Virtual worlds in pre-service teacher education: the introduction of virtual worlds in pre-service teacher education to foster innovative teaching-learning processes

Lisa Jacka
Southern Cross University
Virtual worlds in pre-service teacher education

The introduction of virtual worlds in pre-service teacher education to foster innovative teaching-learning processes

Lisa Jacka
BA(VisArts)(UniSA), BA(Hons)(SCU), GradDipEd(Monash)

Thesis submitted to fulfil the requirements of Doctor of Philosophy
Southern Cross University

2015
Declaration

I certify that the work presented in this thesis is, to the best of my knowledge and belief, original, except as acknowledged in the text, and that the material has not been submitted, either in whole or in part, for a degree at this or any other university.

I acknowledge that I have read and understood the University's rules, requirements, procedures and policy relating to my higher degree research award and to my thesis. I certify that I have complied with the rules, requirements, procedures and policy of the University.

Print Name: ……………………………

Signature:……………………………

Date:…………………………………
Abstract

Pre-service teacher education has an important role to play in the introduction, development and support of innovative educational technology in the K-12 classroom. Pre-service teachers need to be provided with the opportunity to explore and critique innovative educational technology in order to be equipped for the continually evolving classroom of the future. Technology such as virtual worlds has the capacity to provide a platform upon which new forms of teaching and learning can be explored. To date, few pre-service teacher education programs have integrated virtual worlds into their courses. Therefore, an opportunity exists for research to be undertaken that results in strategies to support pro-active and systematic models for the introduction, development and support of virtual worlds in pre-service teacher education.

Between 2010 and 2014 the virtual worlds Second Life and Sim-on-a-Stick were introduced to six pre-service teacher educators and over 1500 students in the School of Education at Southern Cross University. A participatory action research methodology was employed in which the perceptions, experiences, motivations and barriers of the pre-service teacher educators and students were documented via surveys, interviews and observation over three macro-cycles and eleven micro-cycles. The aim of this research was to identify factors that influence the level of readiness of pre-service teacher educators and students to introduce, develop and support innovative teaching-learning processes using VWs. Three main questions provided the basis for the research: how do pre-service teacher educators and students respond to the introduction, development and support of VWs as part of their programs; to what extent do their pre-existing experiences and perceptions, intrinsic and extrinsic motivations and barriers influence their engagement with VWs; and what level of readiness to implement innovative teaching-learning processes using VWs do the pre-service teacher educators and students describe and display?

The pre-service teacher educators and students responded to virtual worlds based on a complex interaction of their perceptions, experiences, motivations and barriers. These inter-related factors provided the basis for the development of a level of readiness model that serves as a tool for pre-service teacher educators to utilise in the integration of virtual worlds. Furthermore, a framework of implementation was developed recommending actions for the successful introduction, development and support of virtual worlds in higher education.
Acknowledgements

This research would not have been possible without the generosity and support of family, friends, colleagues and supervisors. Firstly, to my husband Matthew Hill, for providing care, motivation and perspective throughout, listening with enthusiasm, and proofreading. My children, Gabriella (11) and Cassandra (9), have inspired me to continue to work with pre-service teachers and teachers to encourage and support innovative educational practices. They remind me of the important role that pre-service teacher education plays to develop environments that are engaging and challenging for children. Gabriella and Cassandra have also researched virtual worlds as they played with and evaluated them in order to provide a child’s view of the value of these spaces. I would like to dedicate my thesis to my mother, Gillian Jacka, who passed away before I started this research but always encouraged me to learn all I could and not doubt the capabilities of anyone to tackle complex ideas at any age.

To my supervisors Sharon Parry, Renata Phelps and Allan Ellis. Sharon Parry worked with me for the first twelve months followed by Renata Phelps. Both of them provided me with their insight into educational research and assisted me in progressing my own level of knowledge and skills in research and writing. Allan Ellis deserves a special mention as the one who stuck with me as my supervisor and advocate for the use of virtual worlds in education. I was able to start using Second Life at SCU because Allan had already paved the way with SCU’s first island in Second Life. He encouraged me to be involved in the academic community of virtual worlds users through joining the Virtual Worlds Working Group (VWWG) and most importantly encouraged me to publish throughout this research. His insight provided me with the right amount of scaffolding to develop this research and writing skills.

The pre-service teacher educators and students in the School of Education at SCU provided financial, academic and research assistance as well as personal encouragement. Martin Hayden as Head of School supported the development of the SCU Education Research Island by allocating funds to rent an island in Second Life. A number of pre-service teacher educators participated through their direct involvement in this research and their willingness integrate virtual worlds in their units including - Brad Shipway, Jubilee Smith, Wendy Boyd, Marianne Logan, Deanna Leahy, Judith Wilks and Dave Ellis. The idea to use Second Life with my
students was first suggested by Alan Foster who while not directly involved in this research was always curious and supportive of my progress with virtual worlds. A special thanks to Sarah Craske who has been an advocate for my work in VWs and other technologies. She was always available as a friend and a colleague especially at times when it appeared that students were finding it all too hard.

Undertaking this research has focussed my vision of the future of education and I have developed a wonderful network of like-minded friends and colleagues. In particular the members of the VWWG have kept me focussed on the value of virtual worlds and encouraged me through advice, networking and co-authoring of publications. A special mention to Sue Gregory, Helen Farley, Scott Grant and Lindy Orwin who always managed to say the right thing at the right time. I also wish to acknowledge the work that is being done by outstanding educators across the world that inspire and support my own work.

I am grateful to all of the participants in this research but I wish to make special mention of Kate Booth. She started as one of the first students to try VWs at SCU and has become a valued friend, colleague and co-author. Her commitment to integrating technology in the K-6 classroom to support young learners continues to inspire me and reassure me of the justification of the work that I have undertaken.
Publications arising from this research

Journal Articles


Book Chapters


Note: A DVD of all of these publications has been included as Appendix E to allow the reader easy access to this literature. The opportunity to collaborate with a number of virtual world researchers and contribute to the growing body of research has been an invaluable part of the overall process of undertaking this PhD.
# Table of Contents

Abstract

Publications arising from this research

List of Figures

List of Tables

Editorial Notes

Chapter 1 Introduction

1.1 Education, Learning and Digital Technology in the 21st Century

1.2 Educational Change and Innovation

1.3 Critically Evaluating Educational Technology

1.4 Pre-service Teacher Education

1.5 Virtual Worlds

1.6 Aims of the Research

1.7 Background to the Research

1.8 My Position as a Researcher

1.9 Thesis Structure

Chapter 2 Educational Context

2.1 Change and Innovation

2.2 Diffusion and Adoption of Innovation

2.3 Educational Change and Innovation

2.4 21st Century Learners

2.5 Engagement

2.6 Learning Theories for a Digital Age

2.6.1 Conversational learning

2.6.2 Immersive learning

2.6.3 Situated learning

2.6.4 Connectivism

2.7 Pedagogy, Andragogy, Cybergogy

2.8 A New Culture of Learning

2.9 Research Need

Chapter 3 Technological Context

3.1 Introduction

3.2 The Effect of Technology on Teaching-Learning Processes

3.3 Barriers to Technology Integration and Innovation

3.4 Disruptive Innovations

3.5 Virtual Worlds

3.5.1 Defining virtual worlds

3.5.2 The evolution of virtual worlds

3.5.3 Affordances of virtual worlds

3.5.4 Virtual worlds in pre-service teacher education

3.5.5 Virtual worlds in K-12 schools

3.5.6 Barriers to the adoption of virtual worlds in education

3.6 The Research Potential

3.7 Conclusion

Chapter 4 Methodology

4.1 Research Aim and Questions

4.2 Paradigm Within Which the Research is Situated

4.3 Complexity as the Theoretical Grounding

4.4 Action Research as a Meta-Methodology
4.5 Complexity Theory and Action Research 83
4.6 Research Methods 87
  4.6.1 Sampling 87
  4.6.2 Data collection 88
  4.6.3 Analysis 90
4.7 The Macro-Cycles 93
  4.7.1 Cycle one 94
  4.7.2 Cycle two 95
  4.7.3 Cycle three 96
4.8 The Micro-Cycles 96
  4.8.1 Unit one 96
  4.8.2 Unit two 97
  4.8.3 Unit three 98
  4.8.4 Unit four 99
  4.8.5 Unit five 100
  4.8.6 Unit six 101
4.9 The Virtual World Research Site 102
4.10 Summary 106

Chapter 5 Pre-service Teacher Educators' Responses and Reflections 107
  5.1 Introduction 107
  5.2 Unit one - Jane 107
  5.3 Unit two - Beth 109
  5.4 Unit three - Lisa 116
  5.5 Unit four - Anne 118
  5.6 Unit five - Jon 123
  5.7 Unit six - Alison 128
  5.8 Changes Between the Macro-Cycles 132
  5.9 Conclusion 134

Chapter 6 Pre-service Teachers' Responses and Reflections 136
  6.1 Introduction 136
  6.2 Unit Two 136
    6.2.2 Portfolio responses 137
    6.2.3 Scenario response 139
    6.2.1 Gaby 141
  6.3 Unit Three 142
    6.3.1 Survey 1 142
    6.3.2 Blog post responses 143
  6.4 Unit Four 149
    6.4.2 Survey 2 150
    6.4.3 Helen 151
    6.4.4 Martha 153
  6.5 Unit Five 155
    6.5.1 Heather 155
    6.5.2 Cassie 158
    6.5.3 Survey 4 162
  6.6 Unit Six 166
    6.6.1 Survey 3 166
  6.7 Summary 168
  6.8 Conclusion 170

Chapter 7 Case Study 171
  7.1 Introduction 171
  7.2 Sustainable Design Project 173
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.3</td>
<td>Interactive Maths Space</td>
<td>176</td>
</tr>
<tr>
<td>7.4</td>
<td>From Second Life to Sim-on-a-Stick</td>
<td>180</td>
</tr>
<tr>
<td>7.5</td>
<td>Sim-on-a-Stick in the K-6 classroom</td>
<td>181</td>
</tr>
<tr>
<td>7.6</td>
<td>Gaby's Journey</td>
<td>187</td>
</tr>
<tr>
<td>7.7</td>
<td>Gaby's Teaching-Learning Processes</td>
<td>189</td>
</tr>
<tr>
<td>7.8</td>
<td>Conclusion</td>
<td>191</td>
</tr>
<tr>
<td>8.1</td>
<td>Introduction</td>
<td>192</td>
</tr>
<tr>
<td>8.2</td>
<td>The Teaching-Learning Processes</td>
<td>193</td>
</tr>
<tr>
<td>8.2.1</td>
<td>Pre-service teachers</td>
<td>193</td>
</tr>
<tr>
<td>8.2.2</td>
<td>Pre-service teacher educators</td>
<td>196</td>
</tr>
<tr>
<td>8.3</td>
<td>Barriers</td>
<td>197</td>
</tr>
<tr>
<td>8.3.1</td>
<td>Time</td>
<td>197</td>
</tr>
<tr>
<td>8.3.2</td>
<td>Access</td>
<td>199</td>
</tr>
<tr>
<td>8.3.3</td>
<td>The visceral response</td>
<td>200</td>
</tr>
<tr>
<td>8.3.4</td>
<td>Perceptions of the K-12 classroom</td>
<td>202</td>
</tr>
<tr>
<td>8.3.5</td>
<td>Negative student feedback</td>
<td>203</td>
</tr>
<tr>
<td>8.4</td>
<td>Phases of realisation and engagement</td>
<td>204</td>
</tr>
<tr>
<td>8.4.1</td>
<td>Pre-realisation</td>
<td>209</td>
</tr>
<tr>
<td>8.4.2</td>
<td>Realisation</td>
<td>211</td>
</tr>
<tr>
<td>8.4.3</td>
<td>Replication</td>
<td>213</td>
</tr>
<tr>
<td>8.4.4</td>
<td>Reimagining</td>
<td>215</td>
</tr>
<tr>
<td>8.4.5</td>
<td>Implementation</td>
<td>217</td>
</tr>
<tr>
<td>8.5</td>
<td>Perception/Experience Matrix</td>
<td>218</td>
</tr>
<tr>
<td>8.6</td>
<td>Conclusion</td>
<td>221</td>
</tr>
<tr>
<td>9.1</td>
<td>Background</td>
<td>223</td>
</tr>
<tr>
<td>9.2</td>
<td>Research Aim and Questions</td>
<td>223</td>
</tr>
<tr>
<td>9.2.1</td>
<td>Question one</td>
<td>224</td>
</tr>
<tr>
<td>9.2.2</td>
<td>Question two</td>
<td>234</td>
</tr>
<tr>
<td>9.2.3</td>
<td>Question three</td>
<td>241</td>
</tr>
<tr>
<td>9.3</td>
<td>Recommendations</td>
<td>249</td>
</tr>
<tr>
<td>9.3.1</td>
<td>University</td>
<td>249</td>
</tr>
<tr>
<td>9.3.2</td>
<td>School of Education</td>
<td>252</td>
</tr>
<tr>
<td>9.4</td>
<td>Suggestions for Further Research</td>
<td>254</td>
</tr>
</tbody>
</table>

References: 257

Appendix A Interview Questions: 280
Appendix B Survey Questions: 282
Appendix C Background to Southern Cross University School of Education Program: 285
Appendix D Biographic Information: 287
Appendix E Copies of Publications: 290
List of Figures

Figure 2.1  Rogers five types of adopters ........................................................................ 21
Figure 2.2  The conversational learning framework ..................................................... 31
Figure 4.1  The action research cycle applied to the macro- and micro-cycles ................. 94
Figure 4.2  The landing spot of the SCU Education Research Island in Second Life .......103
Figure 4.3  The central part of the Early Childhood Centre on SERI ................................104
Figure 4.4  The interactive maths playground ..............................................................105
Figure 4.5  Arbennik Island in JokaydiaGRID ............................................................... 105
Figure 6.1  Gaby and Lisa meeting informally by the campfire on SERI .........................141
Figure 6.2  The view of Heather’s build from above SERI in Second Life .......................156
Figure 6.3  Heather’s freedom rides build in Second Life ..............................................156
Figure 6.4  Cassie’s Australian history build in Second Life ........................................159
Figure 7.1  Sustainable strawberry farm created by Gaby’s group ...............................174
Figure 7.2  Gaby’s interactive maths space .................................................................179
Figure 7.3  The children’s response to weather in SoaS ...............................................183
Figure 7.4  Gaby’s Nairobi Village build in Second Life ..............................................187
Figure 8.1  Flow chart of the process of moving through each of the phases of engagement ......207
Figure 8.2  Percentage of students in each of the phases ............................................208
Figure 8.3  Perception/experience matrix .................................................................219
Figure 8.4  Perception/experience matrix applied to the phases of engagement data generated from the student responses .............................................................. 220
Figure 8.5  Perception/experience matrix applied to the six pre-service teacher educators in this research 221
Figure 9.1  Student level of readiness framework applied to all of the data .................245

List of Tables

Table 3.1  Top three VWs as reported by KZero (2014b) in June 2014 ........................... 55
Table 4.1  Number of pre-service teacher educators and students involved in this research .... 89
Table 4.2  Survey number, cycle, unit, focus and number of responses ............................90
Table 4.3  Number of students participating in each Cycle 1 activity ................................95
Table 4.4  Number of students participating in each Cycle 2 activity .................................95
Table 4.5  Number of students participating in each Cycle 3 activity ............................96
Table 4.6  Number of students who participated in VW activities in Unit 1 .......................97
Table 4.7  Number of students who participated in VW activities in Unit 2 ........................97
Table 4.8  Number of students who participated in VW activities in Unit 3 .......................99
Table 4.9  Number of students who participated in VW activities in Unit 4 ......................100
Table 4.10 Number of students who participated in VW activities in Unit 5 .....................100
Table 4.11  Number of students who participated in VW activities in Unit 6 .................................101
Table 6.1  Thematic responses from the portfolios ..............................................................................138
Table 6.2  Number of students in each phase of realisation across the three cycles .........................144
Table 6.3  The barriers expressed by students in their blog posts ..................................................145
Table 6.4  Responses by students to the level of usefulness of each VW resource ..........................151
Table 7.1  Gaby’s VW projects and professional development work ................................................172
Table 8.1  Percentage of students identified in each of the Phases of Realisation in cycle one ......205
Table 8.2  Pre-realisation phase .........................................................................................................210
Table 8.3  Realisation phase ...............................................................................................................212
Table 8.4  Replication phase ............................................................................................................214
Table 8.5  Reimagining phase ..........................................................................................................215
Table 8.6  Implementation phase .......................................................................................................217
Table 9.1  Pre-service teacher educators use of virtual worlds across the cycles of research ......230
Table 9.2  Factors that influenced the students ................................................................................235
Table 9.3  Factors that influenced the pre-service teacher educators .............................................239
Table 9.4  Student level of readiness ...............................................................................................244
Table 9.5  Pre-service teacher educators’ level of readiness ............................................................248
Table 9.6  Recommendations for introduction, development & support of VWs in a university ...251
Table 9.7  Recommendations for introduction, development & support of VWs in a pre-service teacher program ........................................................................................................253
Table C.1  Overview of the courses offered at SCU during the time of the research .......................285
Editorial Notes


Originally formatted in Microsoft Word for Mac and compiled into a pdf. The appendix DVD was compiled on a Mac for access by both Windows and MacOS.
Chapter 1 Introduction

This chapter introduces the context for this research that was undertaken to explore the introduction, development and support of Virtual Worlds (VWs) to foster innovative teaching-learning processes in pre-service teacher education. The chapter describes some of the challenges faced by pre-service teacher education in the 21st century including the way in which networked digital technology has influenced the need to make changes to traditional teaching practices. The VW as an innovative technology is described with a background as to why this technology was central to this research. The chapter concludes with an overview of the thesis structure.

1.1 Education, Learning and Digital Technology in the 21st Century

Networked digital technology has provided unprecedented access to information that was previously only available through interaction with other more knowledgeable individuals or by reading books. This change in the ease of access to information has resulted in a need to rethink the role that formal educational institutions should play in the dissemination of knowledge and manner in which learning is facilitated (Griffin, Care, & McGaw, 2012; Voogt, Erstad, Dede, & Mishra, 2013). For over 100 years most countries have made it compulsory for children to attend an educational institution in order to acquire information deemed relevant and important to improving the standard of the workforce within those societies. As such, schools have become the place in which teaching and learning is perceived to be occurring.

In the 21st century digital technology is playing a significant role in reframing what, when and how individuals learn. While learning was never confined to just the schoolroom there has been a perception, until recently, that this was the case. The ubiquity of digital technology at home and in the workplace has facilitated an ongoing need to learn new things in order to keep up with the demands of technology use. Individuals have become motivated to learn complex processes by, for example, the desire to interact with others in online spaces such as Facebook, operate a remote control to watch TV or DVDs, play interactive games or utilise equipment in the workplace (machinery, computers, coffee machines etc). Research over the past 10 years has shown that young people are learning skills through their participation in computer mediated games that are transferable to their everyday lives and equate to
the same educational outcomes desired of formal schooling such as literacy and numeracy as well as problem solving and team work (Barab, Pettyjohn, Gresalfi, Volk, & Solomou, 2012).

Learning as a result of interacting with digital technology is not unique to young people although the generation of people who were “born around the time the PC was introduced” (Oblinger & Oblinger, 2005, p. 2.2) have been described as displaying unique learning characteristics (Barnes, Marateo, & Ferris, 2007; Kennedy et al., 2006, 2009; Oblinger, 2003; Oblinger & Oblinger, 2005; Oblinger, Oblinger, & Lippincott, 2005). This generation is commonly referred to as the Net Generation or as Millenials due to their birthdates being around the turn of 21st century. Barnes et al., (2007, p. 2) propose that Net Generation learners have a “greater desire for active, engaged learning experiences” than their predecessors and that they become “easily bored with traditional learning methods”. They go on to suggest that the Net Generation are making “conscious choices about what learning techniques work best for them” with an expectation that resources are available from many sources (Barnes et al., 2007, p. 2). Recognition of these unique characteristics can inform the teacher in the classroom when they design learning experiences and can help to reframe what learning is for the educational researcher (Greenhow, Robelia, & Hughes, 2009).

