
School Carpark	X		
School Classrooms		X	X
School Field	X	X	
School Hall		X	X
School Library		X	X
School Playground		X	
School Pool	X	X	
School Sport shed		X	
Vehicles	X		
Woolshed	X		X

6.4.2 Game mechanics

The students indicated they often played *Minecraft: Pocket Edition*. Therefore, students were generally familiar with the gameplay mechanics. Importantly, this usually meant that students did not require in-depth explanations on how to play *Minecraft*. Instead, students were quite competent with the gameplay controls and how *Minecraft: Pocket Edition* operated upon a touch screen device. However, for students with limited experience, the free-play sessions enabled these students to become more familiar with how *Minecraft: Pocket Edition* operated. While the gameplay was relatively straight forward, some students did have difficulty with some mechanics like stopping the flow of added water or planting trees/flowers. Although, nearby students would provide advice to their classmates or help fix the problem in-game. Without access to an in-game minimap, students came up with creative methods to relocate their creations should they leave the area. For example, students would build coloured block towers near or above their creation. Notably, class three were the only class to make full use of the chat mechanic within their gameplay sessions.

6.4.3 Skill-building

With students having engaged in scaffolding and debrief activities around components of disaster and DRR, it would be expected that students would utilise their previous experiences to inform the modifications made to the *Minecraft* worlds. The students identified several natural hazards including, but not limited to, floods (25)/ river (5), cyclone (10), storms (7), fire (8), drought (6) and earthquake (4) that could affect MKK. Areas of flood risk were identified within all three the *Minecraft* worlds, while only class one identified fire hazards (see Figure 6.8). Class three referenced the vulnerability of the school hall should an earthquake occur based upon the fact that the school hall was closed for earthquake strengthening. With regards to the identification of vulnerabilities and capacities, the students use of in-game signs to acknowledge this information was at times relatively superficial and unable to reflect in-depth details as to why these features were classified as a vulnerability or capacity without further discussion with the students (Figure 6.9 and Figure 6.10). Accordingly, this may extend from the complexities of trying to capture less tangible aspects of vulnerability and capacities in comparison to concrete buildings and other infrastructure. For example, many vulnerabilities identified in the carousel activity were situated around social, human and physical structures, in particular, those people who have health conditions, disabilities and mobility issues like requiring wheelchairs, the elderly, school children, toddlers and the homeless. However, beyond this student's also acknowledged people might be living in dangerous areas, like low-lying land, with reflection to the economic situation of different families within the area.

The students emphasised the vulnerability of the regional water supply in response to the water contamination the region experienced in 2016. Although the students demonstrated knowledge of disaster components through *Minecraft*, some further classroom sessions were most likely required in the design of the pedagogy to improve their skills and understanding of DRR. Notably, not all students found *Minecraft* to be a useful tool for their learning. Several students commented that they prefer other tools like reading books rather than the more user-driven nature of Minecraft. In terms of physical skills, students did show an improvement of their gameplay competency, especially surrounding game controls and problem-solving. The students did demonstrate an increase in their gameplay competency. While some students did seek help from their classmates, other students would create imaginative solutions in the building process like building trees block by block, or the use of spider webs to represent power lines.

Figure 6.8: Fire hazard and flood hazard signs. Note different coloured blocks to represent each hazard

Source: Author's own (2020)

Figure 6.9: Memorial identified as a vulnerability and capacity with a rationale

Source: Author's own (2020)

Figure 6.10: School bus and modified fire station including a fire truck identified as capacities without a rationale

Source: Author's own (2020)

6.4.4 Motivation

Significantly, not all students were motivated to use *Minecraft*. Class one and two (ages 9-10) demonstrated purposeful intentions, beyond learning, to connect and inform their *Minecraft* world with their knowledge around hazards, vulnerabilities and capacities. However, while some students in class three (ages 11-12) were also motivated to contribute, often toward features of personal importance such as their family business, the classroom consensus was that *Minecraft* was too old. Students in class three mentioned a preference toward alternative multiplayer video games like *Fortnite* for the competitive aspect of its gameplay. Often, these students would become involved in destructive behaviours (flooding buildings) or playful behaviours (spelling their name in fire or digging holes through the world causing other players, including the researcher's avatar, to drop out).

6.4.5 Social interaction

Overall, the level of social interaction between the students was high both in-game and outside (Figure 6.11 and Figure 6.12). Due to the number of devices connectable to the modem at one time, students were required to work in partnership with each other. These partnerships were not always an everyday classroom pairing and saw different students working together to achieve the set task. Of interest, some partnerships evolved into students fulfilling a distinct role of controller or instructor. The controller would control the avatar during gameplay with input from their partner acting as the instructor. The instructor may draw on paper different designs for creations that the controller would subsequently create in-game in discussion with each other. General observations found the students in class one and two preferred discussing their actions with each other in-person, with students physically moving to different partnerships in the room to converse.

In contrast, students from class three conducted the majority of their discussions through the chat mechanic. Students in class three used the chat function not only for general discussion and asking for help but also to agree on specific ground rules. For example, students going invisible and destroying other student's creations. Therefore, all students could join the conversation and provide their perspective. As such, the students self-policed each other in the game world as per their own agreed rules.

Figure 6.11: Students working and conversing in pairs while playing *Minecraft*

Source: Author’s own (2018)

Figure 6.12: Student asking for help using the in-game chat function

Source: Author’s own (2020)

6.5 Conceptualising the teaching pedagogy as metagaming

This chapter details a scoping study to explore how the use of a geo-referenced *Minecraft* world, alongside an appropriate teaching pedagogy, could foster student participation in learning about disaster and DRR within their local area. The alignment of video games to learning theory is necessary to recognise their potential as learning tools (Turkay et al., 2014; Young et al., 2012). Research confirms the connections of video games to principles of constructivism (Adams, 2007; Chau et al., 2013; Klopfer et al., 2018; Ray et al., 2014). Although, such studies generally focus upon confronting 'serious' video games over mainstream video games. Scholars like Gee (2003, 2005b, 2007) have argued that mainstream video games have embodied deep and meaningful learning practices. Therefore, mainstream video games could provide educators' opportunities to foster more profound thought and reflection that traditional teaching approaches cannot offer (Gee 2003, 2005b, 2007; Kapp et al., 2014; Schifter et al., 2013; Squire, 2006). However, due to a student's learning style, not all students may find video games as beneficial learning tools (Kapp et al., 2014).

Table 6.2 demonstrates the potential influence of *Minecraft* upon the students' learning experience with consideration to constructivist principles. Significantly, *Minecraft* supports collaborative, self-regulated and problem-solving interactivity within the same game world that can also reflect real-life scenarios (Chapter 7; Hewett et al., 2020). Therefore, students are provided with an opportunity to construct actively, build and test new ideas or concepts against existing and prior knowledge and collaboratively confirm these ideas through group activities within a community of learners (Adams, 2007; Becker, 2017; Chau et al., 2013; Garrison & Andrew, 2003; Hewett et al., 2020; Joplin, 1981; Meece & Daniels 2008; Piaget, 1952; Rehmat et al., 2020; Schunk, 2012; Vygotsky, 1978).

Table 6.2: The influence of *Minecraft* upon the students' learning experience with consideration to constructivist principles

Constructivist Principle	Influence of *Minecraft* upon the student learning experience
Learning is an active process	• Students actively participating by playing the game in a multiplayer game environment
	• Interaction with different blocks to make modifications to the in-game environment
	• Interaction and control of the game avatar
People learn to learn while they learn	• Game is bound by rules, rules influence player decision making and actions. Rules can also be created through player-player discussion and consensus
	• No time limit, the ability for continued building and modifications to represent changes over time
	• Rules learnt through gameplay, metagaming sources and other players/ classmates
Meaning construction is mental	• Hands-on activity requires active participation • Decisions made based upon player understanding and subsequent actions
Learning involves language	• The requirement to read and understand one of the 91 available game languages • Disaster vocabulary is dependent upon the understanding of the player and their modifications rather than a requirement to play *Minecraft* • Cooperative in-person situations can encourage dialogue with peers or players talking to themselves to guide through the thought process • Multiplayer game environment can encourage dialogue with peers through in-game chat functions
Learning is a social activity	• Multiplayer game • Can be played cooperatively, if sharing one device - shared control or one controls while the other instructs, players discuss, express and experiment ideas based upon past experiences
Learning is contextual	• Utilise past knowledge and experience from various situations – other video games, technology, insider knowledge of the local area, classroom activities
Knowledge is required to learn	• Real-world/ game world governed by rules, understood by players • Knowledge of rules used to build further knowledge and understanding
Learning takes time	• Experiment with ideas surrounding disaster and DRR • Repetitive gameplay allows better understanding, build confidence, ability and knowledge to improve
Motivation is key	• Motivated repetition of gameplay due to localised relevance of the game world
	• Players motivated for continual gameplay based upon the familiarity and popularity of *Minecraft* in everyday life over a 'serious' video game instructing students what to learn – gameplay allows freedom of creativity and self-regulation of actions

The connection of *Minecraft* to constructivist principles supports the idea that video games can support learning. However, this case study has attempted to move beyond merely demonstrating the potential connections of video games to support learning and directed attention on to the design of the learning process (Clark et al., 2016; Fanning & Mir, 2014; Gee, 2003; Young et al., 2012). Social learning, metagaming and gameplay are considered crucial for classroom teaching strategies with video games (Girgin, 2017; Young et al., 2012). Notably, this concept reemphasises the critical role of the teacher in the success of video games being utilised as learning tools (Prestridge, 2017) and the connections of video games to learning theory to ensure this process is achievable. Significantly, this case study co-designed a teaching pedagogy, with direct influence from teachers and students, ensuring the design aligned with their specific needs, and the process was appropriate to facilitate the learning. Unlike traditional individualistic teaching and learning approaches, the utilisation of student-centred tools drawn from so-called 'participatory toolkits' enables students and teachers to work collaboratively to construct meaning through shared ideas and experiences.

In line with constructivism, the learning process adopted in this study required students to be actively engaged in an authentic activity (Becker, 2017). Kapp et al. (2014) comment that the level of interactivity within a learning environment drives learning. Therefore, a learner needs to be engaged to learn. The co-designed teaching pedagogy of this study emphasises that students should be aware of why the information is essential and that they must be motivated to learn because the content is relevant to them (Sanchez, 2013). The process utilised was not only driven by what the students deemed necessary but was also directly connected to their local environment. Selby and Kagawa (2012) indicate that disaster education directly relating to local hazards is most relevant to learners.

Interestingly, the majority of students could retell the flooding of MKK in 2007. However, many of the students were not yet born at this time. The student's family members and other people within the 'community' have passed down knowledge of the 2007 flood. Therefore, an opportunity arose for the students, teachers and researchers to discuss the impacts of the 2007 flooding. The students were actively engaged and motivated to learn, as the content was relevant and important to them (Sanchez, 2013).

Kapp et al. (2014) suggest the best levels of retention, content acquisition and learning transfer occur when the gameplay is situated between pre-game activities and post-game debrief, similar to the five-stage experiential learning model from Joplin (1981) and the process employed in this case study. The social interactivity of the carousel activity and debrief enabled students to share their ideas and experiences around hazards, vulnerability and capacities in regards to their definition of community with teachers and researchers. Hence, this process offered students transparency around the purpose of their learning. Research suggests learning should not be hidden from students but should instead highlight the lessons learnt, grounding the learners' experience within gameplay (Kapp et al., 2014). The subsequent debrief activity should also discuss the outcomes of the learning process.

From the outset, the students defined 'community' around the idea of a group of people, while the debrief discussion elaborated this toward the school, sports groups, farms and so forth. The students' ideas around 'community' designated areas of importance to them, rather than areas that the teacher or researcher assumed were essential to the students. These activities and debrief sessions not only aimed to provide students with greater control and self-regulation over their learning. Additionally, these activities aimed to ground the student's understandings and experiences to provide the students with adequate scaffolding to support their Minecraft gameplay experience. As such, this process could allow students to undertake more profound thought and reflection that a traditional teaching approach could not offer. Ultimately, the teaching pedagogy serves as a form of metagaming by providing students with information about the real-world environment, which was otherwise unknown within the video game world.

6.6 Limitations and future directions

Clark et al. (2016) call for a shift from proof-of-concept studies and medium analysis studies to cognitive-consequences and value-added studies to explore how theoretical design decisions can influence learning outcomes within and beyond the classroom. Qian and Clark (2016) denote that knowledge is limited around educational models to teach 21st-century skills in the classroom. Therefore, Table 6.3 offers a reflection on how the research process/ teaching pedagogy employed in this scoping study can align with a pedagogical model proposed by Aitken and Sinnema (2012) underpinned by four mechanisms to facilitate effective social science teaching mechanisms. Notably, this is only one example of applying the research process/ teaching pedagogy to a subject area.

Even though the co-designed teaching pedagogy infers a successful connection to teaching mechanisms, further refinement toward the design of the teaching process is required. Prensky (2002) suggested that video games engage players in five levels of learning: how, what, why, where and when. This concept was adapted in Chapter 2, outlining the five levels of potential learning outcomes for a DRR video game. Through this case study process and *Minecraft*, students engaged in learning about disasters and actions necessary for successful DRR (how), and various environmental and cultural considerations (where). However, students were unable to observe the impacts of hazards upon the game environment (when), formulate a strategy to achieve successful DRR for the hazard (why), and learn what can and cannot be made in terms of DRR (what). To achieve the when, why and what components, the geo-referenced design elements of the *Minecraft* world could be further utilised. As the *Minecraft* world has an in-game scale (elevations and buildings), students could complete a preliminary version of the *Minecraft* world. The *Minecraft* world save file could be reprocessed through FME to alter the water level height for bodies of water, like the river, to replicate the flooding pattern like the 2007 MKK flood. Students could then re-engage with this new map, observe the potential impacts and reflect upon areas of high vulnerability (when), work toward a DRR strategy to address the risk (why) under specific conditions (what).

Table 6.3: Reflection of the teaching pedagogy/ research process in connection to effective social science teaching mechanisms

Mechanism	Research process/ Teaching pedagogy
Connection - Connections made to students' lives	• Geo-referenced *Minecraft* world reflective of their local environment • All activities connect student thinking back to Maraekakaho • Visual components can be more inclusive of students understanding
Alignment – Align experiences to essential outcomes	• Student knowledge and understanding of disaster is scaffolded before gameplay. • Video game aligned and integrated into the teaching plan ensuring the satisfaction of the curriculum requirements • Multiple opportunities to revisit and reemphasise concepts through different activities which can attend different learning needs of the students
Community – Build and sustain a learning community	• Students build trust with their teacher and peers to advise and guide their learning • Promotion of dialogue through gameplay, social group-based activities and classroom debrief activities. • Learning process shares the power between students and teacher
Interest – Design experiences that interest students'	• Students have freedom around their learning and how that occurs – cooperative partnership, one person plays the game while the other guides • Not all activities motivate students, therefore, need to understand what does and does not motivate them • Applying hazard scenarios to the students' modified *Minecraft* world can give students first-hand experience of long term processes surrounding different contextual situations and consider strategic actions • Variety of social group-based activities helps students recall of the content embedded within their experiences.

6.7 Conclusion

Notably, this chapter aims to work towards the shift called for by Clark et al. (2016), moving beyond merely analysing *Minecraft* as a learning tool. Instead, this chapter begins to explore how the theoretical design decisions of integrating video games into the teaching pedagogy can influence the learning outcomes within and beyond the classroom. This scoping study demonstrates the potential for using geo-referenced *Minecraft* worlds as a learning tool to foster student participation in learning about disasters and DRR. The integration of *Minecraft* into a teaching pedagogy supported by social group-based learning activities produced three different geo-referenced *Minecraft* worlds. Importantly, the teaching pedagogy incorporated social learning, metagaming and gameplay to frame a cohesive and sequential teaching and learning process in fostering student engagement. The teaching pedagogy employed in this research has constructivist underpinnings, working toward student-centred learning and emphasising the social dimension to learning. Students throughout the process worked collaboratively upon the scaffolding activities to inform their *Minecraft* worlds and also during *Minecraft* gameplay. The nature of the teaching pedagogy served as a form of metagaming, engaging students within real-world information to inform their geo-referenced *Minecraft* worlds. Beyond this, the students' personal experience with *Minecraft* outside of the classroom enhanced their gameplay competency. The three different teaching approaches with *Minecraft* (guided, targeted, hands-off) demonstrate the significant role teachers have to play in ensuring the success for the utilisation of video games as learning tools in the classroom versus simply being a teaching and learning gimmick. *Minecraft* is only one part of a larger picture rather than the critical component in the teaching and learning process. Ultimately, *Minecraft* gameplay should play a recurring role rather than a one-off activity, allowing students to experiment and test their understandings from scaffolding activities continually. The connections of the co-designed teaching pedagogy and *Minecraft* gameplay to constructivism and effective social science teaching mechanisms indicate the potential bridge between *Minecraft* and the classroom. Future research could involve a longitudinal study, integrating *Minecraft* into the classroom, supported by additional teaching tools to engage students in various dimensions of the curriculum.

Chapter 7 Fostering student participation in disaster risk reduction through disaster video games

7.1 Introduction

The Sendai Framework for Disaster Risk Reduction 2015-2030 encourages a broad range of stakeholders, from government officials to local people at risk, to pool their knowledge and understanding of disaster risk to design inclusive policy and practice. While the Sendai Framework refers to the importance of education for reducing disaster risk throughout, Petal (2007) and Luna (2017) concur that disaster risk reduction (DRR) formal education remains largely top-down, with bottom-up perspectives (from teachers and students) lacking. Teachers are explicitly missing from the Sendai Framework, the Australian National Strategy for Disaster Resilience (Council of Australian Governments, 2011) and also many Sendai Framework- inspired national policies like the New Zealand National Disaster Resilience Strategy (Civil Defence National Emergency Management Agency, 2019).

Nonetheless, the Australian National Strategy for Disaster Resilience has two mentions of schools; one for understanding risk by including risk reduction knowledge in education programs and another to empower individuals and 'communities' to exercise choice and take responsibility by having school programs actively encourage volunteering. Contrastingly, New Zealand's National Disaster Resilience Strategy does not explicitly mention schools in any of the 18 specific objectives outlined to achieve the overarching goal of the strategy. However, under the enabling, empowering and supporting community resilience section (p.31), schools are fleetingly mentioned as one possible component of a community to action foundational resilience efforts. Such policies do little to indicate how to design these educational programs to achieve the intended aims for DRR.

The Australian Curriculum and the New Zealand Curriculum share similar aims for young people to become lifelong learners, promoting values, capabilities and competencies (Australian Curriculum, Assessment and Reporting Authority [ACARA], 2019). While the New Zealand Curriculum is an outcome-based curriculum, the Australian Curriculum takes an integrative approach (ACARA, 2019; Moss et al., 2019). Both provide flexibility in implementation to allow schools to tailor what they teach for the local context and students' needs.

New Zealand and Australia are exposed to a range of hazards, including natural hazards, biological hazards and anthropogenic hazards. Problematically, while disaster awareness and DRR is a national priority, students can complete their education without being exposed to disaster preparedness in schools (Johnson, 2011; Selby & Kagawa, 2012). However, teachers are expected by current policy, teaching practices and curricula to help students to reduce their vulnerabilities while enhancing their capacities.

Selby and Kagawa (2012) comment that teachers and school leadership will generally refer to their national education authority for information and guidance (i.e. the Ministry of Education). The Australian curriculum incorporates disaster and DRR concepts from foundation to Year 10 (ages 5-16) through the learning areas of science, social science, technology and languages, including Auslan (Australian sign language). Senior secondary geography students focus on risk identification and management concerning DRR concepts of prevention, mitigation and preparedness. Though the misnomer 'natural' disaster is found within the Australian curriculum, the inclusion of disaster and DRR terminology indicates there are efforts by the national authority to support the delivery of DRR within the national curriculum.

Contrastingly, an analysis reveals that the New Zealand Curriculum does not explicitly define disaster or DRR anywhere. Learning units like the level 3 cross- curricula learning unit 'We Will Rock You' also contain outdated terminology like the use of 'natural' disaster in comparison to current academic literature (Kelman, 2018). In addition, the content studied by senior secondary geography students in NCEA (National Certificate of Educational Achievement) is heavily hazards focused with limited consideration to the social dimensions of disasters. While the Ministry of Education embraces the 'What's the Plan, Stan?' resource developed by education consultancy Educating NZ on behalf of the New Zealand National Emergency Management Agency, they do not proactively reinforce this initiative that provides schools, teachers, students (Years 1–8, ages 5-13) and parents with the support to develop the knowledge and skills to prepare for natural hazards (Selby & Kagawa, 2012). Johnson (2011) advocated that the Ministry of Education should play a significant role in supporting disaster education with a nationally implemented outcomes-based strategy to help students receive the necessary exposure to disaster education (Selby & Kagawa, 2012). Selby and Kagawa (2012) also comment that a DRR curriculum calls for active, interactive and action-oriented learning with connections to local experiences.

This chapter summarises the disaster video game research project built on three series of case studies. Desk research identified relevant video games both 'serious' and mainstream, assessing their main features and potential to inform learning about disaster and DRR. Secondly, three 'serious' disaster video games (*Earth Girl 2*, aka Earth Girl Tsunami, *Sai Fah – The Flood Fighter* and *Stop Disasters!*) were trialled with school students and teachers in Hawke's Bay, New Zealand to understand their concerns and priorities. Finally, insights gathered from the trials informed a larger project involving the video game *Minecraft*, deemed more appropriate by the students than the trialled video games to learn about disaster and DRR. Ultimately, the inclusion of video games within the curriculum offers not only an innovative teaching approach for teachers but also serves as a valuable tool for practitioners and researchers.

7.2 Reviewing 'serious' disaster video games for learning about disaster and DRR

DRR scholars, practitioners and educators propose video games as an innovative teaching method to engage students in learning about disaster and DRR. 'Serious' games refer to games designed for education rather than entertainment (Abt, 1970). Theoretically, video games can be connected to constructivist learning theory. As such, video game design aligns within the player's zone of proximal development, referring to the gap between what learners can do without help and what is achievable with guidance and assistance from a more knowledgeable other (Schunk, 2012). Video games provide players with 'scaffolding' to support the player through the zone of proximal development to overcome the presented challenge(s) (Loparev & Egert, 2015).

To understand the benefits of using video games within the classroom, one must understand how students approach video games both inside and outside of the classroom environment. Since people typically play video games for entertainment, it is essential to consider how video games can and are being used by educators to foster student learning (Dezuanni & O'Mara, 2017). Solely focusing on game content is therefore inadequate when considering the possible contribution of video games to learning within a classroom and school environment. In simple terms, video games comprise several components being game content, game mechanics, the skills players need or can build through gameplay, player motivations for initial and continued gameplay and the social interactions players experience inside and outside the game environment (Chapter 2; Gampell & Gaillard, 2016). Therefore, video games are not only engaging tools that align with learning theory but also offer opportunities to connect to the education curriculum.

A plethora of researchers, international organisations (e.g. United Nations: Educational, Scientific and Cultural Organisation [UNESCO], United Nations Office for Disaster Risk Reduction [UNISDR]), governments (Canada), non-government organisations (e.g. Save the Children, Christian Aid) have developed numerous educational disaster video games. These video games convey disaster and DRR messages, including portrayals of hazards, vulnerabilities, capacities and DRR (prevention, mitigation and preparedness). Table 7.1 provides a non-exhaustive list of disaster video games that connects 'serious' disaster video games to concepts of DRR. Disaster video games from non- government and other organisations are often one-off deliverables developed for a specific project. Research to consider the usefulness of these video games as valuable tools is limited. Significantly, scepticism for whether disaster video games could build disaster awareness in players will be maintained without research to support the beneficial opportunities for learning available.

Table 7.1: Disaster risk reduction content analysis of educational disaster video games

		DRR													
		Prevention				Mitigation			Preparedness						
		Use of human made structures	Landuse regulations	Basic need and services provision	Engineering design	Engineering techniques/ hazard resistant construction	Environmental policies	Public awareness	Disaster risk analysis	Early warning systems	Stockpiling equipment and supplies	Coordinated evacuation	Emergency operations	Public information	Training and field exercises
Educational Disaster Games	Beat the Quake	X			X	X			X						
	Before the Storm														
	Build a Kit										X				
	Citizen Ship			X											
	Disaster Master			X		X		X		X	X	X		X	X
	Disaster Watch	X						X	X			X	X		
	Earth Girl								X	X					
	Earth Girl 2/ Earth Girl Tsunami	X			X	X		X	X	X		X		X	X
	Earth Girl Volcano	X			X	X		X	X	X	X	X	X	X	X
	Earthquake Response			X							X		X		
	FloodSim	X	X	X	X	X	X	X	X	X	X		X	X	
	Hurricane Strike!	X			X	X			X	X	X	X		X	X
	Inside the Haiti Earthquake			X					X		X		X		
	Monster Guard								X		X	X			X
	Quake Safe House	X			X	X			X						

Educational Disaster Games	Red Cross ERU			X					X			X	X		
	Sai Fah - The Flood Fighter	X		X	X	X		X			X		X	X	
	SerGIS: Malmö Flood Scenario	X			X	X		X	X			X	X	X	
	Stormwatchers								X	X	X	X		X	
	Stop Disasters!	X	X	X	X	X		X	X	X		X	X	X	X
	Supervolcano game	X		X				X	X	X		X		X	
	Tanah – The Tsunami and Earthquake Fighter			X	X	X		X	X	X	X	X		X	X
	Young Meterologist								X					X	

Source: Adapted from Gampell and Gaillard (2016)

7.3 Methodological approach to examine disaster video games within the classroom

Research reveals that teacher and student involvement is lacking in the video game development process, as are disaster survivors (Gampell & Gaillard, 2016). This lack of involvement indicates that 'outsiders' are designing and developing these games without necessarily considering nor addressing the actual needs of the target audience (Gampell & Gaillard, 2016). Significantly, Chapter 3 conceptualised and used a methodological approach reflecting the principles of constructivist learning theory and aligning with the participatory and playful nature of video games.

This project was conducted with 171 students from two intermediate school classes (Years 7–8, ages 10-13) and seven high school classes (Years 9–13, ages 12-18). In addition, two workshops were held with social science teachers from around New Zealand at the New Zealand Social Sciences Conference in 2017 (SocCon17) and 2019 (SocCon19). The suggested approach, built upon participatory toolkits, allowed for flexibility to fit local needs and requirements. Other teachers can reproduce this approach in their own classrooms. This research received ethics approval from University of Auckland Human Participants Ethics Committee (#017988).

Within a classroom setting, students were given video game access during the lesson on an appropriate device (i.e. laptop, tablet, iPad). For these particular trials, three 'serious' disaster video games (*Earth Girl 2* aka Earth Girl Tsunami, *Sai Fah – The Flood Fighter* and *Stop Disasters!*) were used based on a hazard fitting the local context. Teachers and researchers selected the specific video game played ensuring the video game aligned with their lesson plans and connected to curriculum expectations. Students worked on individual devices or with a partner; two players per device was preferable if playing together. Students had autonomy over the gameplay process. There were no other guidelines except to play the video game. As such, students could decide whether they played the tutorial or not as well as the game difficulty or hazard scenario.

Gameplay should occur with minimal facilitator interference or rules governing the process. This approach stimulates a learning environment where students self-regulate their learning and actively engage in gameplay. Students could collaborate to achieve the game objectives. Students considered some classmates to be more knowledgeable others, providing support and advice to their peers. Students also considered the teacher a more knowledgeable other. However, interactions between the teacher and the student rested with the student. Such interactions support the students by providing advice and minor demonstrations that allow students to observe and replicate the teacher's actions.

Following gameplay, students participated in a carousel group activity to allow for the co-construction of knowledge through social interaction (Schunk, 2012). In this case, the carousel activity focuses students on topics such as hazards, vulnerabilities, capacities and DRR, including prevention, mitigation and preparedness in the local context. Teachers played a facilitation role. They could help students unpack their ideas to be added to the flipchart without explicitly directing the students to a specific response. The carousel activity was chosen to allow students to discuss and provide responses in a group setting to align with constructivism. Students recorded information on flipcharts using text and pictures. The flipcharts were photographed at the end of the session as a record.

Such activities require a debrief, allowing students to draw verifiable conclusions based on classroom perceptions. This helps students consolidate their new information in a public setting (Joplin, 1981). Students were given control of the debrief. They read aloud the comments written on the flipcharts that lead to a participant-regulated discussion to critically reflect on the information, interact with and question each other. This helped to limit facilitator and teacher-directed conversation except when elaboration was required. Teachers could emphasise specific points or patterns from the carousel if students had difficulty unpacking their responses.

This research approach used a combination of tools to facilitate a process where the usually absent perspectives of the participants (teachers and students) could be brought to the forefront. For teachers, this process allows student perceptions and understandings to be collected. These can be used in subsequent classes to build from or as a reference for students later.

7.4 Current contributions of disaster video games in the classroom

Table 7.2 summarises the findings reported from classroom trials with students, perspectives from the supervising teachers in the classroom and teachers' perspectives from SocCon17 and SocCon19. Teachers involved in classroom trials and in both SocCon workshops made valuable contributions to how video games can be used within the classroom. Overall, the findings indicate that teachers and students share similarities in what they perceive to be necessary aspects of a video game for the classroom. Significantly, the data collected comes directly from the intended audiences of 'serious' disaster video games rather than from outsiders making assumptions about what teachers and students need. Video games developed for learning in the classroom require a dialogue with teachers and students to identify rather than assume their needs. This information builds a greater understanding of what teachers and students require so that practical, appealing and useful disaster video games can foster disaster and DRR awareness among school students.

The findings suggest that video game sessions should not be one-off activities but should allow students to test their skills and experiment with new knowledge through multiple gameplay sessions. Importantly, prior video game experience and familiarity should not be assumed. Time for 'pure play' increases player comfort, allowing skill development and understanding of the game mechanics and rules. Gameplay sessions should allow time post-gameplay for students to debrief their experiences in a group setting. While video games are preferred to reflect aspects of reality, unrealistic portrayals (i.e. in *Earth Girl 2*, babies crawled to evacuation points, wheelchair users went upstairs) encourages discussions about the social dimensions of disasters. Some mainstream video games incorporate academic research into the game world. Mainstream video games like

Assassin Creed Origins and *Assassin Creed Odyssey*, have educational game modes that remove certain game mechanics like 'combat' while introducing 'tours' for players to explore various dimensions of ancient Egypt and Greece. Mainstream video games could prove an effective method for learning too.

Table 7.2: Perspectives and ideas of students and teachers about integrating video games into the classroom, categorised by group

Students	Students and teachers	Teachers
• Text-heavy games (i.e. Stop Disasters!) are less motivating and leads to information overload • Voice-overs should be included in narrative-driven games (i.e. Sai Fah) to provide interactive, visual and aural stimulation and engagement • Video game feedback is useful to show areas of improvement – but does not indicate whether the students has achieved the necessary skills to tackle harder challenges	• The video game should be highly engaging, interactive and fun • The video game needs to be collaborative, cooperative and competitive to encourage social discussion and evaluation of approaches • The video game should be easy to use – clear objectives, purpose, instructions and tutorial • Realistic content and relation to real-life case studies – show the consequences of player (in)action to better translate and apply knowledge/ skills to reality • Video games cannot substitute for a teacher or traditional teaching practices	• Video games, as teaching tools needs to occur in the context of specific curricula area. • Students are focused on playing the game, therefore do not realised they are learning about DRR • Video games offer both teachers and students opportunities to develop 21st-century skills • Transform teaching and learning practices by allowing students to engage in contents and contexts at higher levels • Able to be used offline, online and across devices • Ability to encourage problem-solving and thinking (and vice versa) • Foster partnerships not seen in the everyday classroom • Ability to foster school-home-community engagement

7.5 From research to practice: *Minecraft* as a disaster and DRR learning tool

The insights and perspectives gathered from teachers and students directly informed a subsequent project using *Minecraft* to foster children's participation in DRR (Le Dé et al., 2020). As teachers and students are frequently left out of discussions regarding disaster risk education, even though they should be regarded as critical stakeholders, the research team emphasised their inclusion alongside the local emergency management group in a co-designed process to inform the development of the area's emergency plan. It was important that both teachers and academic researchers worked together to build a lesson plan with targeted learning objectives that could align with the curriculum and the local context rather than imposing outsider assumption and perspectives upon the teachers and students.

The rationale for using *Minecraft* stemmed from students indicating they commonly played *Minecraft*, and therefore, they were highly familiar with the video game. In addition, *Minecraft* could address several requirements as outlined in the previous research findings. *Minecraft* allows cooperative play within the same game environment and can reflect real-life situations. The mainstream popularity of *Minecraft* (having sold 176 million copies worldwide over ten years) indicates the game's ability to motivate and engage students, while also having underlying educational advantages.

A geo-referenced 3-D *Minecraft* game world of the local Maraekakaho area, developed by researchers, contained geographical features such as roads, buildings and rivers served as the base layer for students to plot local hazards, vulnerabilities, capacities and DRR actions identified in the prior participatory activities. The finished *Minecraft* game world could be modified to reflect local hazards like flooding. This provided students with realistic visualisations of potential hazards within their local surroundings.

Three classrooms of approximately 20 students (Years 5-8) each played within the geo-referenced *Minecraft* world for 90 minutes. Students were given complete control over the gameplay process. Within their classroom cohort, students designed a key, or legend, to indicate how various hazards, vulnerabilities, capacities and components of DRR would be identified. Students designated specific bricks or even used in- game signs with written information upon them to show what they had built and associated category. Students decided what they included in the game world. Many focused on aspects close to the school, their homes and included local features like the memorial, woolshed and restaurant. Students used information they had recorded in earlier preliminary scaffolding lessons via several participatory activities, such as one-word, carousel and participatory 2-D mapping to check what may be missing from the game world, the approximate locations or to check what they had categorised as hazards, vulnerabilities and capacities.

Students debriefed all activities to allow discussions on the overall process. These discussions highlighted the students' unique perceptions of hazards, vulnerabilities and capacities that adults may not have been aware of or had previously considered (i.e. the capacities of the swimming pool complex to provide toilets, showers and a substantial body of water). These discussions helped students contribute their ideas to the community resilience plan, fostering a platform for students to hold a dialogue with teachers, parents, practitioners and policy-makers. Teachers and researchers also debriefed after each session, discussing the outcomes of the session, reviewing the plan for the next session and discussing any alterations that should be implemented. Overall, the use of *Minecraft* to foster student learning about disaster and DRR is in its infancy. Figure 7.1 presents an overview of some of the lessons learnt in the form of a Strengths, Needs, Opportunities and Challenges matrix.

Figure 7.1 shows several opportunities for using *Minecraft* as a tool to foster participation in learning about disasters and DRR. A significant advantage of *Minecraft* is the one-off cost to purchase the game that allows unlimited building potential compared to other methods using physical materials. Additionally, the game world can be backed up to a hard-drive or to cloud storage after each session, resulting in a number of world save states.

Figure 7.1: Strengths, Needs, Opportunities, Challenges matrix of lessons learnt

Strengths	Needs
• Students are generally familiar with *Minecraft* versus unknown 'serious' video games • Students will most likely have more experience with *Minecraft* than the teacher and facilitator • Unlimited building potential and possibilities – do not need to pay for more blocks • Game worlds are stored digitally therefore does not require physical storage	• Teacher needs to ensure *Minecraft* connects with specific learning objectives and school curriculum • Teacher must consider the learning styles of all students – some students will be active hands-on learners, others will prefer more traditional methods like reading a book • Teachers must have some level of experience to increase comfort of using *Minecraft* in the classroom – training sessions may be needed
• Students can share existing knowledge and expand understanding of their local area • Game world can be utilised for numerous purposes not just DRR i.e. connection to other subject areas • Students empowered to take ownership of the game world – generally more experience with *Minecraft* than the teacher and facilitator • *Minecraft* can be played on a device, in virtual reality (VR) and augmented reality (AR)	• Cost of *Minecraft* licence for each device – one off purchase • Devices purchased that can run *Minecraft* • School firewalls • Cannot assume everyone is familiar with *Minecraft* • Keeping students focused upon task at hand and not destroying other students' creations: allow for free play sessions; in-game control tools for teachers are available
Opportunities	**Challenges**

For a teacher unfamiliar with using video games, *Minecraft* may be considered complex, but students will possibly have more knowledge and experience than the teachers or facilitators, helping the students take ownership over the process. Educators can use in-game mechanics to maintain a sense of control within the *Minecraft* world, like teleporting players to specific areas of the world or removing players from the game.

The *Minecraft* world can be continually updated with information from various subjects. This process enables an integration of other subject areas of the curriculum and connectivity between subjects and students' understandings of the world. With future iterations of *Minecraft* including *Minecraft Virtual Reality* and augmented reality mobile game *Minecraft Earth*, learning can transcend and make connections between the classroom environment, home and even lead to *Minecraft* field trips using augmented reality.

7.6 For the advancement of learning recommendations for bridging the gap

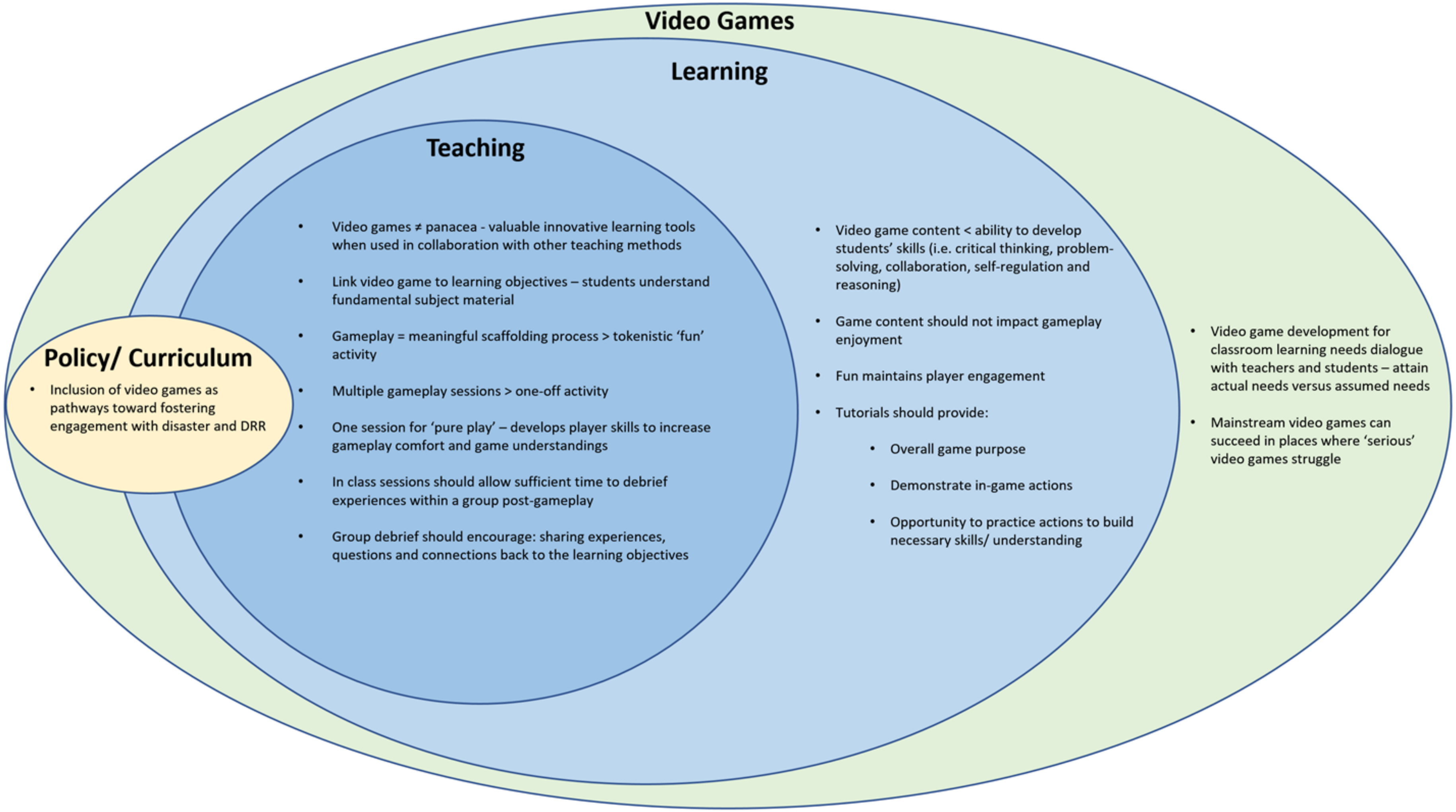
The Sendai Framework, New Zealand's National Disaster Resilience Strategy and the Australian National Strategy for Disaster Resilience encourage the development of children's understanding of disaster risk. However, to foster the genuine participation of children as DRR leaders and change-makers, a reconfiguration of the existing educational framework may be required to better consider and integrate DRR in a meaningful way. Scholarship highlights the need for education authorities to take proactive and leading roles in supporting DRR initiatives in schools (Johnson, 2011, Selby & Kagawa, 2012). To shift thinking and discourse around the complex root causes of disaster, both the nature and consistency of messages could be delivered to students through the curricula (Chmutina et al., 2017). To address gaps within curricula, a collaborative and inclusive effort by stakeholders could include consistent messaging, understandings and the use of terminology that can be implemented by educational authorities.