Globally, an increasing number of governments are investing money and resources into exploring innovation as part of the design and development of engaging classrooms for the future. In the European Union 15 Ministries of Education have joined together as part of the Innovative Technology for an Engaging Classroom (iTEC) project in order to develop resources to help teachers, policy makers and pedagogical experts to “design the future classroom” (iTEC, 2014). They have focussed on researching what works for the Net Generation student, why it works and how to implement it. The iTEC project had the intention to implement sustainable changes to the current pedagogical use of digital technology in order to close the “mainstreaming gap” (W. Ellis, 2013). The mainstreaming gap is a way of describing, “where technology is not yet fully harnessed as a systemic part of everyday classroom practice that integrates learning both in and out of school” (W. Ellis, 2013, p. 12).

The mainstreaming gap is causing what Fullan (2013) noted as a push-pull effect occurring in schools. He observed that both students and teachers are being pushed
away from formal education and pulled towards technology outside of the classroom. He believes that students perceive that their experience at school lacks any relevance to their actual lives; it is linear and on the whole boring, while technology outside of the classroom, that they engage with on a daily basis, has a strong pull. The pull that technology has includes a pull into spaces where they learn and then share what they are learning driven by their individual needs and motivations.

Part of this push away from the current model of education/school is due to the fact that society is no longer in the Industrial Age yet schools are still replicating the Industrial Age model of teaching and learning (Fullan, 2013; Twining, Raffaghelli, Albion, & Knezek, 2013). School curriculums and individual teachers continue to replicate tried and tested routines; set blocks of time, specific disciplines, children seated in rows at desks, bells to signify beginning and ends, teachers who stand at the front and hand out work, punishments to students for not doing as they are told. The Net Generation are being expected to be engaged by models of education that include technology in a manner that is different from how they utilise and embrace technology in their out-of-school lives.

### 1.2 Educational Change and Innovation

Education as a sector is generally considered to be conservative (Apple, 2014; Fullan, 1993; Vrasidas & Glass, 2005) and according to Goodman (2012) has become more conservative in the past twenty-five to thirty years. Both Apple (2014) and Goodman (2012) refer to the current state of education as being in a time of conservative restoration driven by test results and a society that is seeking validation that the money being put into schools is resulting in a measurable output from the students. Fullan (1993) suggested that when innovative change is attempted in conservative circumstances it “results in defensiveness, superficiality or at best short-lived pockets of success” (p. 3). Hargreaves and Shirley (2012) present a case study from the USA where an attempt to implement innovation in the form of charter schools resulted in a return to traditionalism due in most part to the forces of various stakeholders (market forces, parents nostalgia and the schools that responded to both the market and the parents).

Change is challenging for most people and for it to be effective it often requires a variety of stakeholders to introduce, develop and support that change (Fullan, 2004). Education is
a sector that includes many stakeholders; governments, business, administrators, teachers, students, parents and the wider community. Since the 1960s a string of reforms have been implemented in education systems worldwide, most with the perceived intentions of improving student outcomes (Berg, 2011; Cuban, 1984; Hargreaves, Lieberman, Fullan, & Hopkins, 2005). Hargreaves et al. (2005) suggested that educational change is ubiquitous in schools and universities and, as a result, the processes for educational change have often been overlooked, resulting in a backlash from some stakeholders (particularly teachers). Fullan (1993) suggested that educators would benefit by approaching change as a complex process and considering an approach that is not necessarily systematic but is holistic (in that it considers all possibilities).

Innovation in education is not as ubiquitous as change however there have been examples of innovation reported that show that teachers are implementing new models of teaching and learning facilitated by the use of innovative technology (Kirkland & Sutch, 2009; Somekh, 2008). Currently there is growing interest in flipped classrooms, MOOCs, VWs and technology based games. The teachers who are implementing new pedagogical approaches with the use of technology are often acutely aware of the numerous issues that arise when they try to change the Industrial Age classroom. Teachers are increasingly using social networking tools such as Facebook, Yammer and Twitter (Hicks & Turner, 2013) as well as guilds in games such as World of Warcraft, to assist them to initiate change more rapidly and on a larger scale. Rogers (2003, Preface, para. 15) has suggested “the Internet has spread more rapidly than any other technological innovation in the history of humankind” which has resulted in an increased capacity to generate a critical mass for adoption of a teaching approach using a particular technology.

C. Christensen, Horn, and Johnson (2011) optimistically express the potential for technology to effect educational change when they state:

There is power in our communities to effect change. By disrupting the classroom as we now know it, we can break apart the fundamental obstacles with which educators, parents and students have struggled for so many years. These technologies and organisational innovations are not threats. They are exciting opportunities to make learning intrinsically motivating, to make teaching professionally rewarding,
and to transform our schools from being economic and political liabilities to sources of solutions and strength. (C. Christensen et al., 2011, Conclusion, para. 21)

1.3 Critically Evaluating Educational Technology

While it is important to investigate the integration of technology and the potential effect on current teaching-learning processes, Selwyn (2014) warns that it is best to avoid presenting educational technologies in “exaggeratedly enthusiastic terms” (Chapter 5, para. 11). As an example, Selwyn (2014) cites the current enthusiasm for games in education. He believes that when educators become enamoured by a particular technology, such as games in education, there is a tendency not to apply any level of critical evaluation. By so doing he states that there are “silences beneath this notion of games as an inherently ‘better’ means of supporting educational engagement” (Chapter 5, para. 11).

Selwyn (2014) proposes that there is a complexity to the adoption of technology in education that must be considered and that developing a degree of distrust is warranted. This distrust is more akin to developing a critical perspective – something that all stakeholders must consider. While technology is pervasive in society and digital literacy is imperative in the 21st century, not all individuals are willing adopters. Many people have had little choice but to become competent users in order to be part of society.

Selwyn (2014) and Spring (2012) foreground the political nature of technology and reiterate the influence of the stakeholders involved when the use of educational technology is introduced, developed and supported. These perspectives are particularly important in the context of academic research. As Selwyn (2014) writes, an “orthodoxy appears to have developed in most parts of the world that digital technologies are an integral and inevitable feature of ‘modern’ forms of education, and therefore require little or no discussion” (Chapter 1, para. 3). The lack of discussion and the tendency to introduce technology through a teaching about how to use the technology rather than why to use the technology has led to many new technologies failing to live up to expectations.
There has been a tendency for technology to be considered the panacea to improved educational outcomes for students and improved work practices for teachers. When a new technology emerges and becomes utilised in an educational context the research into the use of the technology is often evaluated in terms of the how to introduce the specific technology (including skills in use and barriers to overcome) without a critical evaluation of whether the inclusion adds anything to the current teaching-learning processes (Selwyn, 2010). Therefore the skill of critically evaluating new technologies for use in education requires the stakeholders to be versed in what that means. In pre-service teacher education there is a need to maintain discourses that critically evaluate technologies rather than simply skilling the pre-service teachers in the mechanics of how to use the technology.

The research in this thesis did not set out to justify that the use of VWs in either K-12 education, nor in higher education, is necessarily a valuable endeavour. The intention throughout the research was to explore whether the introduction of VWs could have an effect on the perceptions of pre-service teacher educators and students in relation to the teaching-learning process. In so doing the advice of Selwyn (2010) was heeded:

> While issues relating to the design, development and implementation of ‘effective’ learning technologies will continue to be of central importance to the field, it is reasoned that greater attention now needs to be paid to how digital technologies are actually being used – for better and worse – in ‘real-world’ educational settings. (Selwyn, 2010, p. 66)

### 1.4 Pre-service Teacher Education

Pre-service teacher education has a role to play in introducing, developing and supporting innovative teaching-learning processes as part of the integration of technology to meet the needs of 21\textsuperscript{st} century learners (Twining et al., 2013). Technology needs to be integrated, discussed and modelled in pre-service teacher education in order to influence the capacity of the pre-service teacher to develop teaching-learning processes that are complex, authentic and student-centred. Pre-service teacher education is an important context in which to develop critical thinkers in relation to technology.
There have been a number of studies that examine the way in which pre-service teacher programs introduce the use of technology to their students and the way in which these approaches contribute to future classroom use (Beyerbach, Walsh, & Vannatta, 2001; Gill & Dalgarno, 2008; Gulbahar, 2008; Hare, Howard, & Pope, 2002; Kay, 2006; Mayo, Kajs, & Tanguma, 2005). From these studies some common themes have emerged. The most frequently reported aspect of technology integration are the barriers that effect the capacity of the pre-service teacher and practising teachers when they attempt to implement technology in a classroom. Regardless of the type of technology (since they have changed over time) the barriers cited consistently are a lack of time, information and support. There have also been concerns raised by pre-service teachers that during their university studies they are not provided with appropriate educational technology, computer facilities or knowledge about how to effectively integrate technology in the classroom.

Beyerbach et al. (2001), in their study of pre-service teachers at two state universities in New York found that students wanted “more learning about computer technology, sooner in their programs” and that “they needed a separate course in it, as well as needed to see it infused in all their education courses and field experiences” (p. 118). They reported that pre-service teacher programs had sought to infuse technology use into their programs, and studies such as Kay (2006) demonstrated that “extensive time and money has been spent developing strategies and programs to help pre-service teachers use technology effectively” (p. 392). However, Kay (2006) found despite these undertakings there was scant evidence that these initiatives had been evaluated in relation to the actual affect that the introduction of technology to pre-service teachers had on improving educational outcomes.

The most important factor in the effective implementation of technology in the classroom has been found to be the individual teacher - simply providing the technology hardware and software is not enough (Ertmer & Ottenbreit-Leftwich, 2013; Gulbahar, 2008; Painter, 2001; Twining et al., 2013). The ability of the pre-service teacher to conceptualise how they would integrate technology in their classrooms is a major barrier (Gulbahar, 2008). This lack of self efficacy in integrating technology may be driven by the fact that most pre-service teacher programs teach computer skills, “leaving the application in the classroom” to the pre-
service teacher’s “own initiative” (Mayo et al., 2005, p. 11). Ertmer and Ottenbreit-Leftwich (2013) suggest that in order to provide authentic technology-enabled learning the focus should be placed on the pedagogical rather than the technological.

There is often a gap between what pre-service teachers are taught at university in technology focussed units, how the use of technology is modelled by university pre-service teacher educators and what pre-service teachers are then expected to do with technology when they are in primary and secondary school classrooms (Hare et al., 2002). In order for pedagogical transformation to occur the pre-service teacher needs to move beyond simplistic uses of technology in their classroom and provide opportunities for their students to use technology “to research projects, analyse data, design products, and share their work within and beyond the classroom” (Twining et al., 2013, p. 429). A fundamental shift in the “nature of the teacher-learner relationship” (Twining et al., 2013, p. 429) needs to occur. However, pre-service teachers are often not given the opportunity to experience such pedagogical shifts themselves (as a student), and many have not seen technology utilised in this way in their previous studies (at school or university) or in their practicum classrooms.

1.5 Virtual Worlds

At the commencement of this research there was a great deal of interest in the use of VWs in education but very little empirical research (Dalgarno & Lee, 2010). Educational researchers were suggesting that for VWs to become more widespread in the sector, a systematic study into how and why VWs were important needed to be undertaken. For example Dede (2009) suggested “further studies are needed on the capabilities of immersive media for learning, on the instructional design best suited to each type of immersive medium, and on the learning strengths and preferences these media develop in users” (p. 66). Similarly Dalgarno and Lee (2010) argued that there was a need for “a concerted and systematic effort by researchers to ascertain whether or not, and if so, how, the capabilities and features of 3D VLEs can be exploited in pedagogically sound ways” (p. 23).

Over the course of this research VWs were the subject of much debate particularly in relation to their legitimacy as an educational technology and whether they can actually make a difference in higher education. The period between 2007 to 2010 is
recognised as a time when a significant number of higher education institutions were utilising Second Life as a learning space. In 2007 VWs were cited in the New Media Consortium’s Horizon Report as being within two to three years of adoption in higher education (NMC, 2007):

VWs can be used to create very effective learning spaces. Since they are generalized rather than contextual, they are applicable to almost all disciplines. Settings can be created to pertain to any subject or area of study; locations and artefacts can be as realistic and detailed, or as generic and undefined as desired. 3D construction tools allow easy visualization of physical objects and materials, even those normally occurring at cosmic or nano scales (NMC, 2007, p. 20).

In 2007 claims were made by IT research and advisory company Gartner that “by the end of 2011, 80 per cent of active Internet users (and Fortune 500 enterprises) will have a ‘Second Life’, but not necessarily in Second Life” (Gartner, 2007a). At the end of 2011 there were approximately 1.7 billion registered VW accounts (KZero, 2012) and 2 billion active Internet users worldwide. In 2014 there were approximately 2.8 billion registered VW accounts and almost 3 billion Internet users (ITU, 2014). What these figures reveal is that even taking into account that many VW users are likely to have more than one account in more than one VW these figures still demonstrate that Gartner’s prediction in 2007 was reasonably accurate and undoubtedly shows an increase in VW users from 2007 to 2014.

Much of the growth in VW users has been in the entertainment sector with the rise in popularity of VW games. The adoption of VWs in higher education has occurred at a slower pace. Gartner’s hype cycle for emerging technologies is commonly utilised to chart the journey that technologies are undergoing in terms of use, acceptance and adoption. A closer look at the position of VWs in Gartner's hype cycle reveals that VWs have travelled from the peak of inflated expectations in 2007 (Gartner, 2007b, para. 1) down to the trough of disillusionment in 2008 where they languished until a slight move towards the slope of enlightenment in 2012. In 2013, VWs appeared to have morphed into other versions of the technology with mobile VWs in the innovation trigger, gamification in the peak of inflated expectations and virtual reality in the trough of disillusionment. In Gartner’s hype cycle for education in 2013 VWs were situated between sliding into the trough and climbing the slope.
Lowendhal (2013) stated that the position of VWs in education had “diminished in higher education circles” (p. 68). He surmised that Second Life was not interesting enough for most educators although he did believe that there had been some successes especially with the use of VWs “for the purpose of creating experiences that can take place only in virtual environments” (p. 68).

In 2007 Kapp (2007) wrote a blog post in which he reflected on the similarities between the backlash occurring in education against VWs such as Second Life and the backlash that occurred at the “birth of e-learning”. He describes the hype that surrounded e-learning that led to academics claiming, “e-learning was expensive to build, complicated and boring. The return on investment wasn’t worth it and several high profile online universities closed their doors… it was the end of e-learning” (para. 3). He goes on to recall that a “small group of dedicated people, university departments and companies” ignored the hype and continued on with e-learning developments (para. 4). Kapp (2007) suggested that VWs were in a similar position as they had been subjected to over-hyping and in the long term their true potential would be realised.

This brief history into the predicted adoption and actual adoption of VWs in higher education illustrates that VWs have not yet been widely accepted in higher education. This is despite the belief in their benefits shown by a loyal and not insignificant number of academics and universities worldwide. There is still some sense that VWs are on the periphery and more work needs to be undertaken for university pre-service teacher educators, students and management to fully adopt VWs as a learning space and to adopt appropriate teaching-learning processes and assessment that reflects the affordances of VWs. I. Christensen, Maraunchak, and Stefanelli (2013) also draw similarities to the barriers that occurred in the early years of web-based, distance-learning programs. They believe that “the focus remains on educational methodology and processes as ways to improve learning outcomes, and few resources are spent on investigating the technical aspects of e-learning platforms, standards, and the myriad of technical offers” (Chapter 11, para. 4).

The VWs referred to in this thesis are the 3D VWs of the type that are synonymous with platforms such as Second Life and OpenSim. The definition of a VW that is used throughout this thesis comes from S. Gregory et al. (2013) as “a computer-based, immersive, 3D multi-user environment that simulates real (or imaginary) life,
experienced through a graphical representation of the user” (p. 314). More specific literature in relation to VWs and defining what they are is presented in Section 3.5.1. VWs were chosen because they were, as yet, an unused technology in the university at which this research was conducted. As such VWs were likely to be new for many of the participants and would generate data about the pre-service teacher educators and students' perceptions and experiences about change and innovation in pre-service education.

1.6 Aims of the Research

The aim of this research was to identify factors that influence the level of readiness of pre-service teacher educators and students to introduce, develop and support innovative teaching-learning processes using VWs. The research was guided by three main questions:

1. How do pre-service teacher educators and students respond to the introduction, development and support of VWs as part of their pre-service teacher education program?
2. To what extent do the pre-service teacher educators and students’ pre-existing experiences and perceptions, intrinsic and extrinsic motivations and barriers influence their engagement with VWs?
3. What level of readiness to implement innovative teaching-learning process using VWs do pre-service teacher educators and students describe and display?

1.7 Background to the Research

The research was conducted in the pre-service teacher education program in Southern Cross University’s (SCU) School of Education. SCU is a government funded regional, multi-campus university in Australia that offers pre-service teacher education across three campuses in face-face, external and blended delivery modes. SCU began as a Teacher’s College (1970-73) and subsequently as a College of Advanced Education (1973-94) before it formally became a university in 1994. It currently has around 16,000 students, internal and external. There are three main campuses at Coffs Harbour, Gold Coast and Lismore. Most programs are offered
across the three campuses. The student cohort is approximately 30 per cent external and around 20 per cent school leavers, which indicates that many are in part time or full time employment while studying. Around 23 per cent are low socio-economic status (as determined by the Australian Bureau of Statistics attribution of social-economic status by the student's postcode) and 3.4 per cent are Indigenous (as identified by the student).

The choice of the research site was opportunistic, as I have worked at SCU as a sessional lecturer, tutor, marker and unit designer since 2009. The timing of this research was influenced by the introduction of an innovative technology (VWs) at SCU and the opportunity for me to utilise VWs in my teaching. I was the first person in the School of Education to use VWs in their teaching; this provided me with an ideal opportunity to investigate how a new technology could be introduced and how that technology could assist in introducing, developing and supporting innovative teaching-learning processes.

My first use of a VW for teaching occurred in 2010 while writing a new unit of study as part of a redesign towards a blended delivery mode (one that included face-to-face and online delivery). An important aspect of the new unit was to unite three geographically separate student cohorts. Previously the cohorts had been provided with separate tutors and this mode of delivery had become expensive, as the student cohorts had diminished in size. In that same year SCU developed a virtual campus in Second Life for all staff and students to explore the possibilities of VW in education (A. Ellis, Hassett, & Rowe, 2009). The use of the VW Second Life provided a way to bring all of the students together in one space in which students would be able to discuss discipline specific concepts and explore new technology (Jacka & Ellis, 2010). As I began to use Second Life it became clear that there were a number of factors influencing the students’ ability and willingness to engage in the use of VWs as part of their studies. The mixed reaction from the students, staff and university management was unexpected and led to more questions.

The VW Second Life was first used at SCU in 2009 when Ellis and Rowe (A. Ellis et al., 2009) received an innovation grant to develop a virtual campus for use by SCU staff and students. The SCU virtual campus in Second Life, called Interaction Island, was designed to look similar to the real life University campus and was initially only
accessible to staff and students who registered to enter the environment. The intention was to encourage staff and students to visit and explore in a safe and relatively familiar setting. Second Life was chosen by SCU as it offered a stable and mature platform with a market place from which ready-made objects could be purchased as well as an extensive network of pre-existing communities and simulation resources suitable for teaching and learning. SCU added two more islands in 2010 and 2011: Commerce Town, which had a series of businesses situated around one main street designed primarily for the Business School and Tourism and Hospitality Management; and DBA Island for the Doctor of Business Administration (DBA) program that included domestic and international students. A fourth island was planned for development in 2012, specifically for use by the School of Education students and staff. However, due to the DBA program not wishing to continue with the lease of the third island the School of Education repurposed that island. In 2014 SCU still had three islands in Second Life.