Video games can become valuable teaching tools for teachers, and in collaboration with other tools to encourage participation, can be a potential pathway towards building greater awareness surrounding disaster and DRR. Academics and practitioners, among others, who wish to use video games to spread specific disaster messages and build disaster awareness must realise that video games are not merely products or activities for educational purposes. Significantly, the gaming process underpins the viability of using video games for learning rather than the belief that directly engaging with a ‘serious’ video game will foster learning. As such, existing ‘serious’ disaster video games are often unable to achieve the outcomes made possible by a mainstream game like *Minecraft*. Hence, video games cannot be developed as a deliverable disassociated to the needs of the target audience just to satisfy a checklist. Nor should a video game be used within a classroom because it is considered an innovative approach to learning. Instead, a process inclusive of all stakeholders can appropriately assess needs, which can lead to genuine and meaningful learning outcomes.

Reflecting on the research conducted into the learning potentials of disaster video games, Figure 7.2 provides several recommendations instilled from teachers and students to help inform decision-makers regarding the implementation of a DRR curriculum. Figure 7.2 attempts to broaden current perspectives to consider how video games and the process of gaming can help support not only the aims of national curricula, the Sendai Framework and other national policies, but also serve as engaging teaching and learning tools. As such, using video games to support formal education can also enable opportunities to transcend and make connections between the classroom, home and in the local context.

Video games should not be considered a panacea to bridging the gap between policy, curricula and teaching practices but as one possible pathway to address current gaps. Moving forward, attention and consideration should be given to acknowledging and promoting video games as an example of a learning pathway in policy and curriculum, developing resources that are inclusive of stakeholders to support teachers using video games in the classroom (video game, lesson plans, suggestive teaching approaches) and developing video games to foster and encourage students to engage with disaster and DRR versus detracting from engagement with focus upon content.

Figure 7.2: Recommendations for disaster video games in the classroom



Chapter 8 Conclusion

8.1 Introduction

This thesis opened with a recount from the ancient Greek historian Herodotus, who suggested that the invention of games emerged as a tool to reduce the risk of disaster (Rawlinson, 1861). Notably, despite the three key values that emerged from the Lydian's use of these ancient games (McGonigal, 2011), as a disaster risk reduction (DRR) strategy, the games did not solve the problem of famine and food supply collapse, nor did the games allow for the testing and development of new methods to get or make food. It is here where modern-day game developers and game researchers are attempting to find ways for games to enable problem-solving of real issues and drive collective action toward scientific, social, economic and environmental challenges. Hence, the origins of this thesis are twofold. On one side, there is a disparity observed between the perceptions of some academics, practitioners, policy-makers and people more generally versus those of gamers and game developers. Video games and gamers are continually scapegoated for a variety of reasons, most commonly, the argument that violent game content results in negative social behaviour due to gameplay, or video games as time-wasting activities (McGonigal, 2011). However, video game researchers are pushing back upon the allegations (Drummond et al., 2020), with game developers and gamers recognising the immersive and experimental power video games can provide, especially around problem-solving, creating new experiences and addressing real-world challenges (McGonigal, 2011). On the flip side, researchers unfamiliar with video games sometimes conduct video game research. These studies often focus heavily on game content and disconnect the interrelated dimensions of video games like game mechanics, skill-building, motivation and social interaction from the research. Additionally, the conduction of such research is through conventional quantitative and qualitative methodologies, disassociated from learning theory or worse have no learning theory attached to the research (Wu et al., 2012). With more research being conducted by gamers, game developers and other game-related stakeholders, tangible evidence is emerging to push back against negative perceptions and research.

Disaster video game research has indicated the potential ability of disaster video games to raise player's awareness of disasters and DRR (Di Loreto et al., 2012; Gampell & Gaillard, 2016; Solinska-Nowak et al., 2018). Clark et al. (2016) support this position as their research suggests that video games can achieve better learning outcomes than non-game methods. Yet, despite the number of disaster based 'serious' and mainstream video games available, there is limited research to confirm whether such disaster video games can improve a players awareness of disaster and DRR, nor any longitudinal studies to evaluate the effectiveness of such disaster video games (Di Loreto et al., 2012; Gampell & Gaillard, 2016; Solinska-Nowak et al., 2018). The lack of formal assessment and evaluation methods is a significant challenge for disaster video game researchers. Significantly, game design, alongside teaching pedagogy and learning approaches are crucial components to understand how video games can be used for learning (Becker, 2017; Clark et al., 2016; Wu et al., 2012). Hence, the one-off deliverable nature of 'serious' disaster video games in particular, without any follow-up research to formally assess the effectiveness of these games upon players building disaster and DRR awareness is problematic. Echoing the concerns of Becker (2017), video games require an assessment before being included within a learning environment like classrooms, to reduce the chance of poorly designed video games being utilised for learning. The positivist approach to video game research generates quantitative and qualitative data to demonstrate the potential influence of video games upon learning (Clark et al., 2016). However, such approaches are not necessarily suitable to attain a meaningful understanding of how such games can foster player participation in learning about disasters and DRR. Therefore, there is a need for an innovative approach toward assessments by video game researchers to understand previously undefined research areas like disaster video games (Mäyrä, 2015).

The ultimate goal of this thesis is not only to demonstrate the potential of video games to foster participation in learning about disaster and DRR but also understand how to enhance the process of teaching and learning with video games. Therefore, this thesis identified the requirement of a methodological framework that recognises learning theory (constructivism) and was underpinned by participatory techniques to align with constructivist principles (Chapter 3). Hence, this approach not only enabled participants to inform the research process based upon their perspectives but could also serve as a teaching pedagogy to support the use of video games within the classroom for students to learn about disasters and DRR. While participatory techniques have been utilised within disaster and development research, there is little research to demonstrate their inclusion within video game research methodologies. Hence, the methodological framework conceptualised for this research is novel and innovative. To the researcher's knowledge, the integration of learning theory into the methodological framework has not previously been utilised in existing research. Therefore, the methodological framework provides new data for understanding how video games can be used for teaching and learning, capturing the perceptions of participants and the overall effectiveness of game-based learning and game pedagogy approaches. While this thesis primarily focuses on disaster video games, this thesis makes a broader contribution toward video game research at large. The thesis offers a platform for future research to springboard and further develop the methodological framework for any particular topic or global context. This final chapter concludes the thesis, summarising the key findings, a discussion of the implications and challenges for video games as learning tools for disaster and DRR, alongside an examination of the thesis limitations and outline for future research.

8.2 Key research findings

Objective 1: To build a typology of disaster video games demonstrating the connections to DRR

The first objective of this thesis aimed to understand how disaster video games connect to disaster and DRR, primarily through an analysis of the video game content. To achieve this objective, this thesis built upon the disaster video game typology initially conceptualised by Gampell and Gaillard (2016). The disaster video game typology uses the terminology of the United Nations International Strategy for Disaster Reduction ([UNISDR], 2009, 2017) to unpack the three primary concepts underpinning DRR, namely prevention, mitigation and preparedness. These are further broken into 14 categories to classify actions related to prevention (four categories), mitigation (three categories) and preparedness (seven categories). The research findings demonstrate that the content of both 'serious' and mainstream video games can connect to DRR, as observed in the disaster video game typology (Table 8.1).

Unfortunately, research to specifically test and assess mainstream disaster video games went beyond the boundaries of this PhD. However, several mainstream disaster video games have been included in the disaster video game typology to acknowledge their potential to convey disaster and DRR content. The inclusion of mainstream disaster video games into the typology is limited by several factors including, the size of mainstream video games (in terms of game length, world size, differing storylines), and variation in player gameplay styles mean not all content, or mainstream games are captured in this typology. Additionally, mainstream games are not designed to necessarily engage players in learning about disaster and DRR. Therefore, this content is not always at the forefront of gameplay. The decision was made for this thesis to first focus on understanding how 'serious' disaster video games could foster participation in learning about disaster and DRR upon which this knowledge could set a future research agenda appropriate to mainstream disaster video games. The research findings suggest this is a significant area for future disaster video game research.

As 'serious' disaster video games are mainly developed for educational purposes, the depictions of disaster and DRR content is much more explicit. Hence, 'serious' disaster video games predominantly had their content analysed and added to the typology. The results of the disaster video game typology enable a comparison of the DRR content found within 'serious' disaster video games and whether this content matches the intended learning goal of that particular video game. This is demonstrated within all four 'serious' disaster video games that feature in the museum and school case studies (Chapter 4 and Chapter 5, respectively). For example, the implied intended goal for *Quake Safe House* was to build greater public engagement with strategies that individuals can employ to reduce and prevent earthquake damage to their homes and contents (Chapter 4). The disaster video game typology (Table 8.1) indicates only two of the possible four prevention actions are featured within *Quake Safe House*, namely the use of human-structures and engineering design, alongside one aspect of mitigation (engineering techniques/ hazard resistant construction – similar to engineering design) and risk analysis under the preparedness category. Therefore, given the alignment of the prevention DRR content with the intended goal to raise awareness of earthquake preventative measures, the assessment of the video game with museum visitors should reflect improved awareness of preventative earthquake actions (Chapter 4).

Similarly, the research findings suggest that the intended goals of *Earth Girl 2*, *Sai Fah – The Flood Fighter* and *Stop Disasters!* align with the DRR content (Chapter 5). *Earth Girl 2* aims to save people living in seaside communities from earthquake and tsunami by using different DRR tools. In turn, the typology indicates a connection to nine out of 14 different DRR measures, respectively, two prevention, two mitigation and five preparedness actions. For *Sai Fah – The Flood Fighter* the goal is to raise flood safety awareness and flood preparedness. The typology also connects *Sai Fah – The Flood Fighter* to nine out of 14 different DRR measures with three prevention, two mitigation and four preparedness actions. On the other hand, *Stop Disasters!* aims for players to learn about disaster prevention for a range of natural hazards including earthquake, flood, tsunami, hurricane and fire; this is reflected in the typology with *Stop Disasters!* containing 12 of 14 DRR measures, equalling all four prevention measures, two mitigation and six preparedness. Therefore, the research findings indicate an alignment of DRR content with the intended learning goal of the game, whether that is primarily prevention, mitigation or preparedness focussed.

Table 8.1: Disaster video game typology based upon DRR content

		DRR													
		Prevention				Mitigation			Preparedness						
		Use of human-made structures	Landuse regulations	Basic need and services provision	Engineering design	Engineering techniques/ hazard resistant construction	Environmental policies	Public awareness	Disaster risk analysis	Early warning systems	Stockpiling equipment and supplies	Coordinated evacuation	Emergency operations	Public information	Training and field exercises
Educational Disaster Games	Beat the Quake	X			X	X			X						
	Before the Storm														
	Build a Kit										X				
	Citizen Ship			X											
	Disaster Master			X		X		X		X	X	X		X	X
	Disaster Watch	X						X	X			X	X		
	Earth Girl								X	X					
	Earth Girl 2/ Earth Girl Tsunami	X			X	X		X	X	X		X		X	X
	Earth Girl Volcano	X			X	X		X	X	X	X	X	X	X	X
	Earthquake Response			X							X		X		
	FloodSim	X	X	X	X	X	X	X	X	X	X		X	X	
	Hurricane Strike!	X			X	X			X	X	X	X		X	X
	Inside the Haiti Earthquake			X					X		X		X		
	Monster Guard								X		X	X			X
	Quake Safe House	X			X	X			X						

	Red Cross ERU			X					X			X	X		
	Sai Fah - The Flood Fighter	X		X	X	X		X			X		X	X	
	SerGIS: Malmö Flood Scenario	X			X	X		X	X			X	X	X	
	Stormwatchers								X	X	X	X		X	
	Stop Disasters!	X	X	X	X	X		X	X	X		X	X	X	X
	Supervolcano game	X		X				X	X	X		X		X	
	Tanah – The Tsunami and Earthquake Fighter			X	X	X		X	X	X	X	X		X	X
	What's the plan, Stan?										X			X	
	Young Meteorologist								X					X	
Mainstream Disaster Video Games	Anno 2070	X							X	X	X	X	X		
	Black & White series			X							X				
	Fallout series	X	X	X	X	X		X	X	X	X	X	X	X	
	From Dust					X		X							
	Frostpunk	X	X	X	X	X	X		X	X	X	X	X		
	Metro series	X		X							X		X		
	SimCity series		X	X		X		X		X			X	X	
	Tropico 4	X		X						X	X	X		X	
	Tropico 5		X	X		X	X				X		X		

Objective 2: To assess the impacts of existing disaster video games with a targeted audience to determine whether insightful knowledge is gained, with the potential to improve disaster awareness.

The first research objective demonstrated the connection of disaster video game content with DRR. However, the typology findings cannot determine whether one video game is better than another based solely upon containing more or less DRR content. The lack of formal assessment to evaluate the effectiveness of disaster-based video games, alongside the fact that video game research methodologies generally do not align with learning theory, presents a significant gap in understanding how such video games can improve disaster awareness. Hence, the second thesis objective uses the disaster video game typology as a preliminary step to identify what DRR content is available within a game and then assesses whether the player demonstrates an improved awareness or knowledge of this content. To achieve this objective, the four existing 'serious' disaster based video games were tested with various target audiences, primarily museum visitors (sub-subsection 8.2.1) and school students (sub-subsection 8.2.2) using both conventional methodological approaches (interview questions, questionnaires) and group-based activities (carousel, one-word) supported by participatory techniques (sub-subsection 8.2.3).

8.2.1 Pre and post-game questions to assess disaster and DRR awareness with museum visitors

The museum case study research findings, detailed in Chapter 4, has two significant revelations. Firstly, the assessment of the interactive video game display *Quake Safe House* with museum visitors at Te Papa in Wellington and Quake City in Christchurch confirms the potential for video games to instil improved disaster awareness in museum visitors. The results found that the pre-game knowledge of the 22 research participants was primarily preparedness focused. In particular, participants referenced messages of drop, cover, hold (n=12) and evacuation processes (n=5). Whereas only two participants mentioned preventative measures of securing objects (Table 4.3). Post-game, participants either could not recall any new DRR strategies (n=11) or ultimately referenced preventative actions around securing household objects (n=10). The results suggest the participants did gain insightful knowledge toward the intended game goal surrounding the prevention of earthquake damage to their homes and contents.

Secondly, the research findings indicate that the research methodology should be underpinned by learning theory. Such an approach can offer a more accurate representation of the impact video games can have upon learning. As video games can be connected to several learning theories, researchers continually demonstrate that video games can support productive learning (Becker, 2017; Clark et al., 2016; Wu et al., 2012; Young et al., 2012). Yet, there is limited research that incorporates learning theory (Wu et al., 2012) and even less that aim to integrate the theoretical underpinnings of learning theory into the methodological framework. While the research findings suggest museum visitors do attain a greater awareness of preventative measures to reduce earthquake damage to their homes and contents after playing *Quake Safe House*, such improvements only appear to be superficial. The results show a questionable correlation between the participants pre-game and post-game self-assessment of their DRR understanding. For example, some participants pre-game claimed to have a basic understanding of earthquake preventative measures and post-game a complete understanding. Yet, the research findings show 17 participants provided relevant DRR strategies pre-game, but only nine participants could recall new strategies after playing *Quake Safe House*. In addition, only seven participants (one Te Papa and six Quake City) specified objects to be secured, preventative measures or tools used in the game or items. Therefore, in this instance conventional research methods were unable to confirm the extent of the museum visitors' knowledge post-game and whether the visitors would utilise their knowledge of preventative actions outside of the museum environment.

8.2.2 Pre and post-game questionnaires to assess disaster and DRR awareness with school students

The school case study, detailed in Chapter 5, utilised pre and post-game questionnaires, a common method found in video game research, to determine whether students gained an improved awareness following gameplay. From the 116 questionnaire responses available for analysis, only 56% of students (n=65) could provide examples of their pre-game DRR understanding (Sai Fah n=34, Earth Girl 2 n=27 and Stop Disasters! n=4). The students signalled a strong awareness of preparedness measures reflecting messaging like 'drop, cover and hold' for earthquakes and 'long strong get gone' for tsunami, alongside other evacuation procedures or locations. However, only 11 post-Earth Girl 2 questionnaires and 14 post-Sai Fah questionnaires presented new examples of DRR understanding connected to the respective game content. In the case of *Earth Girl 2*, examples related to building people's awareness of earthquake and tsunami hazards, the evacuation process and improving the structural integrity of infrastructure like bridges. Whereas, *Sai-Fah – The Flood Fighter* responses reflected flood safety and preparedness measures, including comments around learning to move electrical items before a flood, using sandbags and having emergency supplies.

On the flipside, despite *Stop Disasters!* having a nearly complete array of DRR content available, the post-game questionnaires indicated that the students could not provide any new examples of DRR measures. This finding seemingly confirms the suggestion of Gampell and Gaillard (2016), where a diverse range of DRR content may detract from the intended learning content players engage with versus a game with only a few key actions like *Quake Safe House* or *Sai Fah – The Flood Fighter* (Chapter 4; Chapter 5). However, more significant analysis of the pre and post-game questionnaire results demonstrates a trend almost parallel to the museum findings, namely a low number of new DRR examples presented post-game and questionable self-assessments of disaster awareness. For example, while 77% of students (n= 89) indicated they had improved disaster understanding post-game, 78% of students (n=91) could not provide any post-game DRR examples to support their self-assessment (Chapter 5). The research results do not necessarily indicate that these 'serious' games do not have the potential to improve the students' disaster awareness, but rather the questionnaire approach could be generating a red herring. The value of the questionnaire method should not be dismissed; instead, researchers should consider whether the integration of alternative methods or tools could enhance the quality of the research findings.

8.2.3 Participatory tools to assess disaster and DRR awareness with school students

The research findings from both the museum and school case studies indicate that a sole reliance upon individually completed pre and post-game questionnaires to assess the impacts of disaster video games upon learning may not present an accurate representation of the actual learning outcomes. In particular, a methodological approach that aligns with learning theory (Wu et al., 2012), may allow a more representative assessment of the video games potential to improve disaster awareness. Hence, group-based activities, supported by participatory techniques, aligned with the epistemological approach of constructivist learning theory and social interaction to enhance the learning process. Therefore, the inclusion of group-based activities enabled an opportunity to observe whether the students, through social interaction and negotiation, could demonstrate an application of post-game understandings of hazards, vulnerability, capacities and DRR. Hence, the school case study (Chapter 5) enables a comparison between a traditional methodological approach unconnected to constructivist learning theory (pre and post-game questionnaires) and a methodological approach that aligned with constructivism (a participatory process that involves group-based activities, like a carousel).

Significantly, the research findings from the group-based activities demonstrate a greater awareness of disaster and DRR in comparison to the individually completed pre and post-game questionnaires. For example, despite the lack of DRR examples in the post-Stop Disasters! questionnaire, the analysis of the carousel revealed that the students referenced preventative DRR strategies like building sea walls in the case of a tsunami and reinforcing buildings in the case of earthquakes, both tools found within *Stop Disasters!* (Chapter 5). As such, the inclusion of these DRR strategies demonstrates a clear connection to the intended goal of *Stop Disasters!* to learn about preventative actions. Likewise, the carousel activities surrounding *Earth Girl 2* also reflected the intended goal to save people from earthquakes and tsunami through preparedness measures like practicing tsunami walks and having visible evacuation route signs in multiple languages (Chapter 5). Such examples differ from the few post-Earth Girl 2 responses which focused more so upon the strengthening of infrastructure like bridges. Similarly, the Sai Fah carousel examples presented much more comprehensive preparedness measures in comparison to the preparedness measures provided in the post-game questionnaires. In particular, the examples given by the students reflected actions like what is required within an emergency kit, other practical flood safety information like disconnecting the electrical appliances prior to a flood and using sandbags (Chapter 5). Overall, the findings from the carousel activities suggest students had a greater understanding of the video games intended learning objectives than observed in the questionnaires. Hence, it may be concluded that the process of using group-based activities that align with the principles of constructivism, particularly social interactions and debriefing experiences within a group achieved greater insight into confirming that such 'serious' disaster video games indeed have a positive impact upon building people's knowledge of disaster and DRR.

Ultimately, the research findings in connection to objective two confirm that existing 'serious' disaster video games can potentially improve the players' knowledge around disasters and build their disaster awareness. However, these findings suggest video games are not one-stop learning tools, but instead require support from other teaching and learning tools to help facilitate the learning process. The results of the group-based activities conducted within the classroom confirm that social interaction, as a core principle of constructivism, is needed to further enhance students understanding of disaster and DRR awareness. These findings support the comments of Klopfer et al. (2018), whereby the students post-game responses were driven by the content that most strongly resonated with them from their gameplay experience. By sharing their gameplay experiences with others and debriefing these experiences, the students can test their ideas with their peers. In addition, the connection of their gameplay back to their local context helps to demonstrate the relevance of the learning material (Selby & Kagawa, 2012).

Objective 3: To carry out an analysis of disaster video games in collaboration with a targeted audience to understand how each game scores in terms of game content, game mechanics, skill-building, player motivation and social interaction.

Objective three aims to move beyond a proof-of-concept or medium analysis study toward attaining an understanding of how game mechanics, skill-building, player motivations and social interactions work in association to game content to foster the player's participation in learning about disaster and DRR. While gamers, game developers and some researchers recognise the significance of these components, limited research has been conducted to understand their influence on gameplay and learning (Gampell & Gaillard, 2016; Ivory, 2013; Schuurman et al., 2008). Significantly, these components also play a key role in game design and hence the facilitation of positive player learning experiences. Notably, objective three analyses the perspectives of museum visitors, students and teachers, due to their absence from discussions surrounding the development of disaster and DRR teaching and learning approaches (Luna, 2012, 2017; Petal, 2008). There is a requirement for greater integration and inclusion of bottom-up perspectives from various people like teachers and students in DRR education, beyond tokenistic inclusion within the process of developing educational materials (Gaillard et al., 2015; Luna, 2017; Petal, 2007, 2008; UNISDR, 2015a; UNISDR STAG, 2015). Therefore, the inclusion of their views as part of the assessment upon game design and gameplay provides meaningful information to determine how video games can be better utilised as learning tools and their inclusion within the museum environment, classroom and curriculum.

Pulling together the findings for the four 'serious' disaster video games in terms of game content, game mechanics, skill-building, player motivation and social interactions, demonstrates several core factors that can influence the learning experience of the player. Despite the suggestions that 'serious' games have clear learning objectives (Sanford et al., 2015), the research findings suggest video games generate deeper understanding over time, reflection and active engagement (Chapter 5). Hence, players cannot be expected to immediately problem-solve and achieve the intended game goals without time to understand the game mechanics and rules (Chapter 4; Chapter 5; Chapter 7). However, while students and teachers indicated that a video game intended for learning purposes should have easy to use game mechanics, clear objectives, purpose, instructions and tutorials (Chapter 7), Sanford et al. (2015) warn of the potential for game design to trivialise, through simplification and lack of immersion, the significance of the game content. The research found that the poor and outdated graphic quality of *Quake Safe House* meant immersion was difficult for some players, alongside the struggle to understand what purpose *Quake Safe House* was meant to serve (Chapter 4). Additionally, the research found that when the game content was unrealistic like in *Earth Girl 2*, where babies crawled to evacuation points, and wheelchair users went upstairs, players lost immersion and focused upon these inaccuracies instead. Notably, both teachers and students reflected upon the need for realistic game content and relatability to real-life case studies (Chapter 7).

As such, the findings around game mechanics and game content have an interrelated influence upon player skill-building and player motivations. The research findings indicate that game content needs to show the consequences of player (in)action to better translate and apply knowledge/ skills to reality (Chapter 4; Chapter 7). This connects back to Gee's (2008) five elements of a well-designed game, in particular feedback (immediate feedback from experiences help to recognise, assess and explain mistakes) and practice (opportunities are needed to apply previously interpreted experiences to improve interpretations of new experiences). Although, the research findings for these four 'serious' games indicated that feedback was useful to show areas of improvement, this feedback needed to go further and demonstrate whether the student has achieved the skills required to tackle more demanding challenges (Chapter 7). The research findings also support the findings of Wouters et al. (2013), whereby 'serious' games, in comparison to traditional methods of learning and retention, are more effective, but are no more motivating. The research findings demonstrated in terms of text-heavy 'serious' games like *Stop Disasters!* that gameplay became an information overload, and players became less motivated to continue playing. However, students suggested this challenge may be overcome through the inclusion of voice-overs within 'serious' games like the narrative-driven *Sai Fah – The Flood Fighter*. Scholarship suggests players prefer NPCs

(Non-Player Characters) to interact via voice versus text, with voice-overs having a positive effect on a player's learning engagement (Byun & Loh, 2015; Ravyse et al., 2017). This is due to voice communication being less flow-disruptive than text as there is more time needed to read versus the interpretation of social cues like intonation, pauses and emotion of spoken words (Ravyse et al., 2017). This is also supported by DeKanter (2005) reporting that students have a 75% retention level when they interact, see and hear, compared to only 20% what they hear and 40% what they see. Therefore, the inclusion of voice-overs for key NPCs or elements of gameplay are of significant benefit. However, if this cannot be achieved due to the budget of 'serious' games then text should be kept to short bursts to minimise the disruption to the flow of gameplay and engagement in the learning process (Ravyse et al., 2017), although this situation could potentially be navigated in classroom settings through social interactions.

While the previous elements are indeed significant to understand the ability of video games to deliver beneficial learning experiences to players, the research findings emphasised the significance of social interaction concerning both gameplay and learning. Despite constructivist learning theory emphasising social interaction in the learning process, disaster studies aiming to foster collaboration between stakeholders, alongside mainstream video games facilitating cooperative and competitive gameplay, all identified 'serious' disaster video games are single player. While constructivist learning allows time for reflection in a non-competitive environment, competition often drives player gameplay motivations (Ravyse et al, 2017). Yet competition among students in learning situations is discouraged to avoid students being singled out among a group of learners (Ravyse et al, 2017). Time limits are therefore a satisfactory adversary to provide an element of competition for gameplay and also competitive learners, although as suggested by the museum participants, explorative learning with a time limit is counter-intuitive, and hence may require an option to play with or without competitive elements (Chapter 4; Ravyse et al, 2017). The use of time pressure in 'serious' games could still offer a pathway for collaborative learning (Ravyse et al, 2017) by encouraging social interaction.

The participants suggested that video games for learning need to be collaborative, cooperative and competitive to encourage social discussions and evaluate the approaches of other players to in-game challenges (Chapter 7). This aligns with Gee's (2008) debrief element of a well-designed video game, whereby social interactions and discussion with peers and experts help learners to learn from interpreted experiences and gain explanations. Admiraal et al. (2014) note that competition is often an important game element for males while females generally observe other players play first and then aim to explore and discover the game environment. This parallels the research observations across the three case studies, but is not reflected within the conventional methodologies of pre-game questions and questionnaires. Therefore, the contrast between the collected data and the researcher observations questions the reliability of a monodisciplinary methodological approach toward data collection. This is further explored in subsection 8.4.

In the museum case study, despite 14 participants indicating that they did not prefer playing games cooperatively, upon starting the *Quake Safe House* video game, female participants would often call to their friends or family to play with them (Chapter 4). Contrastingly, 68% of the students (n=79) in the school case study preferred to play video games cooperatively, whether this was in-person or online (Chapter 5). Similar to the museum case study, students would often choose to play the 'serious' disaster video game collaboratively with other students upon one device rather than play alone. While competitive players would often retain their device, the competitive dimension to gameplay was only relevant to other students in their classroom or school rather than global scoreboards, which has also been observed by Admiraal et al. (2014). Ultimately, the thesis has identified that there are significant gaps within 'serious' disaster video games based upon the perspectives of museum visitors, students and teachers around how such games can be used for learning about disaster and DRR alongside their integration into a learning environment.

Objective 4: To understand how video games may be used as tools for DRR

Finally, objective four aimed to understand and conceptualise how video games can be effectively utilised as teaching and learning tools for DRR. To achieve this objective, the thesis attempted to put research into practice by using the findings from the previous three objectives to inform the process of the exploratory *Minecraft* case study (Chapter 6). This thesis recognised the exclusion of museum visitors, students and teachers, among others like disaster survivors, within the video game development process, in the development of video game pedagogy (game-based learning and game-based pedagogy), and assessments for effectiveness based upon their teaching and learning needs rather than a research agenda. Hence, the thesis findings support the sentiments of other video game scholars (Clark et al., 2016; Wu et al., 2012; Young et al., 2012), where greater attention is required around how people use video games for learning and how people can use video games to teach.

The *Minecraft* case study identified that a co-designed teaching pedagogy, which recognises the requirements of curriculum and teaching strategies, could be achieved when the process included academics, teachers, students and emergency personnel. The implications of this case study indicate that not only can a co-designed teaching pedagogy be achieved but also enables stronger pedagogical outcomes due to the co-designed approach. The resulting process emphasises that the teachers and students know their needs best rather than having outsiders imposing their assumptions and perspectives upon the teaching and learning process (Chapter 7). Notably, the overall process aligns within Gee's (2008) five elements for a well-designed video game to facilitate meaningful learning experiences. As the geo-referenced *Minecraft* world is still essentially an open world sandbox, there are no specific in-game goals. Therefore, the research findings indicated that by providing students with some goals to achieve, either through a guided or targeted teaching approach during gameplay offered the best learning outcomes rather than an utterly hands-off teaching approach. This way, students still had freedom and autonomy over the gameplay; however, they also had a specific goal that they needed to achieve. The co-designed teaching process enabled several group-based activities, participatory in nature, to facilitate and scaffold the students' engagement in disaster and DRR for their local area before gameplay. Hence, this gave the students the required knowledge and experience, to subsequently apply to the geo-referenced game world and make meaningful connections to their understanding of local disaster and DRR and any emerging challenges. The multiplayer *Minecraft* game environment offered two main methods of feedback provision. In the first instance, feedback could be given to players by not only the researchers, teachers and other students during gameplay, resulting in recognising, assessing and explaining any possible issues within the game environment. The second instance involved a half time feedback session with the whole classroom, this meant the overall group could collaboratively reflect upon the game world and identify any outstanding issues. Subsequently, offering an opportunity for the fourth element of practice, meaning students could improve their previously applied interpreted experiences with new information. Finally, a whole class debrief allows for discussions and social interactions with other students, teachers and researchers upon the outcomes of their gameplay. This offers opportunities for further discussions within the classroom and/ or subsequent classroom activities to improve the students' disaster and DRR awareness or areas of interest. Ultimately, the findings suggest that by addressing the needs and expectations of the students and teachers who are generally the primary audience for disaster video games, there is more likelihood of the game, 'serious' or mainstream, to successfully foster greater disaster and DRR awareness and integration into the classroom environment.

8.3 Implications and recommendations for video games as learning tools for disaster and DRR

The research objectives have resulted in several research findings that have various implications for DRR education, alongside disaster and video game research at large. Notably, this thesis has found that despite the Sendai Framework referencing the importance of education in reducing disaster risk (Aghaei et al., 2018; UNISDR, 2007, 2015a), there is little indication for how Sendai Framework inspired national policies are to achieve the aims of DRR through educational programs (Chapter 7). Wisner (2006) rationalises educational curriculum and teaching pedagogy as primary drivers to engage students in disaster-related knowledge. However, in the context of New Zealand, the New

Zealand Curriculum does not define disaster or DRR nor is there a dedicated DRR curriculum available (Chapter 7; MacDonald et al., 2017). The learning units available like the cross-curricula 'We Will Rock You' or the level one geography achievement standard AS91007 – that aims for students to understand the shaping of environments by extreme natural event(s), heavily reflect the dominant hazard paradigm (Chapter 5; Chapter 7). Additionally, 'What's the Plan, Stan?' resource developed on behalf of the New Zealand National Emergency Management Agency for schools, teachers, students and parents to develop the knowledge and skills to prepare for natural hazards is not proactively reinforced by the Ministry of Education (Selby & Kagawa, 2012). Therefore, even though disaster awareness and DRR is a national priority unless teachers or schools make a dedicated effort to include disaster topics into the classroom, students could complete their education without any exposure to DRR (Johnson, 2011; Selby & Kagawa, 2012). Therefore, Selby and Kagawa (2012) call for a DRR curriculum that is active, interactive and action-orientated learning with connection to local experiences. As such, 'serious' and mainstream disaster-related video games can be one tool to support this DRR curriculum.

This thesis has demonstrated that disaster video games have the potential to foster people's participation in learning about disaster and DRR. This thesis argues that for video games to be realised as powerful learning tools, more significant consideration is needed toward how people can learn from video games (game-based learning) and how video games can be used to teach (game-based pedagogy). In particular, this thesis advocates for a video game pedagogy centred around social interaction, metagaming and gameplay to enhance people's participation in the learning process. Currently, DRR education is primarily comprised of top-down, technocratic, and transmission styled teaching approaches, neglecting the bottom-up perspectives of teachers and students (Luna, 2017; Petal, 2007, 2008). Similarly, the numerous 'serious' disaster video games available are often poorly designed and primarily developed to transmit information reflective of the agenda for the organisation behind the video game. Scholars warn that focusing solely upon the educational content, without consideration to the other aspects of video games, can result in the failure of the video game and trivialise the potential teaching and learning benefits (De Freitas, 2006; Ibrahim et al., 2012a, 2012b; Kelle et al., 2011; Royale, 2008). Hence, DRR education requires recalibration, especially toward effectively incorporating video games within teaching and learning about disaster and DRR. This thesis highlights that an alternative epistemological approach, like constructivism, partnered with video games, as a learning tool, can lead toward active, interactive and action-orientated DRR education. The following recommendations have been developed from the analysis of the research findings in an effort to further understandings toward how to enhance the use of video games for teaching and learning.

8.3.1: Disaster video game-based learning: How people can learn from disaster based video games

The research findings have shown that through gameplay, both 'serious' disaster video games (*Quake Safe House, Earth Girl 2, Sai Fah – The Flood Fighter, Stop Disasters!*) and the mainstream video game *Minecraft* connect to principles of constructivism (Table 8.2). Significantly, this connection moves beyond a sole focus upon game content and considers the influence of game mechanics, skill-building, player motivation and social interaction upon gameplay. Table 8.2 indicates several key differences between each of the video games that ultimately inform the players' learning experience. Importantly, constructivism shows that learning takes time. Despite 'serious' games being marketed as purposefully designed for training and learning, there is a significant gap whereby the gameplay duration of 'serious' games are too short or are positioned as 20-minute activities without motivating player continuity (Young et al., 2012). Museum visitors playing *Quake Safe House*, clearly indicated that the game time limit (total of 2 minutes and 20 seconds) to make decisions meant they were unable to rationalise and understand their gameplay decisions, hence impacting their ability to learn (Chapter 4). Similarly, for the inclusion of video games into schools, such games need to fit within the constraints of classroom timeframe, thereby reducing 'serious' games to an approximate 15-20 minute activity. Therefore, the integration of video games to suit the classroom disassociates them from the constructivist principles that underpin the video games and the time required to foster meaningful engagement with the learning objectives. On the other hand, *Minecraft* aligned with the typical game features observed with mainstream video games, meaning *Minecraft* could offer much more immersive gameplay experiences. As such, the open world game environment and no time limit apart from what is enforced by the classroom teacher meant *Minecraft* has the potential to offer extended gameplay durations, from days to months, for learning about not only disaster and DRR but other topics within the curriculum.

Despite gameplay connecting to constructivism and having an ability to result in learning, Young et al. (2012) suggest that learning outside the game is just as powerful. Unsurprisingly, the dominant approaches observed toward video games that focus upon the influence of game design and game content upon learning means there is not enough consideration or research toward the power of metagaming upon the learning process. This seemingly echoes the comments of Petal (2007), whereby top-down DRR education efforts during the International Decade for Disaster Reduction in the 1990s to foster people's engagement in DRR failed to enter into practice. The research findings indicate that often 'serious' games cannot facilitate any form of metagaming, unlike mainstream video games. This is primarily because 'serious' games are one-off or unknown beyond educational contexts, whereas mainstream games are often situated within popular culture. Hence, mainstream games are part of everyday life, with discussions around gameplay experiences, tips and tricks, certain game content or even streaming of gameplay. However, for 'serious' games to achieve some form of metagaming, to move beyond the educational environment and into the home or other settings, current approaches require rethinking. The research findings suggest an attachment of DRR education to mainstream video games could lead to greater metagaming by players. This was observed through the use of *Minecraft*, whereby the game was already part of the students' everyday life. Therefore, *Minecraft* was already part of their conversations. Significantly, the critical difference, in this case, was that students could connect their gameplay experiences, with their local environment. Hence, discussions began to emerge around disaster and DRR outside of the classroom. Therefore, educators, researchers, game developers, among others, need to consider how to incorporate metagaming to foster people's participation not only during gameplay and the classroom but also toward how to transcend these boundaries into the broader learning objectives for DRR education.