In 2010 Interaction Island was used with the cohort of pre-service teachers studying to be visual arts teachers in secondary schools. At that time the Bachelor of Education (Secondary) degree program was part of a University wide trial to offer a variety of study options to students (Jacka & Ellis, 2010). The unit in which Second Life was first used was one of two units that the students undertook in preparation for teaching specialist visual arts in secondary schools in NSW, Australia. This was the first time that the students had encountered the use of VWs in their higher education studies and the first time that I had used a VW for teaching. In 2011 three pre-service teacher educators across four units in the School of Education introduced VWs through the integration of activities in: Science and Technology Education; Learning Technologies; Curriculum, Assessment and New Media; and Instructional Design and Educational Technology. This implementation was part of this research project and students and subsequent thesis. Pre-service teacher educators and students in these units engaged in activities including virtual field trips, tutorial discussions, building of a sustainable design project, role-play and developing VW teaching and learning resources.

In 2011, during the pilot phase of this research, sections of the SCU Islands in Second Life were utilised to introduce pre-service teacher educators and students to the
affordances of VWs. In 2012 a small internal grant was provided to develop an island specifically for use with School of Education students. The SCU Educational Research Island (SERI) was designed to facilitate best practice in the use of VWs for education informed by the activities that had already occurred and the types of activities that were planned as part of this research. Input about what should be built on the Island was sought from pre-service teacher educators and students and the rationale for these spaces is discussed further in Chapter 4. In 2013 funding for SERI was continued with financial support from the School of Education, recognising that the implementation of VWs for education was a strategy that warranted on-going development. The School of Education also started to use the VW Sim-on-a-Stick (SoaS) in response to some of the barriers that pre-service teacher educators and students expressed in relation to using Second Life.

1.8 My Position as a Researcher

Davis and Sumara (2006) suggest that educational research should be exploring the “current spaces of possibility” as part of the goal of being “oriented toward the as-yet unimagined” (p. 135). I was immediately drawn to their vision of educational research as it synthesised my own view about what I should be doing as a teacher and a researcher. Their statement struck a chord with me when they said “Education – and, by implication, educational research – conceived in terms of expanding the space of the possible rather than perpetuating entrenched habits of interpretation, then, must be principally concerned with ensuring the conditions for the emergence of the as-yet unimagined” (p. 135).

When I began this research I considered myself a constructivist who was committed to the principals of action research. As I progressed further into this research I discovered complexity theory as a body of knowledge that presented a philosophical position that resonated with me both personally and professionally. I still consider that underpinning my ontology and epistemology are the basic principles of a constructivist paradigm; that is, one in which reality is constructed by the individual and exists as real for that individual. I also believe that the construction of each individual’s reality is influenced by the collective - other individuals, society and the artefacts with which they interact. The acknowledgement that the individual’s reality
changes and emerges as they interact is closely aligned with some of the key elements of complexity theory.

Action research provided a meta-methodology by which I have included myself as a participant researcher and enacted both macro- and micro-cycles of planning, acting, observing and reflecting. As each cycle unfolded, the feedback and observations were analysed and informed the redesign of the following cycles. The overall design of this research is situated in the knowledge that action research is generally messy and fuzzy but that leads ultimately to clarity and the capacity to provide recommendations for change. These recommendations are acknowledged as not necessarily generalisable or transferable to other situations, as complexity theory helps to explain that the multifarious nature of the world is such that no two situations can be identical.

I thus offer my philosophical position as that of a constructivist who has embraced a participatory approach. The participatory framework of action research provided the overall meta-methodology that includes a variety of methodologies and methods – including interviews, observation and surveys – situated within macro- and micro-cycles. Complexity theory has added depth to my analysis and has provided me with the insight from the growing collective of complexity theorists who describe a belief system that mirrors my own in terms of my practice as an educator and a researcher.

1.9 Thesis Structure

This thesis is presented in a semi-conventional format that follows through two chapters of literature reviews, three data chapters – pre-service teacher educators' response, pre-service teachers' response and a case study chapter, a discussion of themes and a conclusion and recommendations chapter.

Chapter 2 is the first of two literature review chapters. In this chapter the literature related to the educational context is presented. The chapter begins by outlining some of the theories about educational change and innovation. The educational context in terms of the digital age and the relationship that the moment in time has to the type of learning theories that are relevant is discussed. These theories include conversational learning, immersive learning, situated learning and connectivism. Finally, the role that pre-service teacher education plays in the development and support of innovative teaching-learning processes is explored.
Chapter 3 is the second of two literature review chapters. The literature pertaining to the technological context within which today’s teachers and learners are situated is presented. The impact that technology has on teaching-learning processes and the barriers to integration are discussed. An overview of disruptive innovations and the position that VWs have within this context is outlined. A brief history of VWs and their development in tandem with Virtual Reality (VR) is described as a way to define the nature of rapidly evolving technology. The complexity of VWs is offered through the unique affordances for teaching and learning within these environments and the subsequent rich opportunities to develop research in these areas.

Chapter 4 is the methodology chapter that includes the research aim and questions. The epistemology and methodology are described with complexity theory and action research guiding the research process. Action research was undertaken as a meta-methodology that included three macro-cycles and eleven micro-cycles. An overview and description of the cycles is described including an outline of the data collection instruments and the number of participants. The design process and decisions for the VW teaching and learning space, SERI, is described.

Chapter 5 describes the input that pre-service teacher educators had in the implementation of the VWs in each of their units, as well as their responses, before and after, the implementation process. My role as a pre-service teacher educators involved in teaching one of the units is included with my reflections and critical analysis of my own experiences. At the conclusion of the chapter changes that were enacted in each of the cycles based on the pre-service teacher educators input and responses are discussed.

Chapter 6 describes the data collected from the pre-service teachers (students). Data associated with each of the units is considered separately, and within each section data is further categorised by the types of VW activities the students were involved in. An initial analysis is presented of the student responses. The actions that were undertaken following the students’ responses in each cycle are described in order to illustrate the impact that the responses had on the subsequent cycles.

Chapter 7 is a case study of Gaby who was one of the students who first volunteered to use VWs as part of this research and went on to become an exemplar in the use of
VWs as part of her teaching and learning. Her teaching practice is now recognised as innovative by her colleagues and her description of how that occurred highlights the capacity of the VW as a catalyst. The chapter charts her journey with VWs, starting with the first projects that she undertook using VWs, and concluding with her reflections on how VWs have influenced her teaching practice.

Chapter 8 discusses three key themes that emerged from the pre-service teacher educators and students’ response to the inclusion of VWs in their units. Firstly teaching-learning processes are discussed in relation to those that pre-service teacher educators and students described when they were introduced to VWs. Then the factor of barriers is presented with five main barriers discussed. In conclusion a phases of engagement model is proposed by which pre-service teacher educators and students displayed their readiness to utilise VWs as part of innovative teaching-learning processes.

Chapter 9 answers the research questions based on the data generated through the responses of pre-service teacher educators and students in the School of Education at SCU when VWs were introduced. A perception/experience matrix is proposed in which the pre-service teacher educators and students can be situated and a framework for the implementation of VWs in pre-service teacher education is provided. Within the framework recommendations are made that, if put in place, will help facilitate the introduction, development and support of VWs in pre-service teacher education. The chapter concludes with suggestions for further research.
Chapter 2 Educational Context

In this chapter the literature related to the educational context in which this research is situated is described and discussed. The chapter begins by outlining some of the theories about educational change and innovation. The educational context in terms of the digital age and the relationship that the moment in time has to the type of learning theories that are relevant is then presented. These theories include conversational learning, immersive learning, situated learning and connectivism. Finally, the role that pre-service teacher education plays in the introduction, development and support of innovative teaching-learning processes is explored.

2.1 Change and Innovation

Innovation and change have become increasingly significant in the 21st century as businesses recognise that to compete in the aggressive and rapidly changing marketplace the capacity to be innovative is highly desirable. However, innovation is a high risk activity due to the potentially high costs involved to design, develop, produce and market innovative products with no guarantee for financial return (Dodgson, Gann, & Salter, 2008; Hitt, Keats, & DeMarie, 1998; Ireland & Hitt, 1999; Jones, 2008; Rycroft & Kash, 1999). Furthermore, in order for an innovation to be adopted, change must occur which for many is seen as an equally risky activity (Jones, 2008). Rycroft and Kash (1999) sum this up when they state “adopting new strategies or policies always entails great risks and uncertainties” especially when “the route to success involves doing what has not been done before (innovating), and where complexity makes what is being done today difficult or impossible for individuals to understand in detail” (p. 17).

Kampylis, Bocconi and Punie (2012) in their report into innovation for the European Commission found that there were a number of key components that helped to define innovation. They defined innovation as an intentional activity with the aim “to address unsolved problems and benefit in some way the innovator(s) (individual, team or organization) through the development or improvement of a product, process or method” (p. 6). They stated that the process is a “dynamic and unpredictable social process involving complex interactions between various actors who actively seek to learn from one another” (p. 6). Furthermore, innovation is “about change and implies
a degree of novelty” (p. 6). They also found that the context in which innovation occurs is important as the “specific social, economic, technological, organizational and cultural context” influences the “development, diffusion, and use” of the innovation (Kampylis et al., 2012, p. 6).

Google is a prime example of a business that is recognised as highly innovative. The type of innovations that they have implemented range from the technologies they produce to the workplace in which their employees enjoy benefits, freedom and contemporary workspaces. Over five consecutive years (2009-2014) Fortune magazine has named them as the best company to work for in the USA (Fortune, 2014). Initially their innovative workplace strategies appeared to be quite radical and yet the risk involved initially has been rewarded through increased productivity in terms of financial success and employee satisfaction (Jones, 2008). Their New York City office is described as the workplace of the future that includes “a labyrinth of play areas; cafes, coffee bars and open kitchens; sunny outdoor terraces with chaises; gourmet cafeterias that serve free breakfast, lunch and dinner; Broadway-theme conference rooms with velvet drapes; and conversation areas designed to look like vintage subway cars” (Stewart, 2013, Looking for a lesson in google's perks).

Jones (2008) identified four main actions that Google enact in their workplace that facilitates innovation. He observed that they involve everyone in the process of innovation, they provide time for their staff to be creative through play, experimentation and practices that may appear to be non-work related (such as holding meetings while playing table tennis), they encourage volume, speed and iterations of ideas that increases the capacity for the team to think creatively and to evaluate many different ideas rather than focus on one or two. Perhaps most importantly is that they embrace failure. They have developed a culture within their workplace that it is better to learn from failure than not to have tried. By so doing the level of risk is reduced as lessons are learnt from the failure and built upon to produce better products. They have a culture of no blame risk taking.

What the example of Google as an organisation reveals is that change is often met with resistance and uncertainty and innovation is often associated with risk (Jones, 2008). This can have a significant impact on whether an organisation or an individual will try something new. The example of Google highlights the potential for the initial
stages of innovation to not be seen by the wider community to have relevance or value to what has previously existed. However, continued belief in the need for innovation and change within the organisation results in the adoption of changes that promote a different experience for the individual involved. In relation to the implementation of a new technology such as VWs in education a similar assumption may be made, in that the initial adoption may not be valued, as it does not fit with the status quo. Hence the intention of the research in this thesis is to explore whether the introduction of VWs could have the effect of fostering change in the teaching-learning processes of the individuals.

### 2.2 Diffusion and Adoption of Innovation

Rogers (1995) diffusion of innovation model reveals patterns about why, how and how rapidly innovation is adopted by individuals and groups. He defined the act of diffusion, as “the process in which an innovation is communicated through certain channels over time among the members of a social system” (Chapter 1, para. 18). He stresses, “diffusion is a special type of communication in which the messages are about a new idea” (Chapter 1, para. 19). Ultimately the diffusion of innovation is “a kind of universal process of social change” (Rogers, 2003, Preface, para. 6).

In earlier work, Beal and Bolen (1957) identified five stages of the innovation adoption process (awareness, interest, evaluation, trial and adoption) and five types of adopters (innovators, early adopters, early majority, majority and non adopters). Rogers (2003) modified the names given to the five types of adopters and described their characteristics. He refers to them as innovators, early adopters, early majority, late majority and laggards. His research has shown that within a community of people who are affected by an innovation there will be a distribution of each type of adopter (Figure 2.1). The diffusion of innovation model has been widely accepted as a reliable indicator of the adoption of an innovation and groups of people within a sector that is introducing an innovation are easily identified.
In the most recent edition of *Diffusion of Innovations* (2003) Rogers acknowledged that networked digital technology is changing how diffusion and adoption of an innovation happens. He claims that with the widespread use of the Internet “the role of spatial distance in who talks to whom about a new idea” (Preface, para. 14) is diminishing and as such the speed at which innovations are adopted is increasing. While the speed that an innovation is adopted has increased the groupings within which individuals can be identified has remained remarkably stable and replicates that of Roger’s original model. What has occurred is that individuals move through the stages more quickly.

Wenger, White and Smith (2009) suggest that interplay occurs between the community of users and the technology. As the community use, adapt and disseminate their technological practices they have the capacity to contribute to the development of the technological innovation. They also observed that there is often a person within the community who leads the dissemination of information and motivates others to adopt an innovation. This person is called the technology steward. Their role within the community “typically includes selecting and configuring technology, as well as supporting its use in the practice of the community” (Chapter 3, para. 4). The technology steward is not usually an expert in the particular technology but, more importantly, is an insider in the community, “with enough experience of the workings of a community to understand its technology needs, and enough experience with or interest in technology to take leadership in addressing those needs” (Chapter 3, para. 4).
From Wenger et al.’s (2009) definition, the technology steward is likely to be an innovator without that necessarily being their intention. They describe how the “mutual influence between technology and community creates a vortex of inventiveness that propels both forward” (Chapter 11, para. 2). The technology steward is a linchpin in the conversations between the community, the technology and the community outside of the community of practice as they “articulate the needs of their communities and project them on the landscape of available technologies” (Chapter 11, para. 2).

Green and Hannon (2007) also identified innovators in their study of young people who use technology. They found that despite the fact that “most children simply accept the ubiquitous place of technology as an unremarkable feature of life” (p. 44) there was a small but significant group of children who were digital pioneers. The digital pioneers adopt a similar role to the technology stewards as they are insiders who are able to influence the community through the modelling of their own innovative practice. The categories that Green and Hannon (2007) created in relation to children and their use of technology has similarities to both Wenger et al. (2009) and Rogers (1995). They describe the children as creative producers, everyday communicators and information gatherers. They observed that the children moved between these categories making choices about which technology to use as it fitted with their needs. However, the digital pioneers lead the process of innovation through their desire to experiment without a fear of failure.

Rogers’ (1995) model for the adoption of innovation is highly regarded as a way to predict the manner in which innovation is accepted and utilised in an organisation or in society. In accepting Rogers' model, assumptions may be made that similar adoption phases may occur within the educational setting, in which the research in this thesis was undertaken. Pre-empting these responses can assist in the development of resources to assist individuals and groups to accept the adoption of the innovation and begin to utilise the technology to foster a shift in the teaching-learning process. Further, recognising the importance of leadership in the adoption of technology emphasises that only a small but very significant number of individuals will progress beyond the initial introduction of the technology.
2.3 Educational Change and Innovation

Change and innovation has been a consistent theme in education (Cuban, 1984; Hargreaves, 2005). Since the 1960s a number of reforms have been implemented, reviewed and, in turn, abandoned in a continuous attempt to cater for the perceived needs of learners. Fullan (1993) has suggested that the way in which the “concept of educational change” is discussed and approached needs to be reassessed in order to reconcile the “juxtaposition of a continuous change theme with a continuous conservative [education] system” (p. 3).

Hargreaves and Shirley (2009, 2012) describe the history of educational change as having four distinct phases that have been influenced by social and political factors. They mapped educational change from the 1960s up to the present day and described what they called the ‘four ways’. The first ‘way’ they describe began in the late 1960s and extended into the 1970s with the:

- strong investment in public education, high professional autonomy
- and discretion in selecting and designing the curriculum, passive trust
- from parents who left teachers alone to get on with the job, and
- encouragement of innovation in group-based and open-plan methods
- along with child-centered approaches to learning. (Hargreaves & Shirley, 2009, p. 5)

The second ‘way’ of educational change, according to Hargreaves and Shirley (2012), was driven by ‘Race to the Top’ legislation that focused governments on pressuring schools to achieve at a high level in international testing. This approach is characterised by “intense top-down pressure and little support” (p. 6). They suggest that some countries have continued with this model while others have moved to the third ‘way’ that develops greater collaboration and professional learning communities. The emphasis in the third way is still on achieving well in international testing except that investment has been made to develop “new strategies in professional learning communities, and by moving ideas and instructional strategies around schools through clusters and networks” (p. 7).

Most recently they have proposed the fourth ‘way’ that they believe is an alternative theory of educational change. They state “the fourth way of change leads to different
end points of education that encompass yet also extend beyond high standards and individual achievement” (p. 8). The fourth way includes characteristics of second and third way approaches with new intentions. Underpinning the fourth way is the ability of the teacher, principal or system leader to put their change principles into action. In this way, those that work within the education system are able to act as agents of change.

The fourth way of educational change moves towards addressing the dilemma that Fullan (1993) flagged when he described the need to reconceptualise the profession of teaching to integrate moral purpose and change agency at both the individual and institutional level. He believed that the expectation put upon teachers and schools to engage in a constant process of renewal is often at odds with “the way teachers are trained, the way schools are organized, the way the educational hierarchy operates, and the way political decision makers treat educators” (p. 3). Often, the result is that the educational system and systems within the system maintain the status-quo.

Creating the condition in which change can be facilitated within education systems and schools has become more urgent in recent times due to what Fullan (2013, p. 23) calls the “push-pull factor in schooling”. He suggests, “school is increasingly boring for students and alienating for teachers” pushing them both away. In opposition to the push is the irresistible pull of the “exploding and alluring digital world”. The digital world is pulling students in and creating new spaces in which learning is occurring. He believes “the push-pull dynamic makes it inevitable that disruptive changes will occur” in education (p. 23).

At an individual level the teacher has the capacity to be a change agent through their innate beliefs around the moral purpose of the profession of teaching. Lunenberg, Korthagen, and Swennen (2007) found that teacher educators can affect change in pre-service teachers through modelling of practices and therefore “the way teacher educators model the promotion of certain views of learning could be a more important factor in shaping teacher behaviour than the content of the messages they are sending, despite inherent differences between the university and school contexts” (p. 588). They concluded that the knowledge provided to pre-service teachers by teacher educators was less important than the processes that they were modelling.
What studies of educational change and innovation reveal is that educators are natural change agents who are often restricted by the various levels of stakeholders inherent in educational systems. In examples of effective change and innovation the processes of change have been observed at all levels and supported from within and outside of the systems. Individual teachers within the system have the capacity to affect change through modelling of innovative practices such as: encouraging creativity through play, experimentation and practices that don’t mirror traditional models of learning; providing the opportunity for students to generate multiple iterations of ideas; involving all of the students in the process of innovation; working as a member of a team, and encouraging and rewarding risk taking.

2.4 21st Century Learners

Throughout literature from the past 40 years a number of labels have been applied to different generations. These include the Net Generation, Gen X, Gen Y, Gen Z, Digital Native and Digital Immigrant. In educational research these terms have been used to help delineate between cohorts of learners who may have characteristics based on the period of time in which they were born. For example, the term Net Generation was first coined by Tapscott (1998) to define what he described as the difference between those who grew up with television and those who have grown up with the Internet. By his definition the Net Generation were born between 1977 and 1997 and therefore includes other demographic groups labelled Gen X (1965-1979), Gen Y (1980-1994) and Gen Z (1995-2009) (McCrindle & Wolfinger, 2009). Similarly, Prensky (2001) coined the terms Digital Native/Digital Immigrant to define the same differences that Tapscott observed; those born with digital technology and those born before these were readily available.