Table 8.2: The influence of the four 'serious' disaster video games (*Quake Safe House, Earth Girl 2, Sai Fah and Stop Disasters!*) in comparison to geo-referenced *Minecraft* for participatory disaster and DRR mapping with consideration to constructivist principles

Constructivist Principle	Influence of *Quake Safe House* upon the museum visitor learning experience	Influence of *Earth Girl 2* upon the student learning experience	Influence of *Sai Fah – The Flood Fighter* upon the student learning experience	Influence of *Stop Disasters!* upon the student learning experience	Influence of *Minecraft* upon the student learning experience
Learning is an active process	• Active participation by playing				• Active participation by playing in a multiplayer game environment
	• Interaction with different tools/ items in-game				• Interaction with different blocks to make modifications to the in-game environment
	• Interaction and control of the in-game camera	• Interaction and control of moving the game environment	• Interaction and control of game character Sai Fah	• Interaction and control of moving the game environment	• Interaction and control of the game avatar
People learn to learn while they learn	• Game is bound by rules, rules influence player decision making and actions				• Game is bound by rules, rules influence player decision making and actions. Rules can also be created through player-player discussion and consensus
	• Time limit requires player decisions upon appropriate prevention tool to minimise damage during an earthquake	• Time limit, budgets requires player decisions upon appropriate tools to minimise damage during the games hazard scenario	• No time limit, the story unfolds by completing levels and problem-solving challenges to avoid Sai Fah getting injured	• Time limit, budgets requires player decisions upon appropriate tools to minimise damage during the games hazard scenario	• No time limit, the ability for continued building and modifications to represent changes over time
	• Rules learnt through tutorials and/ or gameplay				• Rules learnt through gameplay, metagaming sources and other players/ classmates

<table>
<tr><td>Meaning construction is mental</td><td colspan="5">• Hands-on activity requires active participation
• Decisions made based upon player understanding and subsequent actions</td></tr>
<tr><td rowspan="5">Learning involves language</td><td>• English language only</td><td colspan="3">• Multiple languages available</td><td>• 91 languages available</td></tr>
<tr><td>• New Zealand context</td><td>• South-East Asian context</td><td>• South-East Asian context</td><td>• Various global contexts</td><td>• Context is not pre-defined</td></tr>
<tr><td colspan="5">• The requirement to read and understand one of the available languages</td></tr>
<tr><td colspan="4">• Specific understanding of vocabulary related to disaster and DRR</td><td>• Disaster vocabulary is dependent upon the understanding of the player and their modifications rather than a requirement to play Minecraft</td></tr>
<tr><td colspan="4">• Cooperative in-person situations can encourage dialogue with peers or talking to themselves guide through the thought process</td><td>• Cooperative in-person situations can encourage dialogue with peers or talking to themselves guide through a thought process
• Multiplayer game environment can encourage dialogue with peers through in-game chat functions</td></tr>
<tr><td rowspan="2">Learning is a social activity</td><td colspan="4">• Single-player game</td><td>• Multiplayer game</td></tr>
<tr><td colspan="5">• Can be played cooperatively, players discuss, express and experiment ideas based upon past experiences with shared device control or controls while the other instructs</td></tr>
<tr><td>Learning is contextual</td><td colspan="4">• Utilise past knowledge and experience from various situations – other video games, technology, disaster awareness</td><td>• Utilise past knowledge and experience from various situations – other video games, technology, insider knowledge of the local area, classroom activities</td></tr>
</table>

<table>
<tr><td>Knowledge is required to learn</td><td colspan="5">Real-world/ game world governed by rules, understood by players
Knowledge of rules used to build further knowledge and understanding</td></tr>
<tr><td rowspan="2">Learning takes time</td><td colspan="5">Experiment with ideas surrounding disaster and DRR</td></tr>
<tr><td colspan="4">Repetitive gameplay allows better understanding, build confidence, ability and knowledge to improve scores</td><td>Repetitive gameplay allows better understanding, build confidence, ability and knowledge to improve</td></tr>
<tr><td rowspan="3">Motivation is key</td><td colspan="4">Attain high score motivated players</td><td rowspan="3">Players motivated for continual gameplay based upon familiarity and popularity of Minecraft in everyday life over a ‘serious’ video game instructing students what to learn – gameplay allows freedom of creativity and self-regulation of actions</td></tr>
<tr><td>The game did not motivate repetition of gameplay</td><td>Motivated to improve upon the number of people saved</td><td>Motivated to complete the story</td><td>Motivation to get fewer deaths and save more people using upgrades to reduce the risk</td></tr>
<tr><td colspan="4">Repetitive players motivated to play again demonstrated improved scores and understanding, compared to original play through – suggests players learnt something</td></tr>
</table>

Social interaction and the social environment are core components of learning (Vygotsky, 1978). Gee (2008) considers debriefing as the social interactions and discussion with peers and experts to help players to learn from interpreted experiences and gain explanations as a key element to good game design and facilitation of meaningful learning. However, all 'serious' disaster video games identified in this research are single-player games. 'Serious' disaster video games cannot continue as individual activities, as research demonstrates that gameplay is an inherently social activity (Brand et al., 2018). The research findings indicated that participants like playing games cooperatively and even if they did not, the research observations demonstrated that they still played in partnership with people around them (Chapter 4; Chapter 5), aligning with the comments of Admiraal et al. (2014). Notably, the benefits of social interactions within gameplay were observed through the multiplayer and cooperative game environment offered by Minecraft (Chapter 6). Without the inclusion of social constructivism within 'serious' disaster video games, the metagaming process becomes more crucial in this regard. Yet, as the previous paragraph outlined, 'serious' disaster video games are not able to adequately facilitate this dimension of game-based learning.

Ultimately, the research findings indicate there is more work required to ensure that disaster video games, in particular 'serious' video games, align with the broader dimensions of a disaster video game pedagogy. As it stands, these findings reflect the concept that 'serious' disaster video games cannot succeed as standalone learning tools. Therefore, the next subsection examines how game-based pedagogy may bridge the gaps in game-based learning.

8.3.2: Disaster video game-based pedagogy: How people can teach with disaster-based video games

Twenty-first-century education expects that teachers use novel methods, technologies and tools to engage learners and promote the key competencies of the curriculum (Kapp, 2012). Such education aims toward the acquisition of high ability literacy skills like critical interaction and complex problem solving (Salen, 2008). The teachers involved in this research shared this sentiment, indicating a need for transformative teaching and learning practices to allow students to engage with content and contexts at a higher level (Chapter 7). Research shows that teachers play an integral role in the success of using video games for enhancing the learning process (Nousiainen et al., 2018; Prestridge, 2017). Hence, scholars call for greater pedagogical attention and consideration of instructional facilitation, in connection tools and technology like video games, to achieve the aims of twenty-first-century education (Salen, 2008; Young et al., 2012).

The research findings suggest that gameplay is a critical component for educators (e.g. teachers and museum curators) to ensure the success of the video game being utilised as a teaching tool. In particular, there are two aspects of educator gameplay. Firstly, the educator should play the game as a player to attain an understanding of the game content, mechanics, skill-building, motivations and social interactions. Secondly, the educator should play the video game to assess the game's connection to the curriculum, specific learning objectives, teaching pedagogy and whether the game appropriately recognises cultural and language considerations (Chapter 5; Chapter 7). Significantly, for educators to conduct such assessments, they require a level of competence or knowledge to understand, not only video games but also the educational content like disasters. Importantly, such assessments must go beyond content and instead should also incorporate the five elements as presented by Gee (2008) to ensure the video game can also facilitate meaning learning experiences. Currently, without any real assessments of 'serious' disaster video games available to educators, there is a danger that inexperienced educators may determine that what is, in fact, a poorly designed video game, to be a well-designed video game, and ultimately lead to a failure to achieve any of the intended learning objectives (Becker, 2017; Nousiainen et al., 2018).

The research continually references that current methods of teaching are not adequately configured to ensure gaming is not merely a tokenistic teaching and learning activity (Becker, 2017; Cohen, 2011; Young et al., 2012). Problematically, research suggests that teachers are unlikely to adapt their teaching strategies to accommodate the use of video games as learning tools (Kim et al., 2013; Prestridge, 2017). However, Prestridge (2017) suggests that the success of a video game as a learning tool is dependent upon the teaching beliefs and pedagogies of the educator. Therefore, this thesis advocates for positioning the teaching pedagogy as a form of metagaming. Currently, the research findings suggest that a downfall of 'serious' disaster video games is their inability to facilitate metagaming, thereby reducing their potential to generate further participation in disaster and DRR outside of the video game. Hence, a repositioning of the teaching pedagogy can serve to bridge this gap. In the case of teachers, the classroom teaching activities can engage players in discussions surrounding DRR education before the video game and then continued discussion outside of the video game post-gameplay. Notably, the teachers can connect their teaching strategy to align with mechanisms of any pedagogical model, as demonstrated in Chapter 5. In the case of museums, acknowledgement of the instructional strategy underpinning the exhibit like discovery-based learning should serve as the starting point for the metagaming process. Thereby, ensuring that the surrounding exhibits have relevance or connection to the video game, which allows for museum visitors to continue their learning and understanding why the game is relevant to what they are experiencing within the rest of the museum exhibit (Chapter 4).

The role of social interaction for an educator using video games in a teaching situation, should be more facilitation or guiding rather than the usual transmission teaching approach (Powell & Kalina, 2009). This, in effect, aims to empower players to become active learners and to develop knowledge for themselves (Schunk, 2012). This approach connects back to the concept of the zone of proximal development as part of social constructivist learning theory. By shifting the approach of the educator, the video game can offer one dimension of instructional scaffolding, with the educator scaffolding through verbal or physical assistance to help the learner increase their competence with a problem outside of their capabilities (Meece & Daniels, 2008; Powell & Kalina, 2009; Pritchard & Woollard, 2010; Schunk, 2012; Wood et al., 1976; Wu et al., 2012). Additionally, the educator should ideally provide opportunities for social interaction more broadly if possible, allowing learners the opportunity to process, what they learnt in a group or from a more knowledgeable other, individually (Powell & Kalina, 2009). Significantly, given 'serious' disaster video games are not currently able to achieve social interactions beyond the external facilitation by educators, this enforces Prestridge's

(2017) belief that the success of a video game as a learning tool is dependent upon the teaching beliefs and pedagogies of the educator.

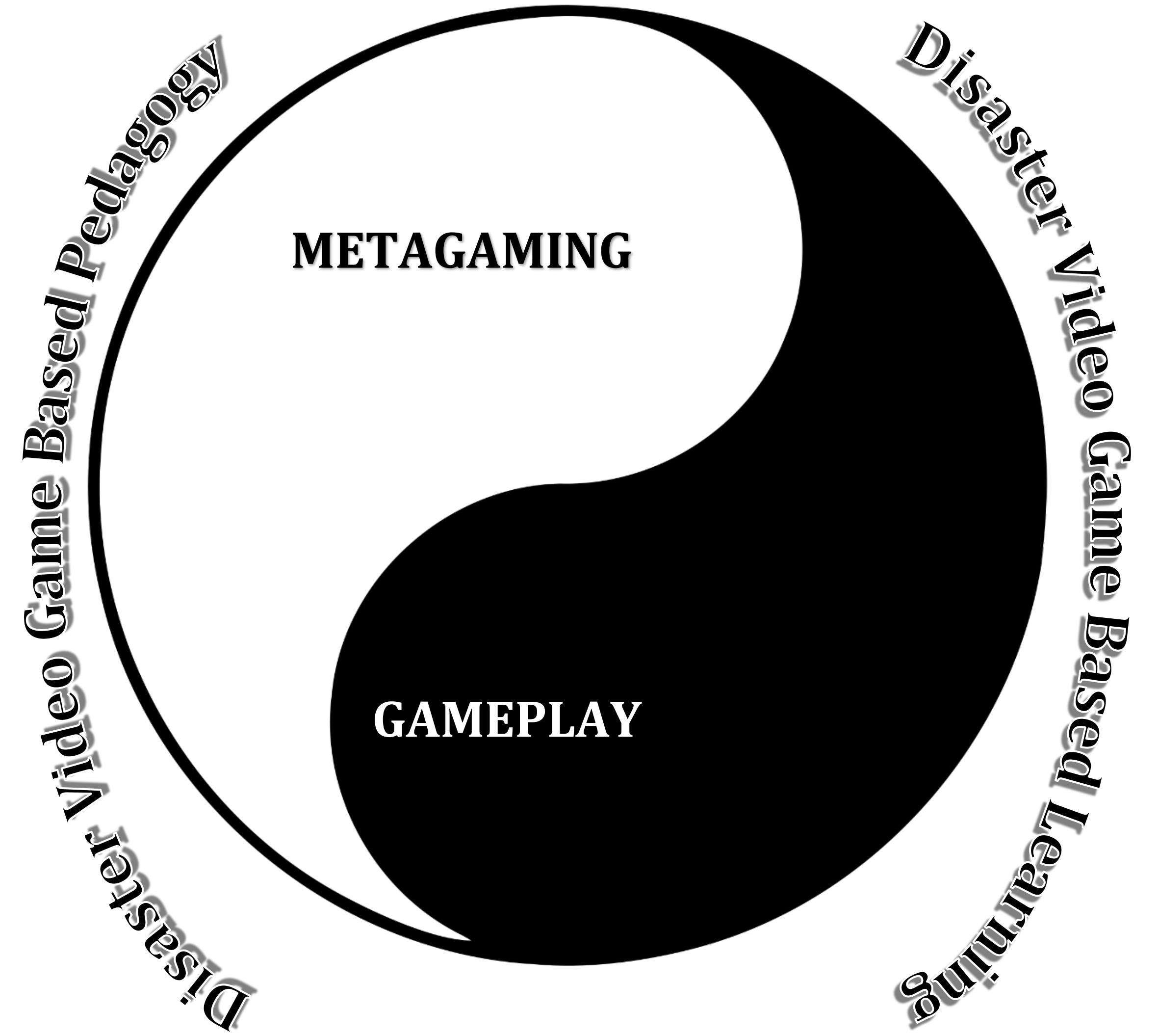
8.3.3: Towards the enhancement of disaster video games as learning tools

The preceding subsections demonstrate the significant gaps between the expectations of DRR education and the use of video games to achieve these aims. To work toward bridging these gaps, the disaster video game pedagogy suggests both disaster video game-based learning and disaster video game-based pedagogy must work in collaboration to better foster people's participation in learning about disaster and DRR. Figure 8.1 revises the initial game-based learning and game-based pedagogy diagram to acknowledge how to address these gaps. Importantly, disaster video game pedagogy requires educator gameplay in order to understand the connections of video games to instructional strategies, whereby disaster video game-based learning requires teaching pedagogy as a form of metagaming to foster discussions outside the video game, in an effort to transcend the information beyond the classroom or museum. Social interaction encompasses both dimensions of disaster video game-based pedagogy and disaster video game-based learning, holding extreme importance for both components.

Beyond this, the research findings call for an assessment framework, co-developed by museum curators, teachers, students, academics, video game designers and developers that is contextually relevant to serve their teaching and learning needs. Significantly, such assessments must go beyond content and instead should also incorporate the five elements presented by Gee (2008) to ensure the video game can also facilitate meaningful learning experiences. While constructivism can be a starting point for the framework to incorporate learning theory, such a framework should also be reflective of different teaching pedagogies and instructional strategies. This framework should provide game developers with criteria to help ensure that their game designs align with the needs of educators and their particular learning environments like museums or schools. Additionally, there is a clear evolution of an assessment framework to offer educators a toolbox of disaster video games, assessed against this framework, with an associated handbook of instructional strategies to accompany the use of the various video games.

Such a toolkit will enable educators to be appropriately trained in using video games for learning and provide teachers, museum curators and other educators with an understanding of disaster and DRR material to help mainstream a DRR curriculum (Luna, 2012). Importantly, such a tool kit should consider incorporating the five levels of learning for a disaster video game, as outlined in Chapter 2. The five levels of learning (How, What, Why, Where and When), originally presented by Prensky (2002) can help in structuring instructional strategies for educators to ensure students are building their awareness over time and whether the educator needs to focus further activities within the classroom to enable the learner to gather the required knowledge to achieve understanding. Therefore, the assessment framework and toolkit can raise the educator's competence twofold. First, this approach will improve educator abilities of understanding and using video games for learning (Kim et al., 2013). Secondly, the approach can work toward mainstreaming DRR education within the curriculum, as teachers, museum curators and other educators, must have an understanding of disaster and DRR, in order to adequately teach their students (Luna, 2012). Hence, educators will have training, support from teaching and learning materials (assessment framework and toolkit) to increase disaster awareness (Luna, 2012; Mutch, 2014; Wisner, 2006). By correctly assessing the video game, educators can ensure that the instructional strategies within the video game work with their teaching pedagogy outside of the video game, and lead toward meaningful usage of video games for teaching and learning.

Figure 8.1: Disaster video game pedagogy



8.4 Potential thesis limitation

Notably, disaster video game research, as a relatively new area of game research, is void of successful research frameworks to guide researchers. The learner-centred methodological framework, conceptualised in this thesis, draws upon the epistemology of constructivism and is supported by participatory techniques. Despite the intentions of this methodological framework to align with the principles of constructivism and participation, this approach was primarily conceptualised to inform the completion of an academic thesis. Hence, while such an approach does have advantages for teaching and learning practices, the use of a participatory approach in an academic context is often disassociated from the actual intentions of participation (Hore et al., 2020; Le De et al., 2015). Chambers (1994a) outlines that people are capable of conducting research, with research objectives that they have defined, a methodological approach they have designed, alongside analysing the data based upon their own criteria. The role of outsiders should be the facilitation of the process and the powerless should be empowered through the research process (Chambers, 1994a). It is acknowledged that there are indeed limitations to the methodological process of this thesis. However, on the flip side, a participatory approach towards video game research has not been previously conducted. Therefore, this section serves as a recognition of the limitations identified from the research process in the aims that future research and greater utilisation of the tools could lead toward overcoming some of the challenges in the context of academic research.

From the outset, the research direction was primarily defined by the researcher as a requirement to collect data for the completion of a thesis rather than it being a genuinely participatory process (Madsen & O'Mullan, 2018; Weaver et al., 2009). In this instance, the research locations were defined by the researcher based upon video games the researcher had identified as being developed for the context of a museum or school. As part of this process, the researcher pre-defined the research objectives and agenda, the methodological approach and associated questions to enable the collection of comparative data. Despite, the collection of qualitative data from the carousel activities, the participants were not involved, beyond the debrief after the activities, in the actual analysis of the dataset. Therefore, the first two case studies (Chapter 4 and Chapter 5) are mostly misaligned to the objectives of participation, as outlined by Chambers (1994a).

Popa and Guillermin (2015) call for reflexive methodologies. Given that a methodological framework that integrated conventional methods (e.g. pre and post-game questionnaires) and participatory techniques (e.g. carousel, one-word, scoring and ranking) for video game research had not previously been conceptualised or utilised, researcher reflexivity was critical. Hence, the researcher continually reflected upon the research process in an effort to overcome some of the limitations identified in the previous paragraph. This reflexive consideration by the researcher upon the methodological process ultimately allowed an opportunity to give careful consideration toward the approach of the *Minecraft* case study (Chapter 6). Fundamentally, the *Minecraft* case study aimed to facilitate a participatory process from the outset rather than researcher-driven research agenda. In this instance, the local people approached the local emergency management personnel to develop a disaster resilience plan for the area. Hence, the researchers attended the location more in a facilitation capacity to support the local teachers and students achieve their objectives rather than impose the researchers own research agenda. Therefore, participants had a greater ability to influence the direction of the research, and such an approach gave the teachers and students greater ownership over the research process. In addition, the co-development of a teaching pedagogy gave significant insight and feedback upon the use of participatory activities for the purposes of teaching (from the teachers) and learning (from the students) within the classroom. Although the analysis of the data was ultimately conducted by the researcher, the results of the participatory activities were analysed and discussed throughout the research process by the students and teachers.

While a longitudinal study that engages the participants in the research design from the outset would be preferable, the timelines and criteria of a PhD, alongside no prior participatory methodological framework for video game research to guide the research meant this was not possible. Therefore, the research process was also unable to build strong relationships with the research participants (museum visitors, school students, teachers), as expected of a participatory approach (Chambers, 1994a; Cornwall, 2011). Ultimately, the researcher arrived at the study location, extracted the research data necessary through activities labelled as 'participatory'. However, given the *Minecraft* case study came after the conceptualisation and utilisation of the methodological framework, greater attention was given toward building a relationship with the teachers and students as the research was conducted over several sessions rather than a single one off-60 minute classroom session.

Video game research often utilises questionnaires for collecting both quantitative and qualitative data, aiming to generate statistically significant results (Chapter 3). However, Mayoux and Chambers (2005) suggest such conventional methods do not mean the data is necessarily better, but could actually result in more bad data. For example, while the researcher could have promoted museum visitor interaction with *Quake Safe House* to generate more research data, this would have biased the sample and not given an actual representation of the situation. Importantly, while this research has not generated data sets large enough to infer statistical representativity, the epistemology of constructivism and the use of activities to engage the participants in a 'participatory process' meant there was a cross-verification of the data that saw more meaningful answers emerge from the carousel activities versus the questionnaires (Chapter 3). Therefore, this process enabled greater insights into how museum visitors and students think and respond to a video game within their respective learning environment.