Being a 21st century learner does not necessarily mean that the learner is of the Net Generation and while Kennedy et al. (2009) used the term Net Generation in their *Educating the Net Generation Handbook*, they also warned “a one-size-fits-all approach to the implementation of learning technologies is unlikely to succeed and should be avoided” (p. 5). They noted that some authors have suggested that there are characteristics that can be identified in Net Generation learners including that they:
prefer receiving information quickly; process information rapidly; prefer multi-tasking and non-linear access to information; have a low tolerance for lectures; prefer active rather than passive learning; rely heavily on communications technologies to access information and to conduct social and professional interactions; and expect technology to be an integral part of their education. (Kennedy et al, 2009, p. 8)

Some authors have suggested that, due to these characteristics, current teaching practices do not cater to the Net Generation’s needs and changes to pedagogy is required (Oblinger, 2003; Prensky, 2010). Others argue that there is a "lack of evidence for the existence of an entire generation of digital natives" (Bennett & Maton, 2010, p. 325) and, while that is not to suggest that educational change is not warranted, it is important to note that a person’s capacity to engage in the use of technology or a particular learning preference can not be solely based on the individual's date of birth.

Mishra and Kereluik (2006) undertook a review and synthesis of the literature in relation to frameworks of 21st century skills. They found that the desirable skills for success in the 21st century were not greatly different from skills needed for the 20th century. For example, the cognitive skills of critical thinking, problem solving, job and life skills and the interpersonal skills of communication, collaboration and ethical awareness/emotional regulation were the same. They did isolate two skills that they felt were “uniquely pressing to the 21st century” (p. 3311). These were the ability to deal with information in new ways (information literacy) and to have cultural competence and awareness in order to collaborate globally and across cultural groupings. They suggested that the new skill set for the 21st century would include:

- Gathering information that is credible and relevant
- Reading and comprehending digital online information
- Navigating the Internet and digital media
- Collaborating digitally
- Contributing to the collective knowledge base (p. 3311)

Trying to label 21st century learners as an homogenous group may be unnecessary as Koh (2015) suggests "any digital immigrant who actively embraces, adopts and
adapts innovations is as much a twenty-first-century learner as any of the Net Gen youths currently being schooled” (p. 2). Such recognition that those born with ready access to computers have different characteristics to those born prior to such access opens up discussion about the relevance of education provision in K-12 and beyond.

2.5 Engagement

Engagement has become a significant driver in the choice of resources that teachers utilise at both university and K-12 level. Educators and governments recognise that increasingly students are demonstrating a lack of engagement with education and are being pushed away from school at a time when the need to have a skilled and educated society is ever more pressing.

The literature on engagement is extensive and is framed in various ways such as student engagement (Reeve & Tseng, 2011), school engagement (Fredricks, Blumenfeld, & Paris, 2004), learner engagement (Romero, 2012) and user engagement (O'Brien & Toms, 2008). The latter term is utilised in the context of Human-Computer-Interface (HCI) design literature whereas the first three terms are used specifically in relation to teaching and learning. Fredricks et al. (2004) present the concept of engagement as one that is multifaceted and includes behavioural, emotional and cognitive aspects. For each of these aspects there are degrees of engagement that can vary in both intensity and duration:

Behavioral engagement can range from simply doing the work and following the rules to participating in the student council. Emotional engagement can range from simple liking to deep valuing of, or identification with, the institution. Cognitive engagement can range from simple memorization to the use of self-regulated learning strategies that promote deep understanding and expertise. (p. 61).

Reeve and Tseng (2011) add the notion of agentic engagement which is defined as “students’ constructive contribution into the flow of the instruction they receive” (p. 258). Whilst the behavioural, emotional and cognitive dimensions can effectively capture how a student responds to a given learning task, the agentic dimension assists in developing an understanding of the extent to which a student is pivotal in the process of adapting or even formulating learning tasks.
The research on engagement has a central focus on improvement in learning outcomes and achievement levels of students. Engagement is critical in developing qualities such as commitment and active involvement, thus preventing students dropping out or becoming alienated. As Fredricks et al. (2004) point out, there is a presumption that engagement is malleable and, as a result, many interventions in education settings focus on improving engagement.

Student engagement with technology, particularly in relation to game based environments (such as VWs) and intelligent tutoring systems, is often taken as a given. However as Rowe, Shores, Mott, and Lester (2011) suggest, there is a concern that such engagement does not necessarily translate to learning. Time on-task is not necessarily an indicator of engagement as learners’ attention may be focussed on off-task thoughts that inhibit cognitive engagement (Romero, 2012). In this view, the distracting entertainment features (Mayer & Johnson, 2010) or the seductive details (Harp & Mayer, 1998) promote engagement but not deep learning. Rowe et al. (2011) present research to refute this concern, finding in an empirical study of 153 secondary school students that engagement with a particular narrative-based learning environment was associated with improved learning outcomes. They suggest that the story and gameplay design elements are critical to ensure engagement leads to learning.

Similarly, Gee (2003) suggests that the motivating elements implicitly designed in digital games can be leveraged for an increased level of engagement in learning. The concept of engagement is often cited when authors provide reasons to implement VWs and digital games for education. Gee and Levine (2009) suggested that "a crucial first step in promoting student engagement is to rethink literacy for the 21st century" (p. 48). By that they promote the use of video games that "involve complex thinking and problem solving married to complex language" (p. 48) that many young people play at length and with great proficiency.

Arnone, Small, Chauncey, and McKenna (2011) emphasise the importance of curiosity in relation to interest and engagement when considering technology rich environments. These environments afford opportunities for new information and new experiences, however the richness of the audio-visual experience can either support or detract from the user’s curiosity. Arnone et al. (2011) suggest that curiosity can lead to “new learning [as in sense-making] but it is curiosity’s power to both trigger and be
triggered through the development and deepening of interest and consequently, the forms of engagement that result in deep learning and effective participation, collaboration, and affinity” (p. 185).

Whilst not directly linking engagement and learning, O’Brien and Toms (2008) deconstruction and definition of the term ‘user engagement’ does provide a useful framework for understanding how some technologies move from being merely usable, to engaging. They defined engagement as “a quality of user experience characterized by attributes of challenge, positive affect, endurability, aesthetic and sensory appeal, attention, feedback, variety/novelty, interactivity, and perceived user control” (p. 938). Through exploring the experiences of users in relation to online shopping, web searching, education webcasting and video games, O’Brien and Toms (2008) revealed that engagement was a process that comprised of four distinct stages. They called these stages; the point of engagement, sustaining engagement, disengagement and possible reengagement.

Models have been developed that assist educators to identify stages at which learners engage with online learning resources (Conrad & Donaldson, 2011) and to develop effective teaching and learning with these resources (Salmon, Nie, & Edirisingha, 2010). Conrad and Donaldson (2011) model was designed to assist the instructor to facilitate the student through each of four phases (co-operator, collaborator, initiator, partner) when engaging in the use of online learning resources. They define engaged learning as “a collaborative learning process in which the instructor and learner are partners in building the knowledge base” (p. vii). Salmon (2002, 2004) developed a five-stage model for effective online teaching and learning which she then applied to the VW of Second Life. She emphasised the importance of students mastering skills at each level in order to remain engaged and persist to the final stage in which a deeper level of learning has occurred. By providing these models researchers have offered a framework by which educators can observe their students and facilitate engagement in technology rich environments.

Engagement plays a role as a motivating factor, influencing whether individuals will utilise a new technology. The level to which someone engages may be measured from the initial introduction to the idea through to a complete self-directed immersion that goes beyond the basic requirements of a course or unit of study. The models discussed in this
section explain or track levels of engagement, and can serve to guide the intentional
design of future iterations of innovation integration in pre-service teacher education.

2.6 Learning Theories for a Digital Age

Education as a discipline brings with it a history of learning theories. In pre-service
teacher education programs behaviorist, constructivist, social constructivist and
cognitivist models have currency. Each of these theories upholds certain assumptions
about what learning is. In this section four different learning theories are briefly
discussed; conversational learning, immersive learning, situated learning and
connectivism. These four learning theories were chosen because they have a potential
role to play in rethinking teaching-learning processes and introducing, developing and
supporting VWs. They were selected following consideration of a range of learning
theories, but focusing on those which have been favoured in relation to education and
the use of technology. The theories foregrounded in this literature review have
underpinned previous studies into new digital technologies such as virtual world and
the way that learning may be understood within these new learning environments.

2.6.1 Conversational learning

Conversational learning theory was first proposed by Pask (1975, 1976) and later
included technology as part of the conversational learning framework and developed a
model that helps to articulate the experience that a learner has with technology. Kolb
et al. (2002) were seeking an approach that would further develop their ideas of
experiential learning.

Laurillard (1993) claims that constructivist approaches have focused on teacher-
student interaction while neglecting the role that the technology plays in the
conversation. She suggests that a teaching-learning conversation occurs not only
between the student and the teacher but also between the student and the technology.
The ability for digital technologies to easily provide feedback means that the student
and/or the teacher can have a conversation with the technology. Laurillard (2012)
believes that this aspect of digital technology has not been fully exploited in higher
education and that “education could benefit so much if teacher-designers could
To further explain the concept of the conversation between student, teacher and technology Laurillard (1993) provided a number of figures, each relevant to the inclusion of a variety of technology. Figure 2.2 is a simplified version in which the feedback between student and technology, student and teacher and teacher and technology is illustrated. The students’ actions in using the technology that is a teacher constructed environment or activity results in feedback (the conversation between the student and the technology). The student adapts their actions and their concepts based on this feedback. They may then apply their new learning in their subsequent actions to the technology and so the conversation continues between the technology and the student.

![Figure 2.2](image)

**Figure 2.2** The conversational learning framework showing the relationship between the teacher, the student and the technology (teacher constructed environment or activity).

Laurillard (2012) discusses the role of VWs in facilitating conversational learning. She suggests that because the VW provides an opportunity for students to engage in experiences that, if undertaken in the real world, would be potentially risky or costly they are able to “take action to produce an effect on an object” and to experience the effect thus learning from the experience in the VW (Chapter 10, para. 100). She describes this as a “well-designed modelling environment” and claims that the proper use of a VW is as a “means to interpret concepts, and reflect on the feedback from goal-oriented interactions” (Chapter 10, para. 93).
Laurillard (1993, 2002) claims that it is inaccurate to believe that university teaching is student-centred and that university students are motivated and willing to pursue knowledge in depth. She has suggested that a major rethink is required in university teaching practice and warns that the choices that the lecturer or educational designer makes in terms of the resources, artefacts and technology presented to the students has a direct impact on the students capacity to learn. As such it is time to reconceptualise the teacher as the mediator of learning because “academic learning is different from other kinds of learning in everyday life… it is not directly experienced, and is necessarily mediated by the teacher” (Laurillard, 2002, p. 4).

2.6.2 Immersive learning

Immersive learning is similar to experiential learning in that the learner is immersed in an authentic experience relevant to that which is being learnt. The term immersive education was coined in the 1990s by Aaron Walsh, a professor at Boston College and the Director of the Immersive Education Initiative (Ramaswami, 2009). The term is commonly used to describe the educational use of virtual environments such as VWs, learning games and serious games, augmented reality, mixed reality and full immersion. Dede (2009) has defined immersion as “the subjective impression that one is participating in a comprehensive, realistic experience” (p. 66). He believes that immersion in a digital environment can enhance education by:

- allowing multiple perspectives (through role-play, adoption of characters via avatars and rehearsal of multiple perspectives)
- facilitating situated learning (particularly in otherwise complex, dangerous or expensive environments)
- the ability to transfer learning in the immersive digital space to the ‘real life’ space of the home or work force (p. 66)

Immersive education and immersive learning have the capacity to situate students in a learning experience that simulates an experience they are likely to encounter in their actual workplace. This type of learning has been gaining momentum as the technologies that facilitate an immersive experience have become more accessible and as educators learn more about how best to utilise them. Sharpe, Beetham, de Freitas, and Conole (2010) suggest:
As we move towards more immersive environments, with more integrated social software capabilities, we see play and discovery becoming the means by which learner approach key concepts. While technology will offer learners the potential to create and share knowledge in ways we can only imagine, it is up to us to make their learning creative, challenging and open-ended (p. 11)

Herrington, Reeves, and Oliver (2007) found that, while it is possible to simulate experiences that are highly realistic, it is more important for the learning environment to have a high level of cognitive realism. That is, students are provided with authentic experiences that are engaging and complex tasks with the need for high fidelity representation being less important in generating an immersive experience.

The characteristics that make a learning experience authentic are defined by Herrington et al. (2007) as:

- having real-world relevance
- ill-defined, requiring students to define the tasks and sub-tasks to complete the activity
- comprising complex tasks to be investigated by students over a sustained period of time
- providing the opportunity for students to examine the task from different perspectives, using a variety of resources
- providing the opportunity to collaborate
- providing the opportunity to reflect
- being integrated and applied across different subject areas and lead beyond domain-specific outcomes
- creating polished products valuable in their own right rather than as preparation for something else
- allowing competing solutions and diversity of outcome (pp. 84-86)

Just as Laurillard suggested in relation to conversational learning, Herrington et al. (2007) recommend putting control in the hands of the student. They found that when the student can chose the appropriate technology as required to “solve complex problems, the responsibility for learning moves back to the learner, rather than the
designer of the virtual environment” (p. 93). Furthermore the capacity of the student to choose technology to “create polished and meaningful products that reflect their own personal construction of knowledge” (p. 93) acts as a facilitator for greater immersion. Immersive learning in this context includes learning experiences that are engaging, motivating and authentic to the student.

According to Dede (2009), for immersion to be successful the participant must have a willing suspension of disbelief. Dede’s hypothesis is based on the participant being immersed in a VW. In this environment the participant is aware that they are manipulating an avatar on a screen via the computer interface however they are cognitively able to identify with the avatar and the environment in which they are engaged. Studies have shown that people engaged in the use of VWs can experience viscerally what their avatar is experiencing (Bardzell & Odom, 2008; Jarmon, 2009). McCarthy and Wright (2004) described people’s interaction with technology as involving four threads:

1. The sensual thread: the concrete and visceral aspect of an experience
2. The emotional thread: the affective dimension of an experience
3. The compositional thread: the sequence of actions in an experience

The threads can be used to help consider the subjective experience that a user has with technology. Bardzell and Odom (2008) applied these threads to 3D computer interfaces; in particular to Second Life. He felt that there was potential to analyse the user reactions because the user is surrounded by the experience as different from McCarthy and Wright’s (2004) first application to 2D interfaces. What Bardzell and Odom (2008) found was that Second Life was a different experience because “participants experience them not by controlling them through dialog boxes and on-screen buttons but by being immersed in them as embodied avatars, avatars inscribed with ever-changing and highly complex meanings” (p. 257).

What is important to note in relation to the use of VWs in the context of creating immersive learning experiences is that the learner and teacher are both embodied as avatars. This experience adds a new layer to the interaction between teacher and
learner. In order for them to be fully immersed in the experience they both must undertake a willing suspension of disbelief.

### 2.6.3 Situated learning

Situated learning describes learning that occurs outside formalised systems of education (such as schools and universities). The learning occurs within the situation that the new knowledge will be applied (such as the workplace). This approach has been discussed in some depth by Lave and Wenger (1991), who argue that this approach is particularly useful in recognising that learning continues lifelong within the workplace and social settings. In school and university based programs (such as pre-service teacher education), situated learning is sometimes evident in professional practicum but most often the learning experience is a mediated one via text, video or teacher instruction.

Lave and Wenger (1991) argue for a shift from perceiving learning as something that only happens in schools, facilitated by teachers. Further they firmly oppose the notion that learning occurs ‘in the head’ of the individual. Rather, they suggest that learning is a collective experience that requires social participation. Their research broadened the field of educational enquiry to look beyond a school-centric approach and beyond an individual psychological perspective. Instead, their research argues that the context in which learning takes place is equally, if not more, important in determining how and why people learn.

Illich (1971), in what he described as deschooling society, argued that the institution of school was based on the idea that learning was a result of teaching. He suggested that most learning occurs outside of school and through processes that are largely self-directed. He made recommendations for a society without schools but instead that networks be formed and games be utilised. It is interesting to note that Illich made these suggestions in a time well before the Internet and the World Wide Web became a ubiquitous part of contemporary society.

In the field of adult education it is especially important to acknowledge that adults do not stop learning after they leave school or university. Organisations where adults work or organisations with which they engage with for recreation or community purposes, are all places of learning. These theories of learning have led to an increased acceptance of what Wenger (1998) called the Community of Practice in
which a novice learns through legitimate peripheral practice using observation and questions until they become integrated into the community. While a community of practice is not a new idea, the theorising of it is relatively recent and the term has now become widely adopted. The capacity for networked technology to facilitate communities of practice that reach beyond the physical workplace has added a new dimension to the concept.

2.6.4 Connectivism

Connectivism offers an alternative to learning theories that are traditionally espoused in pre-service teacher education such as behaviourist, cognitivist and constructivist. Connectivism is a theoretical framework that integrates “principles explored by chaos, network, and complexity and self-organization theories” (Siemens, 2005, p. 4) making it extremely useful in the study of innovative technology and changes in teaching-learning processes. A key element of connectivism is acknowledging the impact that the networked world, connected with the assistance of ubiquitous digital technology, is changing learners and the nature of learning. Siemens (2005) states, “technology has reorganized how we live, how we communicate, and how we learn” (p. 7).

Learning, from a connectivist point of view, is defined by Siemens (2005) as “actionable knowledge” that “can reside outside of ourselves (within an organization or a database), is focused on connecting specialized information sets, and the connections that enable us to learn more are more important than our current state of knowing” (p. 7). He believes, “knowledge today requires a shift from cognitive processing to pattern recognition” (p. 26). He goes on to suggest that learning is the moment that occurs when we have acquired the knowledge we needed to fill the gap of what we didn’t know before we solved the problem or completed a task. In this way learning is a moment of transformation.

Siemens (2005) expresses concerns about the validity of the epistemological traditions of objectivism, pragmatism and interpretivism. He suggests that the problem with these traditions is the assumption that learning occurs inside a person, that these traditional models do not consider “learning that is stored and manipulated by technology” (p. 2) and that they do not describe organizational learning. All of these theories presume that knowledge is something that is attainable through
reasoning or experiences and that learning is in some way objective:

Learning theories are concerned with the actual process of learning, not with the value of what is being learned. In a networked world, the very manner of information that we acquire is worth exploring. The need to evaluate the worthiness of learning something is a meta-skill that is applied before learning itself begins. (p. 4)

According to Siemens (2005) chaos theory and network theory are an important part of the learning landscape. He states that learners need to be able to “recognize the patterns which appear to be hidden. Meaning-making and forming connections between specialized communities are important activities… the ability to recognize and adjust to pattern shifts is a key learning task” (p. 6).

The theory of Connectivism was developed in response to the observation that, despite the new networked technology tools now available, these technologies are still fundamentally being used in ways that are more appropriate for the Industrial Age. Connectivism suggests that technology has the capacity to change the way people work and function but that this needs to be relevant to future needs, not needs based on the past.

### 2.7 Pedagogy, Andragogy, Cybergogy

Pedagogy is the term most commonly used to describe what a teacher does in a classroom when teaching either children or adults. However the term has been challenged, most notably by Knowles (1970), when the context is adult education. Pedagogy, by definition comes from the original Greek term ‘pedagogue’ referring to a slave who took children to and from school. Critics of the term pedagogy suggest that while it is commonly used to refer to all teaching the tendency is to focus on what the teacher does rather than the learner.

Knowles (1970) suggested the term andragogy to more accurately describe what he called assisting adults to learn as distinct from teaching. He and others found, over time, that this approach to teaching adults was successful when applied to older children and in fact should not be restricted to only adults but should be seen as one of a number of ways to approach teaching and learning. He proposed that there are four aspects to how adults learn that were overlooked in work that, at the time, had focused
on theorising the teaching of children (pedagogy), namely that as individuals mature:

1. their self-concept moves from one of being a dependent personality toward being a self-directed human being
2. they accumulate a growing reservoir of experience that becomes an increasingly rich resource for learning
3. their readiness to learn becomes oriented increasingly to the development tasks of their social roles
4. their time perspective changes from one of postponed application of knowledge to immediacy of application, and accordingly, their orientation toward learning shifts from one of subject-centeredness to one of performance-centeredness (p. 45)

The concept of heutagogy, as described by Hase and Kenyon (2000), has also gained some credibility in describing more accurately what occurs in adult education. They described it as self-determined learning that develops an individual as capable and not just competent through formal and informal learning.

In digital cultures authors have tried to redefine the manner in which teaching and learning occurs and the labels that are given to these actions. A variety of ‘agogys’ have been suggested including cybergogy to describe the “strategies for creating engaged learning online” (Wang & Kang, 2006, p. 255) and avagogy to describe teaching in a virtual world. McKerlich (2008) first used the term avagogy in a blog post *Introducing Avagogy* to describe “the strategy, design, art and technique for teaching and learning that uses avatars to represent learners in immersive environments” (Introducing Avagogy, para. 5). McKerlich, Riis, Anderson and Eastman (2011) expanded on the initial brief blog post in order to describe the importance of VWs in relation to communities of inquiry. In so doing they stated that “teaching in VWs is significantly different than teaching in any other online environment” (discussion section, para. 9) and just as Knowles had proposed andragogy they too wished to propose avagogy to signify a different type of teaching and learning experience.

In the context of pre-service teacher education there are a number of different approaches to teaching and learning that occur. The teacher educator is teaching adults (andragogy) about teaching children (pedagogy) and potentially in a digital
context (cybergogy or avagogy). In order to delineate between these terms this thesis uses the term teaching-learning processes to describe the interactions that occur between the teacher, the students and the technology with any age group or context.

Bunkers (1999) described the teaching-learning process as including the many types of teaching and learning that occur and yet she retains the main premise that to learn something is the act of “coming to know”:

The teaching-learning process as a lived experience of engaging with others in coming to know involves the multidimensional processes of expanding imaginal margins, naming the new, going with content-process shifts, abiding with paradox, giving meaning, inviting dialogue, noticing the now, and growing story. The teaching-learning process creates a unique unfolding of human potential. (p. 231)

As such the use of the term teaching-learning processes acknowledges the complexity of the act of teaching as necessarily including the coming to know of learning. Part of the possibility of shifting pre-service teacher educators and pre-service teachers’ discourse and actions in their teaching requires the reframing of that discourse to better describe their actions.

2.8 A New Culture of Learning

For centuries learning has occurred both outside and inside institutions and if the push-pull of technology in relation to education is to be avoided then a shift in our thinking about where learning occurs from the school to the learner needs to occur (Bentley, 2003; Fullan, 2013). Bentley (2003) concludes that the learner needs to be considered as “an intelligent agent with the potential to learn from any and all of her encounters with the world around her” (p. 1).

Thomas and Seely-Brown (2011) propose that there is a new culture of learning that is happening outside the confines of school or university that “takes place without books, without teachers, and without classrooms” (Chapter 2, para. 10). They state that it does require boundaries but that there is freedom within those boundaries. Fundamental to their approach is that students’ imaginations must be cultivated so that they are able to bridge the gap between the vast amount of accessible, networked
information and the structured environment. They state, “the classroom as a model is replaced by learning environments in which digital media provide access to a rich source of information and play, and the processes that occur within those environments are integral to the results” (Chapter 2, para. 10).

Siemens and Tittenberger (2009) found that educators were interested in improving their practices particularly in terms of improving student engagement but that they resisted “advanced pedagogical discussions” in relation to technology especially if they were “not readily transferable to the online or face-to-face classroom” (preface). This indicated that the educators were reluctant to imagine new ways of doing teaching.

Prensky (2010) has described a new culture of learning in what he calls a ‘partnering pedagogy’. His research revealed that technology provided the tools that can facilitate teachers to continue to do what they are already good at “including asking good questions, providing context, ensuring rigor, and evaluating the quality of students’ work” (p. 3) while the students use the technology:

> Concerned teachers are continually requesting more training and additional professional development about using technology. But again, there is a paradox, because to be the most successful at using technology in their classrooms, teachers do not need to learn to use it themselves (although they can if they want to). What teachers do need to know is just how technology can and should be used by students to enhance their own learning. (p. 3)

Davis and Sumara (2012), however, are critical of the facilitation model of much contemporary learning theory as they believe that the concept of the teacher as a facilitator of learning, who scaffolds the experience, has led to a process designed to make learning easy for the student. They propose, “teaching must challenge, push, provoke, stretch, demand, make difficult” and that the student should be engaged in “effortful study”. That is “the sort of practice that happens at the limits of current competence, where there is a genuine likelihood of failure. However, lack of success here is not seen as demeaning or defeating. It is informative and transformative” (p. 33).

In 2003 the Australian Federal Government commissioned a review of teaching and teacher education in order to identify ways to attract innovative individuals to engage
in teaching as a career. The final report *Australia’s Teachers: Australia’s Future* (Dow, 2003) investigated the implications of the rapid changes in society, culture and economic affairs for schooling in the future. One of the key findings was that the capacity for innovation by individuals and schools needed to be addressed.

It is commonly accepted that, for innovation and change to be facilitated in schools, teachers need to be supported to think in creative ways about the nature of teaching and learning. Teachers need more than just to be provided with the technology and be expected to know how to utilise it to enhance teaching-learning processes. Pre-service teacher programs are one of the many places in which teachers become exposed to the roles, responsibilities and philosophy of teaching and learning. Pre-service teacher educators who work in the pre-service teacher programs have a responsibility to assist their students to be what Fullan (1993) calls “a career-long learner of more sophisticated pedagogies and technologies” (p. 9).

The concept of a new culture of learning is important in the context of the research presented in this thesis. In order to foster innovative teaching-learning processes there needs to be some level of recognition that there is a need for new approaches. The use of VWs to help foster these new approaches also requires, from the researcher at least, the belief that the changes in society and culture need to be met with changes in education and the way in which learning is perceived and situated within the context of educational settings.

### 2.9 Research Need

The majority of pre-service teachers and practicing teachers in developed countries are exposed to a significant number and variety of technology in their everyday lives. Exposure to technology and being a ‘digital native’ does not, in itself, necessarily translate into the effective, engaging and relevant use of technology in the classroom. Further development of the capacity of teachers to respond to the learning needs of their technology literate Net Generation students is necessary in order for innovation in teaching-learning processes to occur.

The integration of technology in education is at a stage where a shift in teaching-learning processes is vital in order to model innovation, authenticity and risk taking that is relevant to the contemporary learner. Without this shift, the education system
that is currently provided (in university and in school) will become increasingly irrelevant to the learner, the teacher and society. Research is needed to identify the responses of pre-service teacher educators and pre-service teachers in relation to the introduction, development and support of innovative technology in order to inform the development of sustainable best practice.

While there have been calls for this to happen little empirical research has been undertaken to demonstrate and guide the effective integration of innovative technology to develop and support innovative teaching-learning processes in pre-service teacher education.
Chapter 3 Technological Context

In this chapter the literature related to the technological context within which today’s teachers and learners are situated is presented. The impact that technology has on teaching-learning processes and the barriers to integration are discussed. An overview of disruptive innovations and the position that VWs have within this context is outlined. A brief history of VWs and their development in tandem with VR is described as a way to define the nature of rapidly evolving technology. The complexity of VWs is offered through the unique affordances for teaching and learning within these environments and the subsequent rich opportunities to develop research in these areas.

3.1 Introduction

Today’s teachers and learners are situated in a context that is highly influenced by the rapid changes and developments in technology (Beetham & Sharpe, 2013; Bonk, 2009; Martinovic & Zhang, 2012; Sharpe, Beetham, & Freitas, 2010). C. Christensen (2000, Chapter 1, para. 10) describes this pace of change as “breathtaking”. However, Kukulska-Hulme and Traxler (2013) suggest that the “rapid technological and socio-cultural change is at odds with the more leisurely pace of evolving pedagogy, especially the formal pedagogy within colleges and universities” (Chapter 16, para. 2). Bonk (2009) goes further to suggest, “it is difficult for anyone to keep up with the changes that have occurred” (p. 157). He believes this is because “online technologies have exploded at such a brisk pace that the instructional possibilities have advanced far beyond most of the methods and theories in which teachers have been trained” (p. 157).

3.2 The Effect of Technology on Teaching-Learning Processes

Introducing innovative technology into the teaching-learning environment has the potential to develop and support “new forms of learning” (Beetham & Sharpe, 2013; Laurillard, Oliver, Wasson, & Hoppe, 2009; Oblinger, 2013). Beetham and Sharpe (2013) contend that technology has “the potential to disrupt norms, challenge assumptions, innovate disciplines and professions” (p. 47). Oblinger (2013, p. 5) applies this to the industry of higher education when she claims “technology can change learning experiences, catalyze new forms of scholarship, reveal pathways, and interconnect a
world that is highly interdependent. Information technology can enable alternative business models that have disrupted many industries - and that may disrupt our own”.

Oblinger (2013) describes the current age of education as a connected age because technology has provided the infrastructure to make connections that “magnify the reach and value of not just information but also about relationships, creating opportunities for learning, working, and collaborating on an unprecedented scale” (p. 4). The ease at which connections can be made with the increased access to technology at school, home and the workplace is “altering the experiences and aspirations of learners” (JISC, 2006, p. 4). As such there have been calls to redefine what education is and the role of schools (Halverson & Shapiro, 2012; Prensky, 2010).

The majority of teachers have continued to integrate technology by adding them into their current practices rather than considering new teaching-learning processes that can be facilitated by technology (Laurillard et al., 2009; Martinovic & Zhang, 2012; Prestridge, 2012). Ertmer and Ottenbreit-Leftwich (2010) suggest that teachers need help to “understand how to use technology to facilitate meaningful learning” if they are “to achieve the kinds of technology uses required for 21st-century teaching and learning” (p. 257). They stressed, “despite increases in access and technology training, technology is not being used to support the kinds of instruction believed to be most powerful” (p. 257). A shift in thinking about the role of technology is required “away from the notion that technology provides a supplemental teaching tool and assume, as with other professions, that technology is essential to successful performance outcomes (i.e., student learning)” (p. 256).

There is potential to “trigger pedagogical innovation” by bringing innovative technology into school and universities (Laurillard et al., 2009, p. 290). Facilitating innovation in teaching-learning processes is possibly “one of the strongest arguments” for so doing (p. 290). Beetham and Sharpe (2013) argue that the only way to “transform post-compulsory education” is to reconsider teaching-learning processes to include new ways of working with technology (Introduction, para. 1).

### 3.3 Barriers to Technology Integration and Innovation

In order for technology to affect teaching-learning processes the teacher must adopt the technology. Barriers to adoption, integration and innovation by teachers and pre-
service teachers are consistently cited throughout the literature (Baskin & Williams, 2006; Bitner & Bitner, 2002; Cuban, 1993; Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2013; Gill & Dalgarno, 2008; Gulbahar, 2008; Prestridge, 2012; Wang, 2002). Such models provide guidance to assist in overcoming barriers to technology use through the acknowledgement of these barriers and the context within which they occur. In this section some of the literature in relation to barriers will be presented, with a focus on three models that have been most commonly utilised within the educational context (CBAM, TAM and UTAUT).

In 1993, Cuban documented barriers to the use of technology in education, drawing comparison to the uptake that was occurring in other industries. He observed that there were two factors that had a significant impact on the capacity of teachers in schools to integrate technology, namely: (1) the cultural view of what “proper schooling” is (beliefs about teaching, learning and knowledge shaped not just by scholars in the discipline but by various members of society) and (2) the structure of school (in particular the age-based segregation of learning). These two factors highlight the influence that stakeholders have in shaping what happens in education as well as the institutional factors that can affect the teacher’s capacity to implement innovations when they must “fit the contours of these age-graded settings” (Cuban, 1993, p. 186).

Ertmer’s (1999) early work in the field generalised barriers to technology use into two main areas; first order barriers and second order barriers. The first order barriers were external to the person whereas second order barriers were internal. Ertmer found that, in pre-service teacher education, attempts to overcome first order barriers were given the most attention with a strong focus on providing access to equipment and programs teaching specific technology skills. There was a belief “if teachers had access to enough equipment and training, classroom integration [of technology] would follow” (p. 47). In more recent studies Ertmer and Ottenbreit-Leftwich (2013) have demonstrated that simply providing the equipment and the skills was not enough to facilitate a change in practice. They suggest that the focus needs to be on the “pedagogy that technology enables, rather than on the technology itself” (p. 175). One of the main reasons that a shift away from focussing on first order barriers is more appropriate today is that many of these barriers (resources, training, support) have been
alleviated with money and effort channelled into increasing resources, training and support in K-12 and university education.

The second order barriers that Ertmer described have been noted in other studies (Baskin & Williams, 2006; Bitner & Bitner, 2002; Gill & Dalgarno, 2008; Gulbahar, 2008; Prestridge, 2012; Wang, 2002) and are the internal barriers or ‘human factors’ that include the individual’s attitudes and beliefs, knowledge and skills. These second order barriers have been found to be highly influential and affects the content and delivery of the pre-service teacher programs. Baskin and Williams (2006) claimed “the human factor is perceived as the most critical in nurturing the technology culture and growing the critical mass of teachers able to sustain the use of technology effectively in their teaching” (p. 465).

The necessity to have a “clear vision of their roles as a teacher” is one of the factors that Wang (2002) believed impacted on the successful use of technology in the classroom. Just having a mastery of computer skills was insufficient as pre-service teachers’ personal beliefs led them to maintain the status quo and chose a teacher-centred approach to using technology. Wang’s study of 78 pre-service teachers at a US public university found that two key barriers to technology integration were the ways that technology use had been modelled in pre-service teacher programs and teachers’ pre-existing beliefs about their role as a teacher.

Bitner and Bitner’s (2002) research identified eight areas that needed to be addressed in order to facilitate teachers’ integration of technology. These largely related to human factors that influence the teacher’s decisions and include; a fear of change, a need for training in basic skills, their personal use, the teaching models provided, the technology to be based in learning activities, the school culture, intrinsic and extrinsic motivation and the level of support. Vrasidas and Glass (2005) listed 11 reasons why implementing technology in the classroom has proved difficult. Many of these were similar to those of Bitner and Bitner (2002), however Vrasidas and Glass emphasise “the conservative nature of the traditional culture of schooling and classroom instruction” as well as the “lack of time for teachers to learn how to use and integrate technology into their teaching” (p. 8). They also note that teachers need to “unlearn traditional teaching beliefs and practices” (p. 8).
Straub (2009) proposes "there is no one model for understanding the processes in which an individual engages before adopting a new innovation" (p. 626). He goes on to suggest that while several studies have sought to understand the adoption process only a few theories are used more widely. Straub (2009) highlights what he considers to be the three main theories evident in education research; The Concerns-Based Adoption Model (CBAM), the Universal Technology Adoption and Use Theory (UTAUT) and the Technology Acceptance Model (TAM).

Hall and Loucks (1978, 1979) developed CBAM out of Fuller's (1969) concerns-based model of teacher development in the hope that it would "ease the problems diagnosing group and individuals needs during the adoption process" (Straub, 2009, p. 36) of innovations. It was designed as a way to extend Rogers' Diffusion Theory for application in an academic environment (Straub, 2009) and to provide a perspective on adoption based on teachers' concerns that were seen to be primarily cognitive. As such it was hoped that administrators would be able to include these concerns in their plans to implement innovation within the academic/educational context. There are six assumptions on which CBAM is founded:

1. In educational institutions change is a process not an event
2. The individual must be the primary target of interventions designed to facilitate change in the classroom
3. Change is a highly personal experience
4. The change process is not an undifferentiated continuum
5. Staff development can best be facilitated for the individual by use of a client-centred diagnostic/prescriptive model.
6. The staff developers or other change facilitators need to work in an adaptive, yet systematic way. (Hall & Loucks, 1979, p. 2)

Hall and Loucks (1979) focus was on change and the response that teachers have to change. They suggest "everyone approaching change, initially implementing an innovation or developing skill in using an innovation will have certain perceptions, feelings, motivations, frustrations and satisfactions about the innovation and the change process" (p. 3). While CBAM has been useful in focussing in the educational context, Straub (2009) suggests that one of the limitations is the emphasis that is placed on the teacher and their negative perceptions, without taking into account the
positive response the teacher may already have towards an innovation. The CBAM starts with an inherent assumption that the change agent is the administration and not the individual teacher. The model has also become less relevant in recent decades as more student-centred educational contexts have gained prominence. Anderson (1997) undertook an extensive literature review of work that had utilised the CBAM and discovered that very little had been done since the 70s and 80s.

The Technology Acceptance Model (TAM), proposed by Davis, Bagozzi, and Warshaw (1989), is based on a series of questions that are used to ascertain an individual’s acceptance and use of technology. The model highlights the level of perceived usefulness and ease of use as primary factors in relation to whether a technology is adopted. Cox, Preston, and Cox (1999) applied the TAM model in a study of 82 teachers who were already using technology. This study from the late 1990s found that ease of use and perceived usefulness of a technology were influential in the adoption of a technology. However, they observed that teachers who were regular users of technology were more concerned with personal factors such as “improving presentation of materials, allowing greater access to computers for personal use, giving more power to the teacher in the school, giving the teacher more prestige, making the teachers' administration more efficient and providing professional support” (para. 1). Much later, Gill and Dalgarno (2008) cited the TAM model when they explored the influences on eight first year pre-service teachers. They concluded that critical elements included the perceived usefulness and ease of use as well as the individual’s ability and confidence in using technology. A comparison between Cox et al. (1999) and Gill and Dalgarno (2008) might suggest that confidence of the individual in relation to their teaching practice may also be a factor.

More recently, Prestridge (2012) found “teachers form their own beliefs about the role of technology as a teaching tool, the value of technology for student learning outcomes and their own personal confidence and competency” and that these beliefs “intersect with the teacher’s established pedagogical beliefs” (p. 449). In her Australian based study, that involved participants from four Catholic Primary schools, Prestridge found that first-order barriers were largely being overcome, however the digital pedagogies required for effective implementation were not adopted by the majority of teachers.
Aldunate and Nussbaum (2013) found that the “interplay between the type of user, based on their attitude towards new technology, and the type of technology, in terms of complexity of use” had a significant effect in relation to the level of adoption that the teacher undertook (p. 524). They focussed on the adoption process and concurred that the process happens over a period of time and there are factors that influence the point at which the teacher commits to the process or leaves it. Aldunate and Nussbaum found that early adopters who spend time integrating technology are “more likely to adopt new technology, regardless of its complexity” whereas those who are not early adopters and also don’t commit time to integrating technology “are prone to abandoning the adoption at identified points in the process” (p. 519).

There is an important interplay between pre-service teacher educators, pre-service teachers and K-12 classroom teachers in terms of their level of skills and attitudes towards the role that technology plays in an educational setting. At each stage the attitude of the individual has the capacity to influence those that they teach. Kay’s (2006) literature review of 68 refereed journal articles, that focussed on introducing technology to pre-service teachers, identified barriers to adoption that are common across education sectors. These included: a perceived and a real lack of time; the teaching philosophy of teacher mentors and the school administration in relation to technology; the technological skill of the teacher educators; a fear of technological problems; a lack of clear understanding about how to integrate technology into their teaching; and insufficient access to a variety of technologies.