Similar to the views of Popa and Guillermin (2015), a monodisciplinary approach, unconnected to constructivism, was inadequate to truly understand the use of video games for learning within a museum environment. Therefore, there is a need for greater consideration toward how participatory techniques could potentially be adapted for the museum environment while maintaining alignment to constructivism. The methodological pluralism approach utilised in four Hawke's Bay schools demonstrated greater opportunities for constructivist-based learning and data collection. However, the challenges to achieve methodological pluralism referenced by Midgely et al. (2017) and supported by Popa and Guillermin's (2015) view for reflexive methodological pluralism are important considerations for the research methodology. In the context of academic research, there may be conflicts between paradigms, a resistance of academic research areas toward utilising a mix of conventional approaches and participatory approaches, or quite simply a resistance to learning any new research approaches. Despite the possible limitations, the data collected enabled comparisons and triangulations between different group debrief, interviews and activities with teachers, alongside conventional and participatory tools to support the concept that different methodologies can strengthen the research methodology and research findings (Midgely et al., 2017; Popa & Guillermin, 2015).

Importantly, the video game and teaching and learning approach should reflect local norms and values. Despite the research being limited to New Zealand, the emerging research findings suggest there is great potential for the methodology to be replicated and adapted to other contexts or topics beyond disasters and DRR. For contexts outside of teaching in New Zealand, a constructivist approach may not align with the personal teaching pedagogies or with curriculum requirements; there may be resistance from teachers or students to utilising a mix of different tools and instructional strategies within the classroom or again, simply a resistance toward having to learn a new teaching and learning approach. However, researchers working collaboratively with teachers and students, especially in co-designing the research approach or teaching approach, like the Minecraft case study (Chapter 6), could overcome such challenges with researchers and teachers supporting and learning from each other in regards to methods outside of their skillsets. In this instance, the researchers suggested various tools and activities that teachers could connect to the key competencies of the New Zealand Curriculum, with both researchers and teachers jointly involved in sharing teaching strategies. Therefore, the focus upon New Zealand does not undermine the contribution of the findings nor applicability of the research approach to other teaching contexts, countries or even topics beyond disaster and DRR. Instead, the recognition for the limitations within this thesis can only lead to improvements in the methodological research approach and research findings for future research.

8.5 Oppurtunities for future research

Building upon the limitations identified in the previous section, video game researchers have identified the methodological diversity of research approaches are problematic. As such, without a conceptual or methodological framework to act as a foundation, existing studies generally fail to use a theoretical foundation to support game-based learning and game-pedagogy (Rebetez & Betrancourt, 2007; Wu et al., 2012). The conceptualisation of the learner-centred methodological framework in this thesis had an epistemological foundation underpinned by theories of constructivism, namely cognitive and social constructivism, supported by participatory techniques. However, this approach still mainly focused on constructivism. In line with the views of Wu et al. (2012), there is an avenue to conceptualise further methodological frameworks underpinned by different learning theories (behaviourism, cognitivism, humanism, constructivism, social learning), learning principles or even a combination of learning theories to attain deeper understandings around video games for learning, but also to fit different learning contexts and learning preferences.

The participatory techniques utilised in this thesis supported constructivism, although such techniques and activities are not appropriate in all contexts (e.g. museums) and may need modification or adaptation to increase their suitability. Importantly, while the participatory techniques and activities engaged learners in more meaningful discussions, they did not always resonate with learners and therefore research into different methods and strategies to support different learning needs are required (Chapter 5; Chapter 6; Chapter 7).

Despite the number of international organisations, governmental organisations, non-government organisations, and researchers, alongside mainstream game developers, there exists very little collaboration with disaster survivors, teachers, students, museum visitors among many others, to develop a game-based learning and game pedagogy platform to improve the learning opportunities. Sanchez (2014) suggests 'serious' games are one-off deliverables, exactly what is seen in terms of 'serious' disaster video games, yet this should not be the case (Chapter 7). The *Minecraft* case study (see Chapter 6) demonstrated immense potential in a co-designed and co-developed teaching and learning process with teachers, students, academics and specialist personnel. Such an approach could offer an opportunity to deliver an engaging, motivating and interactive video game, with yearly updates and potential to explore different topics. Therefore, an opportunity exists to work with teachers and students in a longitudinal study to understand how to enhance this process and ensure a connection to learning theory and teaching strategies.

This research has emphasised a need to shift away from solely emphasising the video game and give broader consideration to the learning environment. For museums, it is not enough to simply place a video game within an exhibit expecting interaction. This thesis has shown that there is a need to understand how to connect the museum visitor's gameplay experience with the museum environment (see Chapter 4). In addition, research must conduct an assessment of teachers, regarding not only their capabilities around video games but also their understanding of the core teaching material (e.g. disasters and DRR). Resources could be developed to train teachers, not only around the core teaching content but also toward how teachers can utilise video games within the classroom with support from learning theory and instructional strategies. Therefore, a toolkit of video games could be part of this initiative, with connected classroom activities, teaching strategies and lesson plans, co-developed with teachers and students. Such an approach could also extend into a longitudinal study to explore the influence of active student engagement in the learning process versus passive transmission-orientated teaching processes, and the application of these approaches to formal assessments by students. Ultimately, such research may lead to an inclusion of video games as formal teaching and learning tools, supported by a curriculum that allows for reflective, experiential and exploratory learning and not just transmission-orientated teaching and learning.

The research findings indicate that disaster discourse within video games is another significant area for research, but fell beyond the ability of this thesis. As part of the research process, the portrayal of various disaster discourses within 'serious' and mainstream video games was identified. ‘Serious’ disaster video games are often technocratic and top-down, in terms of gameplay, terminology and the overall video game goal. In particular, such games are often situated around the dominant hazard paradigm, focused more upon the hazard than addressing the root causes of vulnerability. *Stop Disasters!* takes a very top-down approach toward city management, with decisions mostly made based upon the risk map rather than a collaboration with the local people of the area in assessment of their own needs. On the flip side, *Earth Girl 2* gives players an opportunity to engage with the local NPCs prior to decision making in the game scenario. These NPCs have a variety of perspectives, suggested tools and include people from various parts of society like pregnant women, people with disability and older people. Hence, players may shift their gameplay approach to consider the needs and perspectives of these groups of people. Notably, these discourses did emerge through the carousels and post-activity debrief in schools, also through the post-game debriefs with the museum participants to suggest that this is an important area for consideration.

More pressing is the gap in knowledge around mainstream disaster video games. The research findings have shown that mainstream games connect to concepts of disaster and DRR, or can be adapted for the purpose of learning about disasters. However, the portrayal of disaster discourses within mainstream games is of significant interest, especially as such games challenge disaster myths and the dominant hazard paradigm. For example, *Assassin’s Creed Rogue* has a mission set within the 1755 Lisbon earthquake. The player is tasked with collecting a hidden artefact that is ultimately the mechanism that triggers the earthquake. The player must escape the city as the earthquake occurs, running through the city observing immense destruction and NPCs exhibiting panicked behaviour. What is most significant about this particular quest is within a cut scene following the player escaping the destruction and an NPC references the earthquake as an act of God, whereupon the player character responds that God had nothing to do with this. As such, debunking the disaster myth of natural hazards as acts of God and instead brings the idea of the cause of the earthquake back upon the actions of people. Another example is the association of a natural hazard within everyday life rather than a disassociation in *Assassin’s Creed Origins*. As such, the player is confronted with NPCs referring to the flood as a necessity rather than a destructive phenomenon. Without the flood, their livelihoods are at risk, resulting in impacts like inability to farm demonstrating the inclusion of natural hazards within everyday life. Alternatively, city management game *Frostpunk*, demonstrates the complexities of social dimensions when facing a natural hazard, in this case, extreme winter. Players must make decisions that have direct implications upon the livelihoods of their settlement reflecting the vulnerability paradigm in terms of who has access to resources and who has not, which can all impact upon who survives and who does not. Ultimately, these are only a few examples of discourses revealed throughout the course of the research, although this signals the broader significance in understanding mainstream games as tools for disaster and DRR.

Overall, this thesis attempted to move beyond rehashing the same research narrative that aims to demonstrate the connection of video games to learning. Instead, the real core of this thesis lies in an attempt to understand how to enhance the process of using video games for teaching and learning. While this thesis contributes to the sphere of disaster video game research, in no way is this thesis a paragon. Instead, this thesis has cast a pebble into what is a significant expanse for future research opportunities. As such, the preceding paragraphs of this section outlines potential pathways toward defining a research agenda for Stop Disasters 3.0.

Appendices

Appendix A

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

CONSENT FORM
(Museum Management)

THIS FORM WILL BE HELD FOR A PERIOD OF 6 YEARS

Project title: Stop Disasters 2.0: Exploring Video Games as a Tool to Foster Participation in Learning about Disaster.

Name of Researcher: Anthony Viennaminovich Gampell.

I have read the Participant Information Sheet; have understood the nature of the research and why Te Papa National Museum/ Quake City has been selected. I have had the opportunity to ask questions related to the project and have had them answered to my satisfaction.

- I understand that participation by Te Papa National Museum / Quake City in this research is voluntary.
- I agree to support and facilitate the research process within Te Papa National Museum / Quake City.
- I understand that the research will involve the student researcher observing members of the public using the interactive display within the museum, and completing a questionnaire relating to individual's experiences of the interactive display.
- I understand that members of the public will not be identified by name and that data will be non-traceable to individuals.
- I understand that if my organisation chooses to withdraw support for this study, we will not have to provide a reason.
- I understand that this Consent Form will be securely stored separately from other research data for 6 years beyond the completion of the research, when both will be destroyed.
- I understand that the data gathered from Te Papa National Museum/ Quake City will be used for writing a PhD thesis, academic publications, conference presentations and shared with other stakeholders involved in the research process.
- Please indicate by circling YES or NO if you wish to have your institution identified in any reports: YES/NO
- Please indicate by circling YES or NO whether you would like to receive a summary of the findings: YES/NO

Signature...

Email...

Date...

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 03-Oct-2016 for (3) years, Reference Number 017988/

Appendix B

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

PARTICIPANT INFORMATION SHEET: Te Papa National Museum/ Quake City Museum

Project title: Stop Disasters 2.0: Exploring Video Games as a Tool to Foster Participation in Learning about Disaster

Name of researcher: Anthony Viennaminovich Gampell

Supervisors: JC Gaillard, Meg Parsons and Karen Fisher.

Researcher introduction: Anthony Gampell is a PhD candidate specialising in disaster video game research in the School of Environment, The University of Auckland. The research is being conducted under the supervision of Associate Professor J. C Gaillard and co-supervision of Lecturer Meg Parsons and Senior Lecturer Karen Fisher. The project is supported by the Earthquake Commission (EQC) and Auckland Civil Defence. The project is also being partially funded through an EQC scholarship.

Project description and invitation: You are invited to participate in this research project, which will investigate disaster based video games, both serious and mainstream, in an attempt to discover whether such games have the potential to build disaster and Disaster Risk Reduction (DRR) knowledge in players, and if yes (or no), why and how.

The proposed research aims to investigate five main objectives:

1. To expand upon the disaster typology of disaster video games and conduct a desk analysis of discourses on disasters featured by these games.
2. To understand why and how disaster video games are developed for DRR.
3. To test and assess the impacts of existing disaster based video games with a targeted audience.
4. To carry out an analysis of disaster video games in collaboration with a targeted audience.
5. To understand how video games may be used as learning tools, especially in terms of disaster research.

This research will involve visitors of your museum participating in the following research activities:-

- Observing people as they play the EQC Quake Safe house interactive display.
- Completing a questionnaire.

The research will take place over a period of one to three days, at the discretion of the museum. I seek permission to conduct the project in your museum.

Project procedures: If you consent to participate, you will be requested to support and facilitate the research process. Participation by Te Papa National Museum/ Quake City's is voluntary There will be no implications for staff as staff are not involved in the research. The research will involve the student researcher observing members of the public using the interactive display within the museum, and completing a questionnaire relating to individual's experiences of the interactive display. All participants will also receive a participation information sheet (PIS) explaining the research and what their involvement entails. Completion of the questionnaire will be taken as consent to participate in the research. The data collected will be used for the purposes of a PhD thesis, academic publications, conference presentations and shared with other stakeholders involved in the research process.

Data storage / retention / destruction / future use: Information will be entered into an Excel spreadsheet and will be stored by the researcher in password protected folders on his computer and external storage devices. Hard copies will be stored in a locked cabinet. Data will be held for 6 years (this is the usual procedure at The University of Auckland) before it is destroyed. Digital data will be deleted and hard copies will be shredded. A summary of findings will be made available upon the completion of the research project. Please indicate where appropriate upon the CF to receive a copy of this summary.

Right to withdraw from participation: If your organisation chooses to withdraw support for this study, you will not have to provide a reason. Visitors may also decline to participate in the research.

Anonymity and confidentiality: You may choose to have your organisation identified in reports and publication, or you may choose to not have your organisation identified. Information collected will not identify individuals. Only the information provided by the questionnaires will be taken away. Participants will be made aware of this prior to their participation through the Participant Information Sheet and the Consent Form.

For any inquiries and further information please use the contacts details below:-

Researcher: Mr Anthony Gampell, School of Environment, a.gampell@auckland.ac.nz,
Supervisor: Associate Professor J C Gaillard, School of Environment, jc.gaillard@auckland.ac.nz, Ph. (09) 923 9679
Co-Supervisor: Lecturer Meg Parsons, School of Environment, meg.parsons@auckland.ac.nz, Ph. (09) 923 9263
Co-Supervisor: Senior Lecturer Karen Fisher, School of Environment, k.fisher@auckland.ac.nz, Ph. (09) 923 8410
Head of School: Professor Paul Kench, School of Environment, Science Centre, Building 302, 23 Symonds Street, Auckland 1142, New Zealand, p.kench@auckland.ac.nz, Ph. (09) 923 8440 ext 85331

For any queries regarding ethical concerns you may contact The University of Auckland Human Participants Ethics Committee, The University of Auckland, Office of the Vice Chancellor, Private Bag 92019, Auckland 1142, Telephone +64 (0) 9 373-7599 extn. 83711. Email: ro-ethics@auckland.ac.nz

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Appendix C

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

PARTICIPANT INFORMATION SHEET: Museum participants

Project title: Stop Disasters 2.0: Exploring Video Games as a Tool to Foster Participation in Learning about Disaster.

Name of researcher: Anthony Viennaminovich Gampell.

Supervisors: JC Gaillard, Meg Parsons and Karen Fisher.

Researcher introduction: Anthony Gampell is a PhD candidate specialising in disaster video game research in the School of Environment, The University of Auckland. The research is being conducted under the supervision of Associate Professor J. C Gaillard and co-supervision of Lecturer Meg Parsons and Senior Lecturer Karen Fisher. The project is supported by the Earthquake Commission (EQC) and Auckland Civil Defence. The project is also being partially funded through an EQC scholarship.

Invitation: You are invited to participate in this research project, which will investigate disaster based video games, both serious and mainstream, in an attempt to discover whether such games have the potential to build disaster and Disaster Risk Reduction knowledge in players, and if yes (or no), why and how.

Where will the study take place?

You have been invited to participate in this research because you displayed an interest in the interactive display at (insert museum here).

What would be involved (activities)?

If you accept**,** you will participate in the following activities:

- Playing the EQC Quake Safe House interactive video game.
- Participating in a pre-game and post-game questionnaire of no more than 10 minutes in total for both.

Privacy?

The questionnaires do not require you to provide specific personal information that may lead to your identification. The information you provide is non-traceable to individuals; therefore, the risk of identification is low.

Study duration?

1) You have chosen to play the EQC Quake Safe House interactive video game which has taken approximately a maximum of 3 minutes to complete.
2) The questionnaires should take approximately 10 minutes to complete (5 minutes per questionnaire).

What happens to the information I give?
All digital data will be kept safely by the researcher. Data will be password protected and stored on a laptop and external hard drives for 6 years after which time it will be destroyed. The data will be used to complete a PhD thesis, academic publications, conference presentations and shared with other stakeholders involved in the research process.

Your rights and choices:
It is your right and choice to take part in this research. You may choose to refuse to participate in the study. You may also refuse to answer questions or to withdraw your participation from the study up until you submit the post-questionnaire. Once the questionnaires have been submitted, you will be unable to withdraw from the research as they cannot be traced back to individuals. Completion of the questionnaire will be taken as consent to participate in the research.

Where do I get help if I get upset, concerned, worried or require counselling?
Contact the Family Services 211 Helpline (0800 211 211) to find an appropriate counselling service in your area.

Who is doing this research?
Researcher: Mr Anthony Gampell, School of Environment, a.gampell@auckland.ac.nz
Supervisor: Associate Professor J C Gaillard, School of Environment, jc.gaillard@auckland.ac.nz, Ph. (09) 923 9679
Co-Supervisor: Lecturer Meg Parsons, School of Environment, meg.parsons@auckland.ac.nz, Ph. (09) 923 9263
Co-Supervisor: Senior Lecturer Karen Fisher, School of Environment, k.fisher@auckland.ac.nz, Ph. (09) 923 8410
Head of School: Professor Paul Kench, School of Environment, Science Centre, Building 302, 23 Symonds Street, Auckland 1142, New Zealand, p.kench@auckland.ac.nz, Ph. (09) 923 8440 ext 85331

For any queries regarding ethical concerns you may contact The University of Auckland Human Participants Ethics Committee, The University of Auckland, Office of the Vice Chancellor, Private Bag 92019, Auckland 1142, Telephone +64 (0) 9 373-7599 extn. 83711. Email: ro-ethics@auckland.ac.nz

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Appendix D

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

CONSENT FORM
(Parent/Guardian)

THIS FORM WILL BE HELD FOR A PERIOD OF 6 YEARS

Project title: Stop Disasters 2.0: Exploring Video Games as a Tool to Foster Participation in Learning about Disaster.

Name of Researcher: Anthony Viennaminovich Gampell.

I have read the Participant Information Sheet, or the information has been read and explained to me; I have understood the nature of the research and why I have been selected.

- I have discussed the research invitation, in the form of a PIS, with my child, recognising that even with my consent the final decision to participate is up to my child.
- I agree for my child to take part in answering questionnaires, playing a video game, having gameplay recorded and a focus group discussion while being supported by their teacher.
- I understand that it is my child's choice to refuse to participate in the discussion or answering of questionnaires.
- I understand my child may choose not to be part of the study at any time but cannot withdraw any questionnaire answers submitted as these are untraceable to individuals.
- I understand due to the nature of the focus group discussion activity my child will not be able to withdraw any information they may contribute.
- I understand that the focus group discussion can compromise confidentiality and prevent anonymity. To lessen the risk, my child has been asked to keep all information from the study confidential.
- I understand that the principal accepts that if my child takes part in the research, it will not affect their learning, enrolment or relationship with the school.
- I understand that only my child's questionnaire answers, gameplay recordings, information provided in the focus group discussion and researchers' field notes will be taken away.
- I understand that research information will be kept securely for 6 years, after which they will be destroyed.
- I understand that my child's name will not be used in any reports/presentation
- I know who I/ my child can speak to if I am worried, concerned or would like to ask questions about this research (contact details are on the Participant Information Sheet).
- I understand that the data gathered from the focus group discussion will be used for a PhD thesis, academic publications, conference presentations and shared with other stakeholders involved in the research process.

Name of student:

Name of parent:

Signature of parent:

Date:

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 03-Oct-2016 for (3) years, Reference Number 017988/

Appendix E

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

PARTICIPANT INFORMATION SHEET: Parents/ Caregivers

Project title: Stop Disasters 2.0: Exploring Video Games as Tools to Foster Participation in Learning about Disaster.

Name of researcher: Anthony Viennaminovich Gampell

Supervisors: JC Gaillard, Meg Parsons and Karen Fisher.

Researcher introduction: Anthony Gampell is a PhD candidate specialising in disaster video game research in the School of Environment, The University of Auckland. The research is being conducted under the supervision of Associate Professor J. C Gaillard and co-supervision of Lecturer Meg Parsons and Senior Lecturer Karen Fisher. The project is supported by the Earthquake Commission (EQC) and Auckland Civil Defence. The project is also being partially funded through an EQC scholarship.

Invitation: Your child is invited to participate in this research project, which will investigate disaster based video games, both serious and mainstream, in an attempt to discover whether such games have the potential to build disaster and Disaster Risk Reduction (DRR) knowledge in players, and if yes (or no), why and how. Your child has been invited to participate in this research because they are a student of (insert school name).