Unified Theory of Acceptance and Use of Technology (UTAUT) was developed by Venkatesh et al. (2003) based on an examination of eight commonly used models, namely: the Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), Motivational Model (MM), Theory of Planned Behaviour (TPB), Combined TAM and TPB (C-TAM-TPB), Model of PC Utilization (MPCU), the Innovation Diffusion Theory (IDT) and the Social Cognitive Theory (SCT). Venkatesh et al. found that there were four determinants in relation to the acceptance of use of the technology (performance expectancy, effort expectancy, social influence, facilitating conditions) and four moderators of individual’s behaviour in relation to use (experience, voluntariness of use, gender and age). Venkatesh et al. (2003) claim that after developing and testing the UTAUT model that it proved to be "a substantial improvement over any of the eight
models and their extensions” (p. 465) when assessing the usage intention of the participants. UTAUT offers a granular tool for assessing the acceptance and use of technology in an educational context and has been applied in settings such as college students' acceptance of tablet PCs (El-Gayar and Moran, 2006), pre-service teachers acceptance or ICT integration (Birch and Irvine, 2009) and mobile learning adoption in higher education in Guyana (Thomas, Singh and Gaffar, 2013).

In order for teacher educators, pre-service teachers and teachers to become critical users of technology that truly support their practice they need to overcome barriers, many of which are outside of their control. If the barriers are too high then the daily requirements of their own teaching practice takes precedent over initial implementations and subsequent innovation. Identifying the barriers for a particular individual and putting in place strategies to reduce the barriers is the first step in maximizing the potential for innovation in both teaching-learning processes and in the integration of new technologies. Applying models to the context provides empirical value to identifying some of the reasons why adoption of innovations may be limited and the points at which action can be taken.

3.4 Disruptive Innovations

There have been points in history when certain technologies have had the effect of being a disruptive technology or, what is now the preferred term, disruptive innovation (e.g., the printing press, the steam engine and the micro-computer). For an innovation to be disruptive it must at some point supersede what has come before.

One contemporary example is that of digital photography. When first introduced, equipment was expensive and mostly used in professional settings (such as the media). As the technology became cheaper to produce and more people bought into the innovation the previous technology of film and wet processing were superseded. Now most people are able to take photographs with their mobile phones and in some cases the purpose of photography has changed also. Our relationship with the camera has changed and with it our cultural understanding of what photography is.

C. Christensen (1997, 2000) first wrote about disruptive technologies and later disruptive innovation in order to highlight the importance of businesses recognising that the value of an innovation may not at first be obvious or, initially, profitable. He
suggests, “products based on disruptive technologies are typically cheaper, simpler, smaller, and, frequently, more convenient to use” and that they initially do not perform as well as “established products in mainstream markets. But they have other features that a few fringe (and generally new) customers value” (Christensen, 2000, Introduction, para. 21). C. Christensen et al. (2011) also applied the model of disruptive innovation to the K-12 classroom. One of the examples they use is that of online courses. In 2011 they described the exponential growth in enrolments in online courses by public school students. This growth demonstrates classic signs of disruption in which a shift occurs due to offering something that wasn’t previously available. One of the key reasons for this success is that online courses were only competing with non-consumption; that is, the online course was better than no course at all.

Hedberg and Freebody (2007) suggest that the idea of disruptive technology is relevant to the application of technology in the teaching and learning context. They stated that while technology has been heavily invested in and implemented in the K-12 classrooms “no such disruptive technological innovation seems yet to have challenged traditional pedagogies” (p. 8). Hedberg (2011) more recently describes three case studies in which the introduction of interactive whiteboards and learning objects “had motivated both the students and the teachers, to rethink their pedagogies, which had been disrupted by the use of interactivity, speed of access, relevance, pictorial attributes and authenticity” (p. 15).

An example of a disruptive technology and the time in which it takes for the disruption to take place is that of email. First developed in 1971 when Ray Tomlinson connected his computer to his mailbox by using an @ symbol email has moved through various phases of technology adoption before becoming the ubiquitous form that it is today. In the mid 1980s the ARPA Net developed a system to make email more effective for its main users (being the military, students and academics). In 1998 the movie You’ve Got Mail positioned email in popular culture and individual consciousness. Fifteen years later, in 2013, there were nearly 3.9 billion email accounts (Radicati, 2013). Around the mid 90s educational researchers were presenting articles about email use in higher education, detailing the benefits and the barriers. Almost 40 years after Tomlinson first conceived of email, post offices have
been forced to change their business practices as less people send print-based letters and email barely rates a mention in the academic literature.

C. Christensen (2000) describes five principles that he believes have led businesses to fail in terms of harnessing the potential of disruptive technologies, namely: resources, markets, applications, capabilities and supply and demand. He states, “the ultimate uses or applications for disruptive technologies are unknowable in advance. Failure is an intrinsic step toward success” (Chapter 2, para. 5) One of the ways that he reports that successful managers have harnessed this principle is that they “planned to fail early and inexpensively in the search for the market for a disruptive technology. They found that their markets generally coalesced through an iterative process of trial, learning and trial again” (Chapter 2, para. 6).

The lessons that can be learnt from observing the patterns in the adoption of disruptive technologies is that they often at first appear to be of little value to current practices. It is not until the practices have changed in an almost synchronistic manner with the technology adoption that the type of use, usefulness and ease of use of the technology emerge as an obvious and integrated part of society and/or education.

3.5 Virtual Worlds

This section presents the technology that is central to this research, VWs. It begins with a definition of VWs before moving on to discuss literature concerning the affordances of VWs. Following this, research related to VWs in education is presented, particularly as it is relevant to higher education, pre-service teacher education and K-12 schools.

3.5.1 Defining virtual worlds

The definition of VWs has been consistently evolving in reaction to the changes that have occurred in VW applications, computer hardware and networking capabilities. Bell (2008) described VWs as “a synchronous, persistent network of people, represented as avatars, facilitated by networked computers” (p. 2). Warburton (2009) described VWs as having six distinct features:

1. persistence of the in-world environment
2. a shared space allowing multiple users to participate
simultaneously
3. virtual embodiment in the form of an avatar (a personisable 3-D representation of the self)
4. interactions that occur between users and objects in a 3-D environment
5. an immediacy of action such that interactions occur in real time
6. similarities to the real world, such as topography, movement and physics that provide the illusion of being there (p. 245)

Both of these definitions are grounded in the type of VWs that were most commonly being used in 2008/2009 notably Second Life. More recently S. Gregory et al. (2013) defined VWs as “a computer-based, immersive, 3D multi-user environment that simulates real (or imaginary) life, experienced through a graphical representation of the user” (p. 314). This definition was agreed upon after a debate between members of the Australia and New Zealand Virtual Worlds Working Group (VWWG). This group was established in 2009 and represents over 200 academics that are either using, or are interested in using VWs in the higher education sector across Australia and New Zealand. This debate highlighted that educators were using a range of VWs that displayed different characteristics.

Some of the issues that arose from the discussion included whether the VW is the opposite of the real world or whether the VW can be considered real. Of particular concern was whether a Virtual Learning Environments (VLEs), such as the Learning Management Systems (LMS) that most universities use (e.g., Blackboard or Moodle), are VWs or whether online applications such as Facebook, Google Earth or Google Sketch Up are also VWs. The most significant difference between these applications and the types of VWs that most members of the VWWG were using is the “experience through a graphical representation of the user” (i.e., an avatar).

For the purpose of this research the definition of a VW provided by S. Gregory et al. (2013, p. 314) has been adopted because VWs that are accessed through the use of a mouse, keyboard and screen in which the user embodies an avatar were the type utilised in this research.
3.5.2 The evolution of virtual worlds

Computer mediated environments that facilitate immersion of the user in a 3D space have been written about since the 1950s (Bradbury, 1951; Knight, 1952) and were rudimentarily pioneered in the 1960s with the design and development of Heilig’s Sensorama and Sutherland and Sproull’s The Sword of Damocles head mounted display (Sutherland, 1965, 1968). In broad terms these experiences have been labeled Virtual Reality (VR). Today the terms VR and VWs are often interchangeable however VR is more commonly used to refer to experiences in which the user is physically immersed in a computer simulated environment and VW is more likely to include environments in which the user is embodied as an avatar and interacts within the space through a mouse (or other hand held device such as a ‘joy stick’), keyboard and screen (computer or TV monitor).

Development of VR continues with discoveries and developments informing much of the current popular entertainment experiences such as the Kinect, Wii and X-Box. The entertainment industry has helped to spearhead the development of VR and VWs however the potential for the application to education has been consistently noted. In 1962, Heilig, as part of his patent for Sensorama mentioned that he believed that his device could meet the “increasing demands today for ways and means to teach and train individuals without actually subjecting the individuals to the hazards of particular simulations” (cited in Heilig, 1992, p. 292).

The range of VR experiences and environments can be classified in a variety of ways. Tice and Jacobson (1992, p. 281) suggested three types of implementation – immersive, desktop and third-person. Immersive VR requires the user to wear equipment that facilitates the immersive experience by blocking out the real world and projecting image and audio through head mounted displays, gloves, position tracking devices and 3D sound systems. Desktop VR is experienced through a “window” as the user looks onto the VR space and steers themself through that space. Third-person VR is one in which the user sees themselves within the space and steers their persona while viewing from the aspect of a third-person. The three categories proposed by Tice and Jacobson in 1992 can still be applied to today’s VR yet the manner in which the user interacts with the VR has changed to become smaller, faster and more immersive, even within a desktop or third person environment. With the
rapid development of consumer level technology that deliver high speed processing, high definition audio-visuals and high speed Internet connectivity, access to VR is now a reality for most users at home, work, school or university.

According to KZero (2014a) there are approximately 170 VWs that are live or in open beta that have been designed for education, entertainment, content creation and socialization. There are another 45 VWs that are closed and 38 in development or private beta. KZero do not include the VWs that are hosted on private servers or as part of the OpenSim grids. Hypergrid Business maintains a registry of OpenSim grids and reported that there were 224 active grids, 28,684 regions and 359,351 registered users in March 2014 (Korolov, 2014). This growing number of publically accessible VWs demonstrates that there is the potential for growth in the use of VWs for education.

KZero is a VW analytics company that compiles annual reports about the use and development of VWs and Massive Multiplayer Online Games (MMOs). They have been tracking users in VWs since 2009 and their statistics show a steady increase from 441 million user accounts in 2009 (KZero, 2012) to 2.987 billion in 2014 (KZero, 2014b). These reports provide insightful statistics about the use of VWs by children and young people. Table 3.1 represents a summary of the top 3 VWs based on KZero data in 2014 with the VWs classified by the age group to which they are targeted. This data shows that the largest age group in which VWs are being used is between 8-15 year olds.

Table 3.1 Top three VWs as reported by KZero (2014b) in June 2014

<table>
<thead>
<tr>
<th>Age group</th>
<th>VW</th>
<th>Registered Accounts (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-8</td>
<td>Jumpstart</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Boombang</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>mathsblaster</td>
<td>7</td>
</tr>
<tr>
<td>8-10</td>
<td>Club Penguin</td>
<td>225</td>
</tr>
<tr>
<td></td>
<td>Neopets</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>Panfu</td>
<td>29</td>
</tr>
<tr>
<td>10-13</td>
<td>Poptropica</td>
<td>313</td>
</tr>
<tr>
<td></td>
<td>Moviestar Planet</td>
<td>182</td>
</tr>
<tr>
<td></td>
<td>Moshi Monsters</td>
<td>90</td>
</tr>
<tr>
<td>13-15</td>
<td>Stardoll</td>
<td>310</td>
</tr>
<tr>
<td></td>
<td>Habbo</td>
<td>295</td>
</tr>
<tr>
<td></td>
<td>Minecraft</td>
<td>110</td>
</tr>
<tr>
<td>15-20</td>
<td>Maplestory</td>
<td>140</td>
</tr>
<tr>
<td></td>
<td>Dofus</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>Weeworld</td>
<td>55</td>
</tr>
</tbody>
</table>
Many of the VWs marketed at children such as Club Penguin and Moshi Monsters promote themselves as having educational content in order to attract parental consent. They include structured educational games within the open ended worlds and entice the children to play the games with rewards of points that can be used to buy products within the VW. The ability to chat can be prevented if the parent chooses that level of restriction. The child can be given options of dialogue to choose such as “hello” or “how are you?” so as to remove the potential for any chat that might be of an inappropriate nature, such as adults posing as children and grooming children. These concerns about VWs from the adult’s perspective are significant when VWs are being utilised in a classroom setting.

Higher education institutions have primarily used the VW Second Life. Helmer (2007) proposed a number of reasons why Second Life was worth investigating for teaching and learning and described Second Life as a Multi-user environment:

> Though games-based it is not, strictly speaking, a game, because it lacks pre-defined goals. All the content in this virtual world is user-created, and each user makes of their experience in it what they will – within a rapidly evolving framework of regulations laid down by Linden Labs, the provider and (sometimes reluctant) arbitrator of Second Life. (p. 4)

Some of the reasons that Helmer (2007) offers as to why Second Life is a good choice of VW for higher education is that it has a pre-existing engine (hosted technical infrastructure), a global reach, wide range of interest groups/communities, augmented capability (users can teleport, fly, see round corners), it is media rich, links externally to the 2D Web, it has easy to use building tools, a rapidly evolving platform and user-created content. One of the benefits of Second Life for education is the user created content that forms an extensive network of ready-made immersive environments and objects that can be visited, copied, modified and transferred for specific teaching and learning scenarios. Second Life has no pre-defined goals or levels to achieve and participants can create any in-world environment they can imagine with the available in-world tools.
Until 2011 Second Life was the “most popular VW used by educators” (Farley, 2011, p. 382). However, with the removal of the education tiered pricing, in January 2011, and a reduction in the creative and technical support for educators, many started to look at other platforms. OpenSimulator (OpenSim) is one platform that has proven popular due in part to the ability to host the VW locally or to purchase parcels of land (server space) relatively inexpensively on pre-formatted servers (e.g., JokaydiaGRID or Kitely).

OpenSim is an “open source multi-platform, multi-user 3D application server. It can be used to create a virtual environment (or world) which can be accessed through a variety of clients, on multiple protocols” (OpenSimulator Wiki, 2012, para. 1). OpenSim VWs have similar characteristics to other content creation VWs such as Second Life, making them an ideal platform to transfer to from Second Life. However they do require a higher level of technical knowledge if the user is to set up a server and host an OpenSim environment.

Second Life has never been an option in K-6 schools due to age restrictions imposed by Second Life and networking restrictions imposed by Departments of Education. Prior to 2011 Second Life hosted a teen grid on which educators and children aged 13-18 could design and use learning activities. However the Second Life teen grid was removed in January 2011. As a result of these restrictions some K-12 schools set up locally hosted OpenSim environments. This has only been possible in schools that have the technical and financial support to do so. Examples of the use of OpenSim in K-12 schools are provided in Section 3.5.5.

In order to overcome the barriers of technical expertise and access to networked servers, SoaS was developed by a team of interested computer programmers. SoaS is based on the OpenSim architecture with the added capacity to be accessed from a USB flash drive with no requirement for an Internet connection. SoaS works without needing a hosted server because the database technology resides on the USB flash drive and uses MySQL. When the user first enters SoaS they are provided with one or more flat regions on which they can build. If the user requires a ready-made environment they can load OpenSim Archive (OAR) files that are available freely from a number of OpenSim creators. When a teacher or student has built an environment or objects that they wish to share they can export their builds to be imported into other users’ sims. All of the importing and exporting features of SoaS are free.
The platforms used as part of this research presented in my thesis include Second Life, SoaS, and OpenSim worlds (JokaydiaGRID and PLANE).

3.5.3 Affordances of virtual worlds

The term ‘affordance’ was coined by Gibson (1979) and has been subject to various uses dependent to some extent on the context within which it is applied. Gibson first suggested that an affordance was something that was inherent within an object. The affordance was that which the object was designed to do (e.g., a ball was designed to be thrown). On the other hand Norman (1988) used the term affordance to include that which the user may perceive the object could be used for. His idea was one of ‘perceived affordance’ and focussed on the usability of an object (e.g., a ball may be designed to be thrown but a person may choose to sit on the ball and use it as a seat). Norman’s work was influential with those involved in HCI design as he stressed that, while objects are designed for a particular purpose the user may interact with objects in unintended ways. As such the designer of a HCI must at first approach the object as having the affordance most likely to be considered by the user.

As educational researchers have attempted to identify the ways in which technology can offer a different teaching and learning experience, the concept of affordance has provided the language to describe unique features. Once an affordance of a technology is identified the educator is better able to provide concrete reasons why they would choose to use the technology in lieu of a previously accepted educational tool, resource or technique.

Bower (2008), in his discussion of the usefulness of considering affordances of educational technology in the design process, suggested, “determining technological affordances before considering tasks can lead to unnecessary analysis” (p. 9). He recommends that the educational designer should consider the affordance requirements of the task with knowledge of the affordances of the technology to avoid the development of impractical implementation. In his model the educational outcomes are placed before the educational tool. This is a pertinent point to make, as there are often times when technology per se is seen as the solution without consideration for the teaching-learning processes. However an understanding of the
technological affordances of a particular resource may also lead to unexpected uses and the development of innovative tasks.

Dalgarno and Lee (2010) used the term affordance when describing the pedagogical affordances of 3D Virtual Learning Environments (VLEs). 3D VLEs include 3D simulations, games, and other 3D virtual environments all of which may also be termed VWs. They claimed that the “tasks, activities and underpinning pedagogical strategies” (p. 17) that can be facilitated by the use of a 3D VLE has the most impact on learning. As such they sought to identify the learning affordances that 3D VLEs offer as unique from other types of VLEs (such as 2D VLEs that include learning management systems used in universities). From their review of the literature they concluded that there were five learning affordances:

1. learning tasks that lead to the development of enhanced spatial knowledge representation of the explored domain
2. experiential learning tasks that would be impractical or impossible to undertake in the real world
3. learning tasks that lead to increased intrinsic motivation and engagement
4. learning tasks that lead to improved transfer of knowledge and skills to real situations through contextualisation of learning
5. tasks that lead to richer and/or more effective collaborative learning than is possible with 2D alternatives (p. 17)

Each of these learning affordances is supported by the 3D VLEs ability to provide effective representational fidelity and the ability for the learner to interact with artefacts and other users within the shared space. The learner is experiencing the task or activity through the embodiment of an avatar and their suspension of disbelief about the physical reality of the space. This interaction as an avatar generates a sense of presence. On the other hand 2D VLEs create a ‘disembodied’ way of learning and knowing in which the teacher and students are not viscerally in the same space (Dall’Alba & Barnacle, 2005).

The concept of presence is an important element in teaching and learning, whether virtually, on-campus, or blended as has been discussed by Garrison and Anderson.
(2003) as part of their Community of Inquiry framework. Garrison and Anderson (2003) suggested that it is important for teachers and students to share a sense of presence or co-presence within the educational space in order to enhance the learning experience. Warburton (2009) proposed that the VW has the capacity to create a “profoundly immersive experience” one in which the teacher and student (as avatars) can reside in simultaneously thus providing “a compelling educational experience, particularly in relation to simulation and role-playing activities” (p. 419).

Virtual presence has evolved from text based chat rooms, in which participants interacted in real time by typing into their computers, through to web-conferencing and VLEs that include text, video, still image and graphics. However VWs offer a new level of virtual presence as Wenger et al. (2009) describe in their reflection on the type of experience that an individual might have in Second Life:

Seeing others’ avatars, even if we do not interact with them, lets us know we are not alone. No one knows where this trend will lead, but it is clear that it has the potential to transform the way we interact, and more generally, the way we experience togetherness. (p. 175)

Facilitating the ability of teachers and learners to have a similar sense of presence as if they were in a traditional face-to-face classroom yet in a VLE is only one of the affordances of VWs. Warburton (2009) was one of the first researchers to provide a list of affordances for VWs in education and is widely accepted as a seminal text. He suggested that VWs have the potential to provide:

- Extended or rich interactions
- Visualization and contextualization
- Authentic content and culture
- Identity play
- Immersion
- Simulation
- Community presence
- Content production (p. 421)

Savin-Baden (2011) has also suggested that the use of VWs in higher education (in particular Second Life) can provide unique opportunities. She proposes that; (a)
activities can be undertaken that, in real life, would be expensive, dangerous or impossible, (b) the use of the avatar can provide opportunity to play with roles and identities that encourage playfulness and a testing of boundaries, and (c) as a result there is more likely to be experimentation as most actions in the VW have little or no real life consequences.