While you may provide consent for your child to be approached to take part in the research, your child has the final decision on whether they would like to participate, or not participate, in the research. Please read and explain the attached consent form to your child.

The principal gives their assurance that the teachers' and students' decision to participate or not in this research will not affect their employment/learning/enrolment status or relationship (whichever is appropriate) to the school in any way.

What would be involved (activities)?

Your child's involvement in the research will involve participating in the following activities:

- Completing of a pre and post-game questionnaire.
- Playing an appropriate disaster based video game selected from the disaster video game typology.
- Focus group discussion.

I will travel to your child's school and agree with the principal and teacher on a time when it is appropriate for this study to be carried out with minimal disruption to your child's timetables.

Snacks will be provided for the participants in the research, any possible concerns with this aspect can be discussed with the Principal or your child's teacher.

Privacy?

I want to assure you that the questionnaires, gameplay recordings and focus group discussion information will be known only to myself, my supervisor and co-supervisor. Gameplay recordings will only record on-screen actions and does not identify participants. The focus group discussion will involve your child, as part of a collective group, recording ideas upon flipcharts about different themes of the video games trialed and discussing the ideas presented. The information collected will be used for writing my PhD thesis, academic publications, conference presentations and shared with other stakeholders involved in the research process.

Study duration?

1) The pre and post-game questionnaires should take a maximum of 5-10 minutes each to complete, 20 minutes in total.
2) The video game testing should take a maximum of 25 minutes to complete.
3) The focus group discussion should take approximately 45 minutes to complete.

What happens to the information my child will give?

All data will be stored separately from consent forms by the researcher in password protected folders on his laptop and external storage devices. Hard copies will be stored in a locked cabinet. Data will be held for 6 years (this is the usual procedure at The University of Auckland) before it is destroyed. Digital data will be deleted and hard copies will be shredded.

Your child's name will not be reported in any of the publications arising from this research including the thesis. Names and information that might lead to the identification of individual children will not be collected in this research. Information will be presented in a way that does not identify individuals.

Your rights and choices:

It is your right to provide consent to allow the researcher to approach your child; however, your child has the final choice to take part in this research. It is your child's choice to refuse to participate in the study. Your child may choose not to be part of the study at any time; however, any questionnaire information cannot be withdrawn once submitted as these are untraceable to individuals. The focus group discussion information given will not be able to be withdrawn as it is a collaboration of participant ideas.

Where can my child get help if they get upset, concerned, worried or require counselling?

Your child can use the onsite counselling services provided by your school if available or contact the **Family Services 211 Helpline** (0800 211 211) to find an appropriate counselling service in your area.

For any inquiries and further information please use the contacts details below:-

Researcher: Mr Anthony Gampell, School of Environment, a.gampell@auckland.ac.nz
Supervisor: Associate Professor J C Gaillard, School of Environment, jc.gaillard@auckland.ac.nz, Ph. (09) 923 9679
Co-Supervisor: Lecturer Meg Parsons, School of Environment, meg.parsons@auckland.ac.nz, Ph. (09) 923 9263
Co-Supervisor: Senior Lecturer Karen Fisher, School of Environment, k.fisher@auckland.ac.nz, Ph. (09) 923 8410
Head of School: Professor Paul Kench, School of Environment, Science Centre, Building 302, 23 Symonds Street, Auckland 1142, New Zealand, p.kench@auckland.ac.nz, Ph. (09) 923 8440 ext 85331

Appendix F

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

CONSENT FORM
(School Principal)

THIS FORM WILL BE HELD FOR A PERIOD OF 6 YEARS

Project title: Stop Disasters 2.0: Exploring Video Games as a Tool to Foster Participation in Learning about Disaster.

Name of Researcher: Anthony Viennaminovich Gampell.

I have read the Participant Information Sheet; have understood the nature of the research and why (insert school name) has been selected. I have had the opportunity to ask questions related to the project and have had them answered to my satisfaction.

- I understand that the school's participation in this research is voluntary.
- I agree to support and facilitate the research process within the school and in providing initial PIS to potential participants (students, teachers and carers)
- I understand that students are free to withdraw from participating in the research project upon the day, however are unable to withdraw any questionnaire data once submitted as these are untraceable to individuals. I am free to withdraw the school's participation including the withdrawal of any data traceable to the school up until four weeks after the completion of the research activities.
- I understand that if I do decide that the school withdraws participation from this study, I will not have to provide a reason.
- I understand that the teachers 'and students' decision to participate or not in this research should not affect their employment/learning/enrolment status or relationship (whichever is appropriate) to the school in any way.
- I understand that my name and the names of participants will not be used in the research report.
- I understand that only the student's questionnaires, gameplay recordings, information provided in the focus group discussion and researchers' field notes will be taken away.
- I understand that this Consent Form will be securely stored separately from other research data for 6 years beyond the completion of the research, when both will be destroyed.
- I understand that the data gathered from the focus group discussion, gameplay recordings and questionnaires within the school will be used for writing a PhD thesis, academic publications, conference presentations and shared with other stakeholders involved in the research process.
- Please indicate by circling YES or NO if you wish to have your institution identified in any reports: YES/NO
- Please indicate by circling YES or NO whether you would like to receive a summary of the findings: YES/NO

Principals signature...
Email...
Date..

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 03-Oct-2016 for (3) years, Reference Number 017988/

Appendix G

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

PARTICIPANT INFORMATION SHEET: School Principal

Project title: Stop Disasters 2.0: Exploring Video Games as a Tool to Foster Participation in Learning about Disaster.

Name of researcher: Anthony Viennaminovich Gampell

Supervisors: JC Gaillard, Meg Parsons and Karen Fisher.

Researcher introduction: Anthony Gampell is a PhD candidate specialising in disaster video game research in the School of Environment, The University of Auckland. The research is being conducted under the supervision of Associate Professor J. C Gaillard and co-supervision of Lecturer Meg Parsons and Senior Lecturer Karen Fisher. The project is supported by the Earthquake Commission (EQC) and Auckland Civil Defence. The project is also being partially funded through an EQC scholarship.

Project description and invitation: Your school is invited to participate in this research project, which will investigate disaster based video games, both serious and mainstream, in an attempt to discover whether such games have the potential to build disaster and Disaster Risk Reduction (DRR) knowledge in players, and if yes (or no), why and how.

The proposed research aims to investigate five main objectives:

1. To expand upon the disaster typology of disaster video games and conduct a desk analysis of discourses on disasters featured by these games.
2. To understand why and how disaster video games are developed for DRR.
3. To test and assess the impacts of existing disaster based video games with a targeted audience.
4. To carry out an analysis of disaster video games in collaboration with a targeted audience.
5. To understand how video games may be used as learning tools, especially in terms of disaster research.

This research will involve the students of your school participating in the following research activities:-

- The completion of a pre and post-game questionnaire.
- Playing an appropriate disaster based video game selected from the disaster video game typology.
- Focus group discussion.

It is anticipated that the research study will take approximately two hours in total to complete. I seek your permission to conduct the project in your school and to complete the research on school property during school hours. I also seek your assurance that the teachers' and students' decision to participate or not in this research will not affect their employment/learning/enrolment status or relationship (whichever is appropriate) to the school in any way. Snacks will be provided for the participants in the research, any possible concerns with this aspect can be discussed ahead of the research.

Project procedures: If you consent to participate, you will be requested to support and facilitate the research process. The school's participation is voluntary. The consent of parents and students will be sought before conducting research with the students. Copies of the PIS and CF will be provided to teachers, parents and students to enable them to learn more about the research and what their participation involves. The PIS and CF sent home to the parents/ caregivers and needs to be returned to the school before the research takes place. Parents cannot give consent for their children to participate but can give their child consent to be invited into the research. Those students under 16 years of age need to complete the Assent form while those 16 and above can give their consent.

The research will involve identifying and working with a group of students to trial disaster related video games. The students will be asked to complete a pre-questionnaire, to play a game, complete a post-questionnaire and participate in a focus group discussion. Students may choose to withdraw their participation from any of these activities when I am at the school; however, they will not be able to withdraw any submitted questionnaire answers after submission as they are untraceable to individuals. The teacher(s) supervising the project would ideally be someone familiar with the student participants that will be involved. The teacher(s) working with students will receive the relevant participation information sheet (PIS), as will student participants.

I would travel to your school and conduct the research activities at a time and place nominated by the teacher(s), and that is appropriate for the participants and approved by you.

I will assure the students and teacher(s) that data collected will be known only to me, my supervisor and co-supervisor. The data collected will be used for the purposes of a PhD thesis, academic publications, conference presentations and shared with other stakeholders involved in the research process.

Data storage / retention / destruction / future use: Questionnaire information will be entered into an Excel spreadsheet and will be stored by the researcher in password protected folders on his laptop and external storage devices. Hard copies will be stored in a locked cabinet. Data will be held for 6 years (this is the usual procedure at The University of Auckland) before it is destroyed. Digital data will be deleted and hard copies will be shredded. A summary of findings will be made available upon the completion of the research project. Please indicate where appropriate upon the CF to receive a copy of this summary.

Right to withdraw from participation: As the school principal you may withdraw the school's participation and any data traceable to your school up until four weeks after the research activities. Participants may decline to participate on the day; however, they will be unable to withdraw any questionnaire data once submitted as these are untraceable to individuals. Participants are unable to withdraw any information provided in the focus group discussion as it is a collaboration of student's ideas.

Anonymity and confidentiality: The focus group discussion can compromise confidentiality and prevent anonymity. Students will be warned of this in their consent form (CF) and encouraged to keep the information shared in the activity confidential. Gameplay recordings will only record on-screen actions and does not identify participants. Reports and publications will be done in a way that does not identify the participants. As principal of the school you may choose to having your school identified in reports and publication, or can choose to not have your school identified. However, please note that even if you do not wish to have your institution identified, there is still the possibility of identification. Only the questionnaires, gameplay recordings, information provided by the focus group discussion and researchers' field notes will be taken away. Participants will be made aware of this prior to their participation using Participant Information Sheet, Consent Form and orally.

For any inquiries and further information please use the contacts details below:-

Researcher: Mr Anthony Gampell, School of Environment, a.gampell@auckland.ac.nz
Supervisor: Associate Professor JC Gaillard, School of Environment, jc.gaillard@auckland.ac.nz, Ph. (09) 923 9679
Co-Supervisor: Lecturer Meg Parsons, School of Environment, meg.parsons@auckland.ac.nz, Ph. (09) 923 9263
Co-Supervisor: Senior Lecturer Karen Fisher, School of Environment, k.fisher@auckland.ac.nz, Ph. (09) 923 8410
Head of School: Professor Paul Kench, School of Environment, Science Centre, Building 302, 23 Symonds Street, Auckland 1142, New Zealand, p.kench@auckland.ac.nz, Ph. (09) 923 8440 ext 85331

For any queries regarding ethical concerns you may contact The University of Auckland Human Participants Ethics Committee, The University of Auckland, Office of the Vice Chancellor, Private Bag 92019, Auckland 1142, Telephone +64 (0) 9 373-7599 extn. 83711. Email: ro-ethics@auckland.ac.nz

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 03-Oct-2016 for (3) years, Reference Number 017988/

Appendix H

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

ASSENT FORM
(Student Under 16 Years)

THIS FORM WILL BE HELD FOR A PERIOD OF 6 YEARS

Project title: Stop Disasters 2.0: Exploring Video Games as a Tool to Foster Participation in Learning about Disaster

Name of Researcher: Anthony Viennaminovich Gampell

Name of Supervisors: JC Gaillard, Meg Parsons and Karen Fisher.

I have read the Participant Information Sheet, or the information has been read and explained to me; I have understood the nature of the research and why I have been selected.

- I understand it is my choice to take part in this study.
- I agree to answer questionnaires, playing a video game, having my gameplay recorded and a focus group discussion with our teacher present.
- I understand I do not have to take part in any of the activities.
- I understand I can leave the study at any time, but any questionnaire answers I give cannot be removed.
- I understand I cannot remove any information I give in the focus group discussion.
- I understand that the focus group discussion can risk my identity. I have been asked to not tell people outside of the study about the information given.
- I understand that the principal accepts that if I take part in the research, it will not affect my learning or relationship with the school.
- I understand that only my questionnaire answers, gameplay recordings, information provided in the focus group discussion and researchers' field notes will be taken away.
- I understand that all the information will be kept securely for 6 years, after which they will be destroyed.
- I understand that my name will not be used in any reports/presentation.
- I know who I can speak to if I am worried, concerned or would like to ask questions about this research (contact details are on the Participant Information Sheet).

Name of student

Signature of student

Date:

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 03-Oct-2016 for (3) years, Reference Number 017988/

Appendix I

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

PARTICIPANT INFORMATION SHEET: Student (Under 16 Years Old)

Project title: Stop Disasters 2.0: Exploring Video Games as Tools to Foster Participation in Learning about Disaster.

Name of researcher: Anthony Viennaminovich Gampell.

Supervisors: JC Gaillard and Meg Parsons.

Researcher introduction: My name is Anthony and I research disaster video games at the University of Auckland as a PhD student.

Invitation:

I would like to invite you to take part in my research, looking at how playing disaster video games could help you learn about disasters. You have been invited to take part because you go to (insert school name here).

The principal has said the school will support your choice about taking part in the research or not.

Your parents or caregiver has agreed you can take part, but you must decide if you would like to take part. Please read the consent form attached and choose Yes or No.

Where will the study take place?

The study will take place at your school (insert school name).

What will I be doing?

If you accept, you will be part of the following activities:

- The completion of a pre and post-game questionnaire
- Playing a disaster video game.
- Group discussion after the game.

I will travel to your school and agree with the principal and teacher on a time to hold the activities.

Privacy?

The data provided in questionnaires, gameplay recordings and group activity information will be known only to myself, my supervisors. Gameplay recordings will only record what's on the screen and will not record you. I will run an activity in your class that will ask you to share your ideas about the video game. The information will be used to write my PhD thesis and other work related to my PhD.

Study duration?

1) The pre and post-game questionnaires should take a maximum of 10 minutes each to complete, 20 minutes in total.
2) The video game should take a maximum of 25 minutes to complete.
3) The group discussion should take approximately 45 minutes to complete.

What happens to the information I give?

I will keep all information safe. Digital data will be password protected and saved on my computer and external hard drives. Hard copies will be stored in a locked cabinet. Data will be held for 6 years before it is destroyed. Digital data will be deleted and hard copies will be shredded.

Your name will not be used in any report as this information is not collected.

Your rights and choices:

It is your right and choice to take part voluntarily in this research. It is your choice to refuse to take part. You can stop being a part of the research at any time but any information given cannot be removed as the data is untraceable to individuals. The group discussion information cannot be removed because everyone is sharing ideas.

Where do I get help if I get upset, concerned, worried or require counselling?

You can use the onsite counselling services provided by your school if available or contact the Family Services 211 Helpline (0800 211 211) to find an appropriate counselling service in your area.

Who is doing this research?

Researcher: Mr Anthony Gampell, School of Environment, a.gampell@auckland.ac.nz
Supervisor: Associate Professor J C Gaillard, School of Environment, jc.gaillard@auckland.ac.nz, Ph. (09) 923 9679
Co-Supervisor: Lecturer Meg Parsons, School of Environment, meg.parsons@auckland.ac.nz, Ph. (09) 923 9263
Head of School: Professor Paul Kench, School of Environment, Science Centre, Building 302, 23 Symonds Street, Auckland 1142, New Zealand, p.kench@auckland.ac.nz, Ph. (09) 923 8440 ext 85331

For any queries regarding ethical concerns you may contact The University of Auckland Human Participants Ethics Committee, The University of Auckland, Office of the Vice Chancellor, Private Bag 92019, Auckland 1142, Telephone +64 (0) 9 373-7599 extn. 83711. Email: ro-ethics@auckland.ac.nz

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 03-Oct-2016 for (3) years, Reference Number 017988/

Appendix J

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

CONSENT FORM
(Student Between 14 and 16 Years)

THIS FORM WILL BE HELD FOR A PERIOD OF 6 YEARS

Project title: Stop Disasters 2.0: Exploring Video Games as a Tool to Foster Participation in Learning about Disaster.

Name of Researcher: Anthony Viennaminovich Gampell.

I have read the Participant Information Sheet, or the information has been read and explained to me; I have understood the nature of the research and why I have been selected.

- I understand it is my choice to take part in this study.
- I agree to take part in answering questionnaires, playing a video game, having my gameplay recorded and a focus group discussion while being supported by our teacher.
- I understand that it is my choice to refuse to participate in the discussion or answering of questionnaires.
- I understand I may choose not to be part of the study at any time but cannot withdraw any questionnaire answers submitted as these are untraceable to individuals.
- I understand due to the nature of the focus group discussion I will not be able to withdraw any information I may contribute.
- I understand that the focus group discussion can compromise confidentiality and prevent anonymity. To lessen the risk, I have been asked to keep all information from the study confidential.
- I understand that the principal accepts that if I take part in the research, it will not affect my learning, enrolment or relationship with the school.
- I understand that only my questionnaire answers, gameplay recordings, information provided in the focus group discussion and researchers' field notes will be taken away.
- I understand that research information will be kept securely for 6 years, after which they will be destroyed.
- I understand that my name will not be used in any reports/presentation
- I know who I can speak to if I am worried, concerned or would like to ask questions about this research (contact details are on the Participant Information Sheet).
- I understand that the data gathered from the focus group discussion will be used for a PhD thesis, academic publications, conference presentations and shared with other stakeholders involved in the research process.

Name of student

Signature of student

Date:

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 03-Oct-2016 for (3) years, Reference Number 017988/

Appendix K

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

PARTICIPANT INFORMATION SHEET: Student (Under 16 Years Old)

Project title: Stop Disasters 2.0: Exploring Video Games as Tools to Foster Participation in Learning about Disaster.

Name of researcher: Anthony Viennaminovich Gampell.

Supervisors: JC Gaillard, Meg Parsons and Karen Fisher.

Researcher introduction: My name is Anthony and I research disaster video games at the University of Auckland as a PhD student. This research project is being partially paid for by the Earthquake Commission (EQC).

Invitation:

I would like to invite you to take part in my research, looking at how playing disaster video games could help you learn about disasters. You have been invited to take part because you go to (insert school name here).

The principal has said the school will support your choice about taking part in the research or not.

Your parents or caregiver has agreed you can take part, but you must decide if you would like to take part. Please read the consent form attached and choose Yes or No.

Where will the study take place?

The study will take place at your school (insert school name).

What will I be doing?

If you accept**,** you will be part of the following activities:

- The completion of a pre and post-game questionnaire
- Playing a disaster video game.
- Group discussion after the game.

I will travel to your school and agree with the principal and teacher on a time to hold the activities.

Privacy?

The data provided in questionnaires, gameplay recordings and group activity information will be known only to myself, my supervisors. Gameplay recordings will only record what's on the screen and will not record you. I will run an activity in your class that will ask you to share your ideas about the video game. The information will be used to write my PhD thesis and other work related to my PhD.

Study duration?

1) The pre and post-game questionnaires should take a maximum of 10 minutes each to complete, 20 minutes in total.
2) The video game should take a maximum of 25 minutes to complete.
3) The group discussion should take approximately 45 minutes to complete.

What happens to the information I give?

I will keep all information safe. Digital data will be password protected and saved on my computer and external hard drives. Hard copies will be stored in a locked cabinet. Data will be held for 6 years before it is destroyed. Digital data will be deleted and hard copies will be shredded.

Your name will not be used in any report as this information is not collected.

Your rights and choices:

It is your right and choice to take part voluntarily in this research. It is your choice to refuse to take part. You can stop being a part of the research at any time but any information given cannot be removed as the data is untraceable to individuals. The group discussion information cannot be removed because everyone is sharing ideas.

Where do I get help if I get upset, concerned, worried or require counselling?

You can use the onsite counselling services provided by your school if available or contact the Family Services 211 Helpline (0800 211 211) to find an appropriate counselling service in your area.

Who is doing this research?