Thomas and Brown (2009) suggest that it is the visual aspect of VWs that redefines “the landscape of online interaction away from text and toward a more complex visual medium that provides a sense of place, space, and physiological embodiment” (p. 2). They also observed that the capacity for the user of the VW to “shape and to a large extent create the world they inhabit” (p. 1) was an affordance that had significant consequences for changing the current model of teaching and learning in higher education.

What is important, as shown in the literature, is that in order for technology to be effectively utilised in the educational context, the role that the technology plays in supporting learning must not be overshadowed by the technology itself. Clark (1994) suggested in the early 90s, when the use of multimedia resources was being seen as a solution to engaging students in learning, that if the same learning outcome could be derived from more than one type of media then it was not the media that was the influencing factor but more so the delivery of the learning activity. Clark was highly critical of claims being made at that time by educators that different forms of media could have a causal effect on student’s learning.

In relation to VWs there is some value in highlighting the affordances that are unique to the technology of VWs (some that are very different to previous media and technology) and connecting them to the teaching and learning affordances of VWs. Undertaking research that links the two provides the pre-service teacher educator and student reasons to overcome any initial barriers in order to move towards a deeper level of understanding about how and why VWs can be utilised.

3.5.4 Virtual worlds in pre-service teacher education

Pre-service teacher education is a sector of higher education that has introduced VWs in order to explore discipline content and innovative teaching-learning processes. However, research into the utilisation of VWs in pre-service teacher education is still in its infancy. Albion (2008) suggested that the “new generation of teachers and students
are likely to be familiar with games and 3D online spaces as players and residents but may not be so familiar with the educational affordances that are on offer” (p. 1610). As such, there is an opportunity for pre-service teacher educators to make those connections for the pre-service teacher and to provide insight into the future classroom.

There are an increasing number of studies describing and analysing the use of VWs in education and a growing body of knowledge specifically relating to the use of VWs in pre-service teacher education (Albion & McKeown, 2010; B. Gregory et al., 2011; S. Gregory et al., 2012, 2013, 2014; Kirriemuir, 2008, 2010; Messinger, Stroulia, & Lyons, 2008; Moschini, 2010; Warburton, 2009). In 2011 B. Gregory et al. (2011) highlighted that, of the 39 teacher education institutions in Australia, 14 were using VWs in their pre-service teacher education programs, another 10 were using VWs but not in pre-service teacher education and 15 were not using VWs at all.

It is difficult to specifically track the use of VWs in pre-service teacher education as pre-service teacher educators and students may use VWs and not report on the use or may only engage with VWs for a short period of time. There has been a steady growth in the membership of the VWWG that represents university staff in Australia and New Zealand who either use or are interested in the use of VWs. Australian pre-service teacher educators who have been active in VWs and who have presented their work through publication are a small but consistent group (Albion, 2008; Albion & McKeown, 2010; Bower, Cram, & Groom, 2010; C. Campbell, 2009; Campbell & Jones, 2008; M. Campbell, 2009; Cram, Hedberg, Lumkin, & Eade, 2010; S. Gregory et al., 2011; S. Gregory & Masters, 2010; S. Gregory & Tynan, 2009; Grenfell, 2010, 2011; Kennedy-Clark, 2010, 2011; Zagami, 2008, 2009).

There are a number of case study based examples of the use of VWs in pre-service teacher education. C. Campbell (2009), for instance, taught an elective unit in Interactive Technologies that introduced students to VWs and provided them with an opportunity to create their own VW teaching activity suitable for teaching in secondary schools. Typical comments from her students included “I learnt so much about Second Life as I had never heard of it before. It brings up some great points of interest” and “if this is where the future of education lies, I feel informed and confident about my ability to use it” (p. 14). Over half of the cohort expressed their willingness to use a VW again, including in their future teaching. She observed that
VWs “is an exciting new area that, although still being researched by many, has a lot of scope, particularly in education and with students studying teaching” (p. 14).

S. Gregory and Tynan (2009) and S. Gregory and Masters (2010, 2012) worked for a number of years with a large cohort of education students in VWs. One of their projects explored de Bono’s six thinking hats through role-play in Second Life (S. Gregory & Masters, 2010, 2012). Each student was given an oversized coloured hat that their avatar wore and a topic for discussion. Using group chat, students presented a point of view based on their hat colour. Concurrently, students did the same role-play in the traditional tutorial setting, with some students participating in both the traditional and the Second Life sessions. They reported that students found both sessions of equal value. They concluded, “analysis of the results provide a positive reflection on Second Life as a teaching aid, particularly for novice users of Second Life, both academics and students, and discerns how it might be used as an alternative teaching aid in a variety of contexts” (S. Gregory & Masters, 2010, p. 12).

Zagami (2008) used VWs as part of a creative arts and technology program with primary pre-service teachers in Queensland. He found that the students using the VW were able to articulate their understanding of the Queensland Essential Learnings in the Arts (the syllabus document for Creative Arts in Queensland) equally and sometimes better than those who had not experienced the VW. Grenfell (2010, 2011) also used VWs with creative arts pre-service teachers to form authentic collaborative learning across disciplines, such as visual art education and public relations.

Cheong, Yun, and Collins (2009) researched the “potential power of Second Life as an environment for pre-service teachers’ teaching practice” (p. 1418). Their intention was to increase the students’ access to teaching practice by providing a simulated environment in which they could “experience an artificial teaching environment, practice skills without any harm to real students, and participate in problem solving by reflecting on their decisions and the effects they have had on students (p. 1418). The study included 156 pre-service teachers at Korea National University of Education of which 59 were asked to rate their experiences. The students’ response was that the experience was beneficial and all of them satisfactorily completed their VW teaching practice. As a result Cheong et al. (2009) concluded that using Second Life for teaching and learning with pre-service teachers was a viable option and
suggested “more creative methods for providing with these kinds of experiences” (p. 1421) should be developed in the future.

VirtualPREX was a research project funded by the Office for Learning and Teaching (OLT) in 2011-2012 and it replicates Cheong et al.’s study on a larger scale. Five Australian and one international university utilised Second Life for pre-service teacher professional experience role-play to “test and develop a better range of professional skills and acquire confidence in, and more realistic awareness of, their skills before being placed in real-life classrooms” (S. Gregory et al., 2011, p. 491). They combined “role-play in a realistic setting and Machinima for reflection and self, peer, formative and summative assessment [to] offer a significant, new option for supplementing pre-service teacher learning” (Gregory & James, 2011, p. 7).

A similar project investigating the use of Second Life to develop pre-service teachers’ classroom practice was conducted at the University of Tasmania (Muir, Allen, Rayner, & Cleland, 2013). In 2013 a pilot study was conducted in which eight pre-service teachers undertook role-play activities. The role-play required the pre-service teachers to behave as though they were school students with a range of diverse behaviours. After the role-play the pre-service teachers reflected on their experiences through group discussion. The intention was to provide the pre-service teacher with authentic simulated experiences to help prepare them for their practicum. They found “the use of a virtual classroom enabled real time role-play for geographically dispersed pre-service teachers who did not have access to on-campus facilities or the opportunity to engage in collaborative reflection and peer discussion” (p. 13). They reported that Second Life had the potential to become a more efficient tool in education in the future when “the provision of adequate time and resources and some of the limitations” (p. 14) were overcome.

Bower, Kennedy, Dalgarno and Lee (2011) described the Blended Synchronous Learning Project as “identifying, characterising and evaluating technology-enhanced ways of bringing together on-campus and geographically dispersed students and engaging them in media-rich collaborative learning experiences” (p. 150). In order to do this they focussed on three technologies – video conferencing, web conferencing and virtual worlds focussing on seven case studies of use across a range of universities. One of the conclusions that they made was that the required level of
bandwidth and technology are not yet available to create a ubiquitous experience of synchronous face-to-face and remote delivery, suggesting “until that time, teachers will need to leverage the potentials of the available media-rich technologies to unite remote and face-to-face students, employing appropriate strategies in an attempt to mitigate or overcome the constraints” (Bower, Kenney, Dalgarno, Lee, and Kennedy 2013, p. 101).

What the literature to date has shown is that the discipline of education in universities is a significant site for research into VWs. One of the reasons for this may be that pre-service teacher educators are concerned with preparing students to teach in classrooms of the future. As such there is a pressing need to engage with technology that has the potential to challenge teaching practices and to align more closely with children’s use of technology in their everyday lives.

3.5.5 Virtual worlds in K-12 schools

The use of VWs in K-12 schools is less prominent in the literature due in part to the fact that teachers implementing VWs are less likely to be reporting on their use than those in higher education. However, a number of key investigations have occurred with K-12 students using VWs, including the highly successful work of educators such as Sheehy and Gillespie (2014) in the use of World of Warcraft to engage students who were not finding success in the regular school system.

Barab is another educator who has worked extensively with K-12 educators to design and implement the VW Quest Atlantis (QA). For over a decade QA has been utilised in school settings as a vehicle to harness game design features to engage students in deeper levels of thinking about authentic problems linked to the school curriculum. The outcomes witnessed in the use of QA has led to a “rise in the belief that videogames are a powerful medium in which curriculum designers can create new worlds that invite youth to become scientists, doctors, writers, mathematicians, and the like” (Barab, Gresalfi, & Ingram-Goble, 2010, p. 525). They describe the type of learning that occurs in QA as “transformational play”:

The idea of transformational play draws upon the epistemological position that both knower and known constitute, and are constituted through, meaningful inquiry. Such a transactive view, as it relates to
designing game-based curricula, requires not only recognizing the interrelations between the ways that person and situation can change one another, but also intentionally leveraging that realization to design for more powerful learning experiences. (p. 526)

The Schome project in the UK was founded on the idea that a group of educators at the Open University, London could design an “optimal educational system for the 21st century”; the premise being “there is widespread agreement that current education systems are failing to meet the needs of individuals and society in the 21st century” (Twining, 2009, p. 496). Schome was designed to mesh school and home (Sc-home) through the use of a VW space in Teen Second Life. Teen Second Life allowed teenagers to access Second Life without being able to access adult areas, thus creating a safe space monitored by teachers (C. Johnson, 2008; L. F. Johnson & Levine, 2008). The Schome project ran from 2007 to 2008 with 149 gifted and talented youth given access to the pilot program (Twining, 2007). While Schome had strong beginnings with many positive outcomes (Gillen, 2010; Gillen et al., 2009; Twining, 2007) the project did not continue due to a lack of ongoing funding (Gillen, personal correspondence, 2014).

In K-12 schools in New South Wales, Australia there are restrictions to accessing VWs that require connecting to a server that is external to the school. One of the ways to overcome this barrier is to use the stand alone VW SoaS. Jacka and Booth (2013) documented the first successful implementation of SoaS in a regional public primary school. This implementation is discussed in Section 7.6. SoaS appears to be gaining in popularity through the dedicated online community; however there has been no published academic literature about its use in education other than the aforementioned paper.

SoaS is based on OpenSimulator and there is scant literature on the use of OpenSimulator in the K-12 classroom. Independent schools (those not governed by the state or district governments) have been more able to host their own OpenSim environment and to access external VWs. Independent Schools using OpenSimulator and documenting their activities on school websites and blogs (at the time of writing this thesis) include: Northern Beaches Christian College (Sydney, Australia), China International Schools (Beijing, China), Gaelscoil Eoghain uí Thuairisc (Carlow, Ireland) and the Elizabeth Morrow School (New Jersey, USA). A small number of
NSW Department of Education schools have had access to OpenSimulator VWs through collaboration with Macquarie University as described by Cram et al. (2010).

### 3.5.6 Barriers to the adoption of virtual worlds in education

With the implementation of VWs across sectors of education a number of reports and case studies have highlighted the barriers, problems or limitations that are impacting on the capacity for VWs to be more fully adopted. An early report undertaken by NMC (2007) surveyed 209 higher education staff and identified some of the negative experiences they encountered as; technical issues, grieving, communication issues, a feeling of isolation or being lost and feeling embarrassed. Also in 2007 the US-based EDUCAUSE Center for Applied Research (ECAR) released a research bulletin (Kelton, 2007) that provided an overview of the institutions which were using Second Life. The main concern raised in this report was that Second Life can appear to not be a serious place for learning because “those involved in Second Life appear to be having fun” (p. 8). In the following year Kelton (2008) produced a report that identified barriers that were situated within the perceptual, technical, operational and pedagogical.

In the UK JISC commissioned a scoping study (de Freitas, 2008) that included an overview of the challenges being experienced by educators at that time using VWs. de Freitas (2008) reported that the main challenges were “accessibility and the need for broadband capability, the requirement for open standards and more support for tutors and practitioners aiming to use virtual worlds such as guidelines, case studies and implementation models” (p. 30). She noted that the necessary shift to exploratory learning as the main form of teaching in a VW presented its own challenge for “teaching practitioners well versed in traditional approaches to learning where information transferal from tutor to learner is more characteristic” (p. 30). Between 2007 and 2012 Virtual World Watch produced 10 snapshot surveys each providing an overview of the institutional use and attitude towards VWs in the UK (Kirriemuir, 2014). While attitudes appear to have changed to some extent, some of the challenges remained over the five year period including the level of “institutional support, such as IT provision and VW access, staff time, VW technology acceptability, and funding for staff and infrastructure” (Kirriemuir, 2012, Summary, para. 6). Other factors included the steep learning curve involved for staff and students and the perception that VWs were a game environment not suitable for serious learning activities.
Warburton (2009) cited barriers to the adoption of VWs in education as technical, identity, culture, collaboration, time, economics, standards, scaffolding persistence and social discovery:

- Technical: bandwidth, hardware and firewalls, down time and lag, navigation, creating objects, manipulating one’s avatar and developing a visual 3-D grammar.
- Identity: The fluidity and playfulness inherent in identity construction can be disconcerting and confusing. Building social relations can be problematic.
- Culture: Second Life can be an isolating experience. Communities are not always easy to find and can be demanding to participate in. Second Life is a place of no limits, no boundaries and no restrictions on behaviour.
- Collaboration: Cooperation and co-construction need to be scaffolded, and building trust and authenticity are critical factors for successful group activities.
- Time: Even simple things can take a long time.
- Economic: A basic account is free but anything beyond simply being present in-world costs money: buying land to create teaching spaces; uploading images and textures; and purchasing useful in-world tools, employing building and scripting expertise.
- Standards: The lack of open standards and interoperability between VW platforms potentially locks any investment, both time and economic, inside a single non-transferable setting.
- Scaffolding persistence and social discovery: The in-world profiles associated with each avatar provide a limited mechanism for the social discovery of others resulting in the avatar being trapped at the centre of its own community. (pp. 422-423)

While almost five years have passed since Warburton stated these as barriers the rapid upgrades of VW technology and the slower uptake and research within educational settings has resulted in many of these barriers still existing today. Dudeney and Ramsay (2009) distilled these factors into four areas – institutional, pedagogical, technical, and
end-user. They suggested that while Second Life provided an entry-level environment for higher education users the perception of Second Life by some sections within an institution made it often difficult to get funding or other support. They found that persons wishing to use Second Life often chose to not name Second Life as the VW in order to gain institutional support and funding. In relation to teaching-learning processes they found that educators were concerned about how to manage the student behavior within the space; for example, how would the students ask questions if they can’t raise their hands or how will they stop the students flying around the room. The perception that Second Life was a game environment was also a concern and a potential barrier for those wishing to have the VW recognised as a learning space.

Duncan, Miller, and Jiang (2102) undertook a survey of 100 published academic papers, reports and websites in order to distill the research and practices associated with VWs. In relation to barriers they found:

- Second Life requires computers with high specifications, especially graphic cards and high RAM (Random Access Memory, main memory). Internet broadband speed is also crucial to the use of VWs
- students sometimes found it hard to concentrate on the learning activity
- it can be hard for educators to monitor the educational process due to the lack of body language for feedback
- in-world activities, such as building objectives using prims, might have no value or relationship to students’ real-life world
- the use of virtual simulation for teaching purposes might be challenged by the use of simulation in the real world
- additional context information may be required, which may be distracting
- some VW participants find that their first visit is too overwhelming and unguided to provide a meaningful experience
- new students are unaware of social norms within a VW and require some understanding of language usage and gesturing
- simply using a VW is not sufficient to improve cognitive
More recent studies have revealed that many of the barriers cited in earlier studies still remain. Dalgarno, Gregory, Carlson, Lee, and Tynan (2013) scoping study in Australia and New Zealand asked users to “list up to five general limitations/disadvantages of VWs for university learning and teaching” (p. 109). From the responses seven overarching categories were identified: technology; support, funding and time; usability and familiarity; equity and ethical issues; inherent limitations of VWs; acceptance of VWs; and management and planning. Newman et al. (2013) also investigated why educators were not using VWs in education. The issues they found were primarily related to the institution, including a lack of funding, technical support, teaching support or adequate level of technology. Blackmon (2014) described four specific categories for barriers: equipment challenges; in-world VW challenges; university readiness and student readiness. What she found was that despite the challenges, the university staff in her study persisted with their use of VWs because they believed “the potential the technology has to provide an added dimension of interaction or a dynamic versus static connection …is greater than the toying, tinkering, and tweaking those types of technologies often require” (p. 16).

The literature cited here in identifying barriers is all derived from investigations of the use of VWs in higher education. There was no distinction between disciplines and as such the potential to specifically identify barriers unique to pre-service teacher education is open to investigation. Furthermore the barriers to adoption that arise in K-12 educational settings have the potential to impact on pre-service teacher’s perceptions and experiences.

3.6 The Research Potential

Pre-service teacher education programs have been integrating technology for a number of years and research has been conducted into various aspects of this integration in the K-12 classroom and higher education. Previous studies have suggested that pre-service teacher education programs have “not been successful in preparing new teachers to use technology effectively” (Kay, 2006, p. 386). Kay felt that the numerous strategies utilised to implement technology in pre-service education were “complex, diverse, often conflicting, and rarely evaluated well” (p. 384). As a
result she suggested, “to date, there is no consolidated picture on how to effectively introduce technology to pre-service teachers. A comprehensive description and evaluation of strategies is a necessary step, then, to guide researchers, administrators, and educators” (p. 387).

Significant action has occurred across all sectors of education in a concerted effort to implement new technologies. However Lawless and Pellegrino (2007) suggest, “it is often not guided by any substantial knowledge base derived from research about what works and why with regard to technology, teaching, and learning” (p. 576). Hedberg (2011) suggests “there is so far little evidence of any radical shifts in learning and teaching arising from classroom use of technology” (p. 3) despite the investment in both hardware and software and in implementing strategies to improve the pedagogical approach of pre-service teachers. Henderson, Bellis, Cerovac, and Lancaster (2013) proposed “it is not unreasonable to make the claim that pre-service teacher education as a whole risks failing in their mission to adequately prepare prospective teacher graduates” (p. 69) in the implementation to utilise technology as an effective part of the teaching-learning processes.

Gill and Dalgarno (2008) suggested that it was the combination of technology “skills and pedagogical knowledge that will enable” pre-service teachers and in turn teachers to “effectively use today’s technologies in the classroom as well as continue to develop and adapt to new technologies that emerge in the future” (p. 330). More recently, in Australia, the Teaching the Teachers for the Future (TTF) project (2011) looked for ways to address some of the issues in relation to the readiness of pre-service teachers to utilise technology in the classroom. They too felt that teacher required content knowledge, pedagogical knowledge and technological knowledge and the skills to interweave any of these at anytime. As a result of the TFF project Koehler and Mishra’s (2009) technological pedagogical content knowledge (TPCK) framework was adopted and has been applied in many of Australia’s pre-service teacher education programs.