Researcher: Mr Anthony Gampell, School of Environment, a.gampell@auckland.ac.nz
Supervisor: Associate Professor J C Gaillard, School of Environment, jc.gaillard@auckland.ac.nz, Ph. (09) 923 9679*Co-Co-Supervisor*: Lecturer Meg Parsons, School of Environment, meg.parsons@auckland.ac.nz, Ph. (09) 923 9263
Co-Supervisor: Senior Lecturer Karen Fisher, School of Environment, k.fisher@auckland.ac.nz, Ph. (09) 923 8410
Head of School: Professor Paul Kench, School of Environment, Science Centre, Building 302, 23 Symonds Street, Auckland 1142, New Zealand, p.kench@auckland.ac.nz, Ph. (09) 923 8440 ext 85331

For any queries regarding ethical concerns you may contact The University of Auckland Human Participants Ethics Committee, The University of Auckland, Office of the Vice Chancellor, Private Bag 92019, Auckland 1142, Telephone +64 (0) 9 373-7599 extn. 83711. Email: ro-ethics@auckland.ac.nz

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 03-Oct-2016 for (3) years, Reference Number 017988/

Appendix L

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

CONSENT FORM
(Student Over 16 Years)

THIS FORM WILL BE HELD FOR A PERIOD OF 6 YEARS

Project title: Stop Disasters 2.0: Exploring Video Games as a Tool to Foster Participation in Learning about Disaster.

Name of Researcher: Anthony Viennaminovich Gampell.

I have read the Participant Information Sheet, or the information has been read and explained to me; I have understood the nature of the research and why I have been selected.

- I understand it is my choice to take part in this study.
- I agree to take part in answering questionnaires, playing a video game, having my gameplay recorded and a focus group discussion while being supported by our teacher.
- I understand that it is my choice to refuse to participate in the discussion or answering of questionnaires.
- I understand I may choose not to be part of the study at any time but cannot withdraw any questionnaire answers submitted as these are untraceable to individuals.
- I understand due to the nature of the focus group discussion I will not be able to withdraw any information I may contribute.
- I understand that the focus group discussion can compromise confidentiality and prevent anonymity. To lessen the risk, I have been asked to keep all information from the study confidential.
- I understand that the principal accepts that if I take part in the research, it will not affect my learning, enrolment or relationship with the school.
- I understand that only my questionnaire answers, gameplay recordings, information provided in the focus group discussion and researchers' field notes will be taken away.
- I understand that research information will be kept securely for 6 years, after which they will be destroyed.
- I understand that my name will not be used in any reports/presentation.
- I know who I can speak to if I am worried, concerned or would like to ask questions about this research (contact details are on the Participant Information Sheet).
- I understand that the data gathered from the focus group discussion will be used for a PhD thesis, academic publications, conference presentations and shared with other stakeholders involved in the research process.

Name of student

Signature of student

Date:

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 03-Oct-2016 for (3) years, Reference Number 017988/

Appendix M

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

PARTICIPANT INFORMATION SHEET: Student (16 Years and Above)

Project title: Stop Disasters 2.0: Exploring Video Games as Tools to Foster Participation in Learning about Disaster.

Name of researcher: Anthony Viennaminovich Gampell.

Supervisors: JC Gaillard, Meg Parsons and Karen Fisher.

Researcher introduction: Anthony Gampell is a PhD candidate specialising in disaster video game research in the School of Environment, The University of Auckland. The project is being partially funded by the Earthquake Commission (EQC).

Invitation:

You are invited to participate in this research project, which will investigate disaster based video games, both serious and mainstream, in an attempt to discover whether such games have the potential to build disaster and Disaster Risk Reduction (DRR) knowledge in players, and if yes (or no), why and how. You have been invited to participate in this research because you are a student of (insert school name).

The principal gives their assurance that whether or not you participate will have no affect on your grades or your relationship with the school.

It is your choice to take part. Please read the consent form attached and choose Yes or No

Where will the study take place?

The study will take place at your school (insert school name).

What would be involved (activities)?

If you accept, you will participate in the following activities:

- The completion of a pre and post-game questionnaire.
- Playing an appropriate disaster based video game.
- Focus group discussion.

I will travel to your school and agree with the principal and teacher on a time when it is appropriate for this study to be carried out with minimal disruption to your timetables.

Privacy?

I want to assure you that the data provided in questionnaires, gameplay recordings and focus group discussion information will be known only to myself, my supervisor and co-supervisor. Gameplay recordings will only record on-screen actions and does not identify participants. The focus group discussion will involve, as a classroom collective, recording ideas upon flipcharts about different themes of the video games trialed and discussing the ideas presented. The information collected will be used for writing my PhD thesis, academic publications, conference presentations and shared with other stakeholders involved in the research process.

Study duration?

1) The pre and post-game questionnaires should take a maximum of 10 minutes each to complete, 20 minutes in total.
2) The video game should take a maximum of 25 minutes to complete.
3) The focus group discussion should take approximately 45 minutes to complete.

What happens to the information I give?

All information will be kept safely by the researcher. Digital data will be password protected and saved on the student researcher's computer and external hard drives. Hard copies will be stored in a locked cabinet. Data will be held for 6 years (this is the usual procedure at The University of Auckland) before it is destroyed. Digital data will be deleted and hard copies will be shredded.

Your name will not be used in any report as this information is not collected. Instead, the research will be reported in in a way that does not identify the names of those who gave the information.

Your rights and choices:

It is your right and choice to take part voluntarily in this research. It is your choice to refuse to participate in the research. You may choose to withdraw from the study at any time; however, any questionnaire information submitted will be unable to be withdrawn as these are untraceable to individuals. The focus group discussion information you give will not be able to be withdrawn as it is a collaboration of participant ideas.

Where do I get help if I get upset, concerned, worried or require counselling?

You can use the onsite counselling services provided by your school if available or contact the Family Services 211 Helpline (0800 211 211) to find an appropriate counselling service in your area.

Who is doing this research?

Researcher: Mr Anthony Gampell, School of Environment, a.gampell@auckland.ac.nz
Supervisor: Associate Professor J C Gaillard, School of Environment, jc.gaillard@auckland.ac.nz, Ph. (09) 923 9679
Co-Supervisor: Lecturer Meg Parsons, School of Environment, meg.parsons@auckland.ac.nz, Ph. (09) 923 9263
Head of School: Professor Paul Kench, School of Environment, Science Centre, Building 302, 23 Symonds Street, Auckland 1142, New Zealand, p.kench@auckland.ac.nz, Ph. (09) 923 8440 ext 85331

For any queries regarding ethical concerns you may contact The University of Auckland Human Participants Ethics Committee, The University of Auckland, Office of the Vice Chancellor, Private Bag 92019, Auckland 1142, Telephone +64 (0) 9 373-7599 extn. 83711. Email: ro-ethics@auckland.ac.nz

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 03-Oct-2016 for (3) years, Reference Number 017988/

Appendix N

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

CONSENT FORM
(Teacher)

THIS FORM WILL BE HELD FOR A PERIOD OF 6 YEARS

Project title: Stop Disasters 2.0: Exploring Video Games as a Tool to Foster Participation in Learning about Disaster.

Name of Researcher: Anthony Viennaminovich Gampell.

I have read the Participant Information Sheet; have understood the nature of the research and why I have been selected. I have had the opportunity to ask questions and have had them answered to my satisfaction.

- I agree to take part in this research.
- I understand that my participation in the research is voluntary.
- I understand that I will be required to be present and provide support to the student participants during the research (answering the questionnaires, playing the video game and during the focus group discussion).
- I understand that the Principal has given assurance that my decision to participate, or not, in the research will not affect my employment status or relationship with the school.
- I understand that no identifiable information from the focus group discussion will be reported back to the Principal.
- I understand that this Consent Form will be securely stored separately from the research data for 6 years beyond the completion of the research, when both will be destroyed.
- I understand that the student researcher and his supervisor will make every effort to ensure personal information about the participants, including who participates, remains confidential.
- I understand that only the student's questionnaires, gameplay recordings, information provided in the focus group discussion and researchers' field notes will be taken away.
- I understand that my name will not be used in any written documents or oral presentation; however, I understand that I may become identifiable due to the information I provide.
- I understand that the data gathered from the focus group discussion will be used for a PhD thesis, academic publications, conference presentations and shared with other stakeholders involved in the research process.
- Please indicate by circling YES or NO if you wish to have your institution identified in any reports: YES/NO
- Please indicate by circling YES or NO whether you would like to receive a summary of the findings: YES/NO

Name: ……………………………………………………………………………………………………

Signature: …………………………………………………………………

Email: ………………………………………………………………………………

Date: ………………………………………………………

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 03-Oct-2016 for (3) years, Reference Number 017988/

Appendix O

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

PARTICIPANT INFORMATION SHEET: Teacher (Supervising)

Project title: Stop Disasters 2.0: Exploring Video Games as a Tool to Foster Participation in Learning about Disaster.

Name of researcher: Anthony Viennaminovich Gampell.

Supervisors: JC Gaillard, Meg Parsons and Karen Fisher.

Researcher introduction: Anthony Gampell is a PhD candidate specialising in disaster video game research in the School of Environment, The University of Auckland. The research is being conducted under the supervision of Associate Professor J. C Gaillard and co-supervision of Lecturer Meg Parsons and Senior Lecturer Karen Fisher. The project is supported by the Earthquake Commission (EQC) and Auckland Civil Defence. The project is also being partially funded through an EQC scholarship.

Project description and invitation: You are invited to participate in this research project, which will investigate disaster based video games, both serious and mainstream, in an attempt to discover whether such games have the potential to build disaster and Disaster Risk Reduction (DRR) knowledge in players, and if yes (or no), why and how.

The proposed research aims to investigate five main objectives:

1. To expand upon the disaster typology of disaster video games and conduct a desk analysis of discourses on disasters featured by these games.
2. To understand why and how disaster video games are developed for DRR.
3. To test and assess the impacts of existing disaster based video games with a targeted audience.
4. To carry out an analysis of disaster video games in collaboration with a targeted audience.
5. To understand how video games may be used as learning tools, especially in terms of disaster research.

This research will involve the students of your school participating in the following research activities:-

- The completion of a pre and post-game questionnaire.
- Playing an appropriate disaster based video game selected from the disaster video game typology.
- Focus group discussion.

Additionally, the research project invites you to participate in the following research activities:-

- Semi-structured interview relating to the usage of video games in the class room. If you agree to participate a separate participant information sheet will be provided.

It is anticipated that the study will take approximately two hours to complete in total. You have been invited to participate in this research as you are a teacher at (insert school name here). The principal gives their assurance that the teachers' and students' decision to participate or not in this research will not affect their employment/learning/enrolment status or relationship (whichever is appropriate) to the school in any way. Before conducting the research, I must first obtain your agreement to be present and to support the student participants undertaking the video game trials and focus group discussions. Snacks will be provided for the participants in the research, any possible concerns with this aspect can be discussed.

Project procedures: If you consent, you will be present and provide support to the students while they carry out their video game trials and focus group discussions. Your participation is voluntary. I would travel to the school and conduct the study at a time and place nominated by you, appropriate for the students and approved by the school principal.

I want to assure you that any data collected from the study will be known only to me, my supervisor and co-supervisor. The data collected will be used for the purposes of writing my PhD thesis, academic publications, conference presentations and shared with other stakeholders involved in the research process.

Right to withdraw from participation: You may decline to be involved in the research project at any time. Participants are unable to withdraw their questionnaires information once submitted as these are untraceable to individuals. Due to the nature of the focus group discussion, participants will be unable to withdraw this information.

Anonymity and confidentiality: Individuals will not be identified by name in reports and publications arising from this project. Instead, information will be reported in a way to reduce the risk of identification; however, it is possible that participants may become identifiable because of the information they provide. Only the questionnaires, gameplay recordings, information provided by the focus group discussion and researchers' field notes will be taken away. Gameplay recordings will only record on-screen actions and does not identify participants.

Where can the students get help if they get upset, concerned, worried or require counselling: If any students were to get distressed during the research study and wanted to discuss this with someone, they could contact the onsite counselling services of the school if available or contact the Family Services 211 Helpline (0800 211 211) to find an appropriate counselling service in the area.

For any inquiries and further information please use the contacts details below:-

Researcher: Mr Anthony Gampell, School of Environment, a.gampell@auckland.ac.nz
Supervisor: Associate Professor J C Gaillard, School of Environment, jc.gaillard@auckland.ac.nz, Ph. (09) 923 9679
Co-Supervisor: Lecturer Meg Parsons, School of Environment, meg.parsons@auckland.ac.nz, Ph. (09) 923 9263
Co-Supervisor: Senior Lecturer Karen Fisher, School of Environment, k.fisher@auckland.ac.nz, Ph. (09) 923 8410
Head of School: Professor Paul Kench, School of Environment, Science Centre, Building 302, 23 Symonds Street, Auckland 1142, New Zealand, p.kench@auckland.ac.nz, Ph. (09) 923 8440 ext 85331

For any queries regarding ethical concerns you may contact The University of Auckland Human Participants Ethics Committee, The University of Auckland, Office of the Vice Chancellor, Private Bag 92019, Auckland 1142, Telephone +64 (0) 9 373-7599 extn. 83711. Email: ro-ethics@auckland.ac.nz

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 03-Oct-2016 for (3) years, Reference Number 017988/

Appendix P

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

CONSENT FORM
(Teacher semi-structured interview)
THIS FORM WILL BE HELD FOR A PERIOD OF 6 YEARS

Project title: Stop Disasters 2.0: Exploring Video Games as a Tool to Foster Participation in Learning about Disaster.

Name of Researcher: Anthony Viennaminovich Gampell.

I have read the Participant Information Sheet; have understood the nature of the research and why I have been selected. I have had the opportunity to ask questions and have had them answered to my satisfaction.

- I agree to take part in this research.
- I understand my participation is voluntary.
- I agree to participate in a semi-structured interview, and understand it will take approximately 30 to 60 minutes.
- I understand that depending upon the nature of my interview the potential for recording will be different. If my interview is through email, I will have a written recording. For in-person interviews I will get an audio recording.
- I understand that I may withdraw the information I provided in the interview up until four weeks after the interview.
- I understand that the Principal has given assurance that my decision to participate, or not, in the research will not affect my employment status or relationship with the school.
- I understand that this Consent Form will be securely stored separately from the research data for 6 years beyond the completion of the research, when both will be destroyed.
- I understand that the student researcher and his supervisor will make every effort to ensure personal information about the participants, including who participates, remains confidential.
- I understand that my name will not be used in any written documents or oral presentation; however, I understand that I may become identifiable due to the information I provide.
- I understand that the data gathered from semi-structured interviews will be used for a PhD thesis, academic publications, conference presentations and shared with other stakeholders involved in the research process.
- I understand I can request a copy of the transcript for editing with a editing duration of two weeks.
- Please indicate by circling YES or NO if you wish to have your institution identified in any reports: YES/NO
- Please indicate by circling YES or NO whether you would like to receive a summary of the findings: YES/NO

Name:

Signature:

Date:

Email:

First name pseudonym..

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 03-Oct-2016 for (3) years, Reference Number 017988/

Appendix Q

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SCIENCE
SCHOOL OF ENVIRONMENT

Science Centre, Building 302
23 Symonds Street, Auckland,
New Zealand
The University of Auckland
Private Bag 92019
Auckland 1142
New Zealand

PARTICIPANT INFORMATION SHEET: Teacher (Semi structured Interview)

Project title: Stop Disasters 2.0: Exploring Video Games as a Tool to Foster Participation in Learning about Disaster.

Name of researcher: Anthony Viennaminovich Gampell.

Supervisors: JC Gaillard, Meg Parsons and Karen Fisher.

Researcher introduction: Anthony Gampell is a PhD candidate specialising in disaster video game research in the School of Environment, The University of Auckland. The research is being conducted under the supervision of Associate Professor J. C Gaillard and co-supervision of Lecturer Meg Parsons and Senior Lecturer Karen Fisher. The project is supported by the Earthquake Commission (EQC) and Auckland Civil Defence. The project is also being partially funded through an EQC scholarship.

Project description and invitation: You are invited to participate in this research project, which will investigate disaster based video games, both serious and mainstream, in an attempt to discover whether such games have the potential to build disaster and Disaster Risk Reduction (DRR) knowledge in players, and if yes (or no), why and how.

The proposed research aims to investigate five main objectives:

1. To expand upon the disaster typology of disaster video games and conduct a desk analysis of discourses on disasters featured by these games.
2. To understand why and how disaster video games are developed for DRR.
3. To test and assess the impacts of existing disaster based video games with a targeted audience.
4. To carry out an analysis of disaster video games in collaboration with a targeted audience.
5. To understand how video games may be used as learning tools, especially in terms of disaster research.

This research will involve you participating in a semi structured interview. It is anticipated that the interviews will take approximately 30 to 60 minutes. The principal gives their assurance that the teachers' and students' decision to participate or not in this research will not affect their employment/learning/enrolment status or relationship (whichever is appropriate) to the school in any way. You have been invited to participate in this research so you can share your opinions on video games in the classroom and their use as educational tools.

Project procedures: If you consent, you will participate in a semi-structured interview (30-60 minutes) about your understanding/ involvement surrounding disaster video games. Your participation is voluntary. You may choose the most appropriate method to conduct the interview from a selection of either in-person, via email or Skype. You may also choose the time and location that is convenient for you.

I want to assure you that any information given in the interview, or emails will be known only to me, my supervisor and co-supervisor. The information collected will be used for the purposes of writing my PhD thesis, academic publications, conference presentations and shared with other stakeholders involved in the research process.

In the case where semi-structured interviews are recorded, either in written (email) or audio format (in-person interviews/ Skype), an opportunity will be available for editing the interview transcript. Please indicate upon the CF if you wish to receive a copy of the transcript for editing. If you wish to edit the transcript of the interview, you will have two weeks from the date you receive the transcript to edit and return the modifications to the research team.

Data storage / retention / destruction / future use: All data will be stored separately from consent forms by the researcher in password protected folders on his laptop and external storage devices. Hard copies will be stored in a locked cabinet. Data will be held for 6 years (this is the usual procedure at The University of Auckland) before it is destroyed. Digital data will be deleted and hard copies will be shredded. A summary of findings will be made available upon the completion of the research project. Please indicate where appropriate upon the CF to receive a copy of this summary.

Right to withdraw from participation: You may decline to be interviewed and/or stop the interview at any time. Participants may withdraw from participation without providing a reason and may withdraw their data from the research up until 4 weeks after the interview.

Anonymity and confidentiality: Individuals will not be identified by name in reports and publications arising from this project. Instead, information will be reported in a way to reduce the risk of identification; however, it is possible that participants may become identifiable because of the information they provide.

Where can I get help if I get upset, concerned, worried or require counselling:

Contact the Family Services 211 Helpline (0800 211 211) to find an appropriate counselling service in your area.

For any inquiries and further information please use the contacts details below:

Researcher: Mr Anthony Gampell, School of Environment, a.gampell@auckland.ac.nz

Supervisor: Associate Professor J C Gaillard, School of Environment, jc.gaillard@auckland.ac.nz, Ph. (09) 923 9679

Co-Supervisor: Lecturer Meg Parsons, School of Environment, meg.parsons@auckland.ac.nz, Ph. (09) 923 9263

Co-Supervisor: Senior Lecturer Karen Fisher, School of Environment, k.fisher@auckland.ac.nz, Ph. (09) 923 8410

Head of School: Professor Paul Kench, School of Environment, Science Centre, Building 302, 23 Symonds Street, Auckland 1142, New Zealand, p.kench@auckland.ac.nz, Ph. (09) 923 8440 ext 85331

For any queries regarding ethical concerns you may contact The University of Auckland Human Participants Ethics Committee, The University of Auckland, Office of the Vice Chancellor, Private Bag 92019, Auckland 1142, Telephone +64 (0) 9 373-7599 extn. 83711. Email: ro-ethics@auckland.ac.nz

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 03-Oct-2016 for (3) years, Reference Number 017988/

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[15] The University of Auckland has transitioned from APA 6th to APA 7th. A key change between editions means the place of publication is no longer required.

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