VWs offer the possibility to unpack the technological pedagogical content knowledge of students who are introduced to them. In terms of research potential VWs are in their infancy and, until the release of Dalgarno, et al. (2013), there were no “published studies reporting on the breadth of use and the nature of experience of adopters of [VW] environments across the [higher education] sector” in Australia and New Zealand (p. 8).
Haycock and Kemp (2008) suggested that staff and students were “woefully unprepared and supported to manoeuvre in immersive space” such as VWs. They suggested that research was “needed to fine-tune both the academic processes and administrative infrastructure necessary to develop and support” VWs. They believed that research could “help direct instructional developers working in immersive spaces to create original learning experiences, to assess them and gauge improvements” (p. 95). VWs have continued to evolve and be incorporated into education and as such researchers continue to suggest that more research needs to be undertaken into the learning affordances of VWs so “there will be a much greater likelihood that sound instructional design and pedagogy will prevail over the mere novelty of the technology” (Dalgarno & Lee, 2010, p. 27).

Consalvo (2011) recommends that VWs “have great potential, but research on them is only really beginning” (p. 344). He states that it is important “to critically investigate them, asking thoughtful questions and using careful methods, to best arrive at an understanding of what VWs are and can be” (p. 344). Most recently C. Christensen, Marunchak and Stefanelli (2013) claimed “the development of education in VWs in the next five to ten years has the potential to radically change not only how we learn but also the face of education” (Chapter 11, para. 2).

Pre-service teacher education has an important role to play in the development of new ways of implementing teaching-learning processes that are relevant to today’s students. The literature reveals that pre-service teacher educators are deeply concerned with providing opportunities for their students to overcome barriers to the integration of technology in their future classrooms. However there is also scepticism in relation to new technologies due to the lack of in depth, longitudinal research that links the pre-service teacher educator, pre-service teacher and the teacher’s experience. Laurillard et al. (2009) suggests that education systems are “still in the relatively early stages of mainstream implementation of digital technologies for enhancing learning” (p. 304). They believe that the full potential of technology will only be realised through the “building and sharing” of knowledge about the “implementation of digital technologies for enhancing learning” (p. 304). This connection between the technology and learning needs to be explored from a variety of perspectives in order to fully understand the breadth of experiences and diversity of
learning. The power of VWs is yet to be realised and research to continue to support the implementation needs to occur so that VWs do not become another new technology that is replaced by the next new technology without being fully explored in a systematic manner.

3.7 Conclusion

The literature revealed that research into the introduction of technology in pre-service teacher education is widespread and often aligns with the introduction of new technologies. Educational researchers are keen to try new technologies in order to evaluate the potential for the technology to influence current practices and theories. However, without continued interest, support and development the technology fails to move into mainstream use and is replaced by the next new technology. As a result, pre-service teacher educators and students are in a continual cycle of introduction without the opportunity to develop more in-depth capabilities beyond the initial skills in how to use the technology. However, research that focuses on the perceptions and experiences of pre-service teacher educators and pre-service teachers in relation to the potential to change their teaching-learning processes through the use of the technology, rather than their perceptions of the technology itself, has the potential to illuminate the role that technologies with unique teaching and learning affordances can have in the educational context.
Chapter 4 Methodology

In this chapter the research aim and questions are presented. The epistemology and methodology are described with complexity theory and action research guiding the research process. With action research as the meta-methodology three macro-cycles and eleven micro-cycles were undertaken. Each of the cycles are described with reference to the data collection instruments and the number of participants. The research site is the pre-service teacher education program at SCU. For ease of distinction between pre-service teacher educators and students in the pre-service teacher program any future reference to students will be identifying pre-service teachers and reference to pre-service teacher educators will mean the staff that were co-ordinating the units of study in which the pre-service teachers were participating. The design of SERI concludes the chapter as it played a pivotal role as the main VW space that pre-service teacher educators and students used.

4.1 Research Aim and Questions

The aim of this research was to identify factors that influence the level of readiness of pre-service teacher educators and students to introduce, develop and support innovative teaching-learning processes using VWs. The research was guided by three main questions:

1. How do pre-service teacher educators and students respond to the introduction, development and support of VWs as part of their pre-service teacher education program?

2. To what extent do the pre-service teacher educators and students’ pre-existing experiences and perceptions, intrinsic and extrinsic motivations and barriers influence their engagement with VWs?

3. What level of readiness to implement innovative teaching-learning processes using VWs do pre-service teacher educators and students describe and display?
Based on the responses, factors and level of readiness recommendations are made to assist the future introduction, development and support of VWs in pre-service teacher education.

### 4.2 Paradigm Within Which the Research is Situated

Denzin and Lincoln (2011) describe the paradigm within which the researcher works as a net that “contains the researcher’s epistemological, ontological, and methodological premises” (p. 13). Guba (1990) provides a generic definition of a paradigm as the “basic set of beliefs that guides action, whether of the everyday garden variety or action taken in connection with a disciplined inquiry” (p. 17). Guba (1990) and Guba and Lincoln (1994) suggested that there are four main research paradigms – positivism, post-positivism, critical theory (ideology) and constructivism. Lincoln, Lynham, and Guba (2011) revisited Guba and Lincoln (1994) and suggested, “substantial changes have occurred in the landscape of social scientific inquiry” since the first publication in 1994 (p. 97). They contend, “various paradigms are beginning to ‘interbreed’ such that two theorists previously thought to be in irreconcilable conflict may now appear… to be informing one another’s argument” (p. 97). The result being the formations of new paradigms such as participatory/cooperative research, as described by Heron and Reason (1997), which borrow aspects of previous paradigms to build new approaches to the rich and complex nature of reality and our relationships with knowledge.

The research in this thesis was at first influenced by a constructivist paradigm. Guba and Lincoln (1994) suggest that a constructivist is ontologically relativist, epistemologically subjectivist and methodologically hermeneutic. Being relativist suggests, “realities are multiple, and they can exist in people’s minds” (Guba, 1990, p. 26); there are always many interpretations of reality. To be epistemologically subjectivist one believes that subjectivity is “the only means of unlocking the constructions held by individuals” (Guba, 1990, p. 26). What constructivism seeks to do is not to “predict and control the ‘real’ world nor to transform it but to reconstruct the ‘world’ at the only point at which it exists: in the mind of the constructors” (Guba, 1990, p. 27). What this means is that the real world is not transformed through knowledge but rather it is the mind of the individual that is.
Heron and Reason (1997) described some of the ways in which the constructivist paradigm was deficient, including the acknowledgment that reality exists in the individual rather than the collective or the social. Furthermore they point out “constructivist views tend to be deficient in any acknowledgment of experiential knowing; that is, knowing by acquaintance, by meeting, and by felt participation in the presence of what is there” (p. 277). Experiential knowing is an important element in relation to both my own ontological and epistemological beliefs and resonates with research that is conducted in spaces such as the highly experiential VWs.

The constructivist paradigm provided the starting place for the development of my own philosophical position. As I moved into a participatory paradigm in the development of an action research methodology I also grappled with the complexity of the participants, the context, and the way in which digital technology was affecting the construction of knowledge. From a review of the literature I found that complexity theory had been suggested as a new paradigm (Byrne & Callaghan, 2014; Haggis, 2008; Kuhn, 2008; Patton, 2002; Tremblay & Richard, 2011). Haggis (2008) suggested that complexity theory offers “the basis of a different kind of ontology, which might open up possibilities for creating different types of knowledge” (Chapter 11, para. 1).

Law and Urry (2004) describe complexity theory as providing the “tools for understanding” the complex connections of the world, arguing that conventional social science methods have proved problematic when trying to understand “non-linear relationships and flows” (p. 402). They suggest “current methods do not resonate well with important reality enactments” and deal poorly with the fleeting, distributed, multiple, the non-causal, chaotic and the complex. They believe, as do complexity theorists, that “relationships between variables can be non-linear with abrupt switches, so the same ‘cause’ can produce qualitatively different kinds of effect in specific circumstances” (p. 403). Kuhn (2008) describes how complexity theory exists as a new paradigm in which both new ontological and epistemological points of view are revealed:

From a complexity perspective both the nature of the world and human sense-making are dynamic and emergent. Ontologically, complexity depicts the world as self-organising, non-linear, sensitive to initial conditions and influenced by many sets of rules. Epistemologically,
human-sense making is also construed in exactly the same way, as self-organising, non-linear, sensitive to initial conditions and influenced by many sets of rules. (Chapter 12, para. 23)

Hence I have found complexity theory, when viewed as a paradigm, provides a way to understand the non-linear, emergent and unpredictable nature of knowledge.

4.3 Complexity as the Theoretical Grounding

The emergence of complexity theory is aligned with a shift that has occurred in the way that the world is viewed as “linear and mechanistic” to “nonlinear and organic, characterised by uncertainty and unpredictability” (Regine & Lewin, 2000, p. 6). It has its roots in chaos theory, catastrophe theory and open systems theory (Mason, 2008) and social science researchers have been receptive to complexity theory as it offers an alternative to the often deterministic processes of many other methodologies. Scientists and social scientists that have adopted complexity theory have done so as they believe that the simple models of classical science are too simplistic in situations that are inherently dynamic, unstable and unpredictable (Uhl-Bien, Marion, & McKelvey, 2007).

N. Johnson (2010) suggests that there is no rigorous definition of complexity theory and instead proposes that, in its simplest form, it is “the study of the phenomena which emerge from a collection of interacting objects” (Chapter 1.1, para. 3). These interacting objects are autonomous agents that form complex open systems that are able to adapt according to feedback, meaning that the system is learning from itself. Importantly, there is an emergent quality to the system in which surprising or extreme occurrences may arise sometimes without being facilitated by something outside of the system (an ‘invisible hand’ or ‘central controller’).

There are a number of states that a complex system exhibits including connectedness through networks, feedback loops (feedback and feedforward), self-organisation and self-regulation, disequilibrium, emergence and their nested nature (Clarke & Collins, 2007; N. Johnson, 2010). Each of these states acts upon each other. The networked structures are non-linear and, with the aid of feedback loops, change can occur quickly and from a variety of points. This further enhances the capacity for the system
to be self-organising and self-regulating. From these interactions within the system new phenomena (or systems) emerge.

Social science researchers seeking to understand complex systems have adopted complexity theory in the fields of organisational leadership (Morrison, 2002; Uhl-Bien et al., 2007); psychology (Bütz, Chamberlain, & McCown, 1997; Van Eenwyk, 1997), economics (Hawken, 2010), sociology (Eve, Horsfall, & Lee, 1997), and business (Regine & Lewin, 2000). Within the field of educational research complexity theory has been embraced most notably by Davis and Sumara (1997, 2005). Others in the field include: Davis, Smith, & Leflore, 2008; Doll, Fleener, Trueit, & St Julien, 2005; Morrison, 2008; Phelps and Graham, 2010.

Davis and Sumara (2005) contend, “the only approaches to investigation and reporting that are defensible for educational action researchers are those that are able to acknowledge the ‘fuzziness’ of insights that are associated with phenomena studied” (p. 460). As such the complexity theory researcher is not looking to provide “all-encompassing explanations” but is seeking to elaborate on the “the human tendency to notice similarities among seemingly disparate phenomena” (p. 454). Complexity theory provides a language with which to articulate these phenomena.

Fullan (2004), in his research into educational change, has suggested that it is impossible to “get to new horizons without grasping the essence of complexity theory” and that it is important “to tweak and trust the process of [educational] change while knowing that it is unpredictable” (p. 21). He suggested that there are elements of complexity theory that "policymakers and practitioners can find usable" (p. 21) They include:

- Non-linearity: don't expect reforms to unfold as intended
- Unpredictability: surprises will happen as a result of dynamically complex interactive forces
- Interaction or correlation: a key element of moving towards order
- Auto-catalysis: occurs when systems interact and influence each other toward new patterns
- The edge of chaos: (could easily be called the edge of order) when systems avoid too little and too much order
• Social attractors: compelling social motivators - can extract periodic patterns of order (consolidate gains) as complex system dynamics unfold
• Butterfly effects: (when small numbers of key forces coalesce) - can have disproportionately huge effects
• A complex adaptive system: consists of high degrees of internal interaction, and interaction externally (with other systems) in a way that constitutes continuous learning. (Fullan, 2004, p. 21)

Another reason why complexity theory is relevant in educational research is that the situation in the learning environment is not stable as the variables of the “time of the day, day of the week or mood of the students” will have an affect on the choices that the teacher makes (St. Julien, 2005, p. 101). St. Julien goes on to suggest, that because of the complexity of education, many of the problems that have been attempted to be solved, through educational research, have failed due to the past practices of freezing a situation “for the purposes of a reductive analysis” (p. 102). Complexity theory provides a new lens through which to view educational problems and has been described by Cohen, Manion, and Morrison (2011) as an emerging paradigm in educational research.

4.4 Action Research as a Meta-Methodology

Action research has gained credibility in the last 40 years as an increasing number of researchers and, more importantly, participant (and practitioner) researchers have undertaken the processes first suggested by Lewin (1946) and later outlined by Kemmis and McTaggart (1988). In simple terms action research is research by doing (action). For most action researchers the result of the research is the bringing about of some form of change. Lewin (1946) sought to enact change in the lives of disadvantaged groups in post-war America because he believed “research that produces nothing but books will not suffice” in the endeavour of social change (p. 35). At that time it was a significant shift in the established view of what constituted research. Lewin’s concern with the capacity of research to affect real change is a feature that has continued to underpin the philosophical approach of many action researchers. Action research has become recognised as a powerful tool to assist in
change, especially in organisations such as schools and universities (Cohen et al., 2011; Zuber-Skerritt, 1996).

Corey (1953a, 1953b) was one of the first to use action research in education. He suggested that action research could be “of great value to practitioners as they try not only to study their problems but to do something about them” (Corey, 1953b, p. 24). He was driven by a desire to promote an alternative to what were then the traditional forms of educational research. He believed that empowering teachers in schools to be able to take action based on research would promote positive outcomes and real change for the teacher, the students and the institution. Critical to his approach was that the process was undertaken collaboratively (Corey, 1953a).

Educational research is one of the main fields in which action research has been embraced, one of the reasons being that teachers who may have traditionally been the subjects of the research are empowered to “conduct research in their own situations and circumstances in their classrooms and schools” (Pine, 2009, p. 31). Britzman (2003) suggests that when the teacher becomes a researcher their identity shifts to being that of an inquirer and when they “view their work as research, it becomes more difficult to take the dynamics of classroom life for granted” (p. 239). Furthermore, the teacher’s role as a researcher aids them in the creation of “meaningful pedagogy” (p. 239).

In applying action research to educational contexts Kemmis and McTaggart (1998) state that it provides:

on the one hand a framework for recognising ideals in the reality of the work of the school’s ideas-in-action, and on the other, a concrete procedure for translating evolving ideas into critically informed action and for increasing the harmony between educational ideas and educational action. (p. 7)

Lewin (1946) first suggested that action research required the undertaking of a process that included a number of steps (or cycles). He described the process within each step as a “circle of planning, executing, and reconnaissance” (p. 38). The reconnaissance includes ‘fact finding’ in order to evaluate the results of the previous step and to plan the subsequent step. Before implementing a step he suggests that modifications may be made to the plan and, in turn, the execution.
Since Lewin first advocated this model of research many have undertaken what would be considered action research. However, Dickens and Watkins (1999) suggest that there is “no definitive approach… which is part of its strength and part of its problem” (p. 185). While there may be no definitive model there is a general consensus that the process of cycles or spirals is part of the research design. While these steps or cycles may appear to be sequential Kemmis and McTaggart (2005) argue:

In reality, the process might not be as neat as this spiral of self-contained cycles of planning, acting and observing, and reflecting suggests. The stages overlap, and initial plans quickly become obsolete in the light of learning from experience. In reality, the process is likely to be more fluid, open, and responsive. The criterion of success is not whether participants have followed the steps faithfully but rather whether they have a strong and authentic sense of development and evolution in their practices, their understandings of their practices, and the situations in which they practice. (p. 563)

Kemmis and McTaggart (1988) are considered the seminal writers on educational action research planning and design. They suggest a process that involves “a thematic concern and four moments” (p. 9). The four moments are part of a spiral that includes; plan, act, observe and reflect. They developed their model based on Lewin (1946) and Corey (1949) but they have since lamented that “the action research spiral” is seen as “the method of action research” (Kemmis & McTaggart, 2005, p. 569) when there are many aspects to action research beyond the action research cycles. Researchers have modified the cycles based on what is most relevant to their context. Zuber-Skerritt (1996), for instance, described a process of strategic planning, implementing the plan, observation or evaluation or self-evaluation, critical and self-critical reflection of the results. There are others who have extended the four stages into eight or more such as Bassey (1998), Tripp (2003) and Cohen et al. (2011).

Kemmis (2010) suggests that understanding, acting and relating are the three main goals of action research. He stresses that a crucial element of action research is to develop “our understandings of our practices” and of the practices of those participating in the research (p. 421). The methods used to achieve these goals are likely to vary and are likely to be drawn from any number of other methodological
approaches. Calling action research a meta-methodology acknowledges the likely inclusion of a variety of methods (included mixed-methods). Kemmis (2009) has referred to action research as a meta-practice as he sees it as a “practice that shapes other practices” (p. 467).

Kemmis and McTaggart (1988) claim that action research is not constrained by specific research methods but that an action researcher may choose the tools that best suit the context. As such action research often involves a mixed methods approach (both quantitative and qualitative) and/or the use of various methodological resources such as surveys, interviews, reflective diaries etc. Action research is often a messy process as Goodnough (2008) explains:

Messiness and uncertainty are inherent, and often necessary, elements of action research. Those who engage in action research need time to grapple with new ideas, to make sense of an emergent process, and to construct shared meaning within PAR communities of practice? (p. 520)

Dick (2006) suggests that because of the nature of social systems any initial research questions are likely to be fuzzy and, in turn, the methodology will be fuzzy. He states, “if you address a fuzzy question with a fuzzy methodology the best you can hope for initially is a fuzzy answer” (p. 10). However he goes on to suggest that it is possible to “converge towards precision” if the “fuzzy answer allows you to refine both question and methods” (p. 10).

Fundamental to participatory action research is the fact that the research is investigating “actual practices and not abstract practices” (Kemmis & McTaggart, 2005, p. 564). Furthermore, it “involves learning about the real, material, concrete, and particular practices of particular people in particular places… Participatory action researchers may be interested in practices in general or in the abstract, but their principal concern is in changing practices in the here and now” (p. 564). The research undertaken as part of this thesis was in the framework of participatory action research. The researcher was also the learning designer and lecturer in a number of the units. The pre-service teacher educators involved in the research were participants in the research process as reflective practitioners, contributing data as well as collaborating in data analysis through feedback in the reflection and planning phases of each cycle.
Action research has been utilised as a meta-methodology in a number of projects investigating the use of VWs in education. These studies include the exploration of virtual action learning methods to empower learners (McKeown & Sanders, 2007; McKeown Orwin, 2009); implementing VWs with pre-service teachers (S. Gregory et al., 2011; S. Gregory & Masters, 2012; Muir et al., 2013); language learning (Kongmee, Strachan, Pickard, & Montgomery, 2011; Panichi & Deutschmann, 2012); children using VWs in education (Bailey & Moar, 2001; Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005); investigating the user experience (Kohler, Fueller, Matzler, & Stieger, 2011); learning and teaching with university students (Carr, Oliver, & Burn, 2010; Mathews, Andrews, & Luck, 2012); evaluating teaching practices (MacKinnon & Saklofske, 2011) and serious games (de Freitas, 2008; Kock, 2008).

4.5 Complexity Theory and Action Research

Action research and complexity theory share many similarities. Phelps and Hase (2002) first suggested that complexity theory “presents possibilities for revolutionising approaches to action research as well as strengthening arguments promoting the value of action research in a wide range of contexts” (p. 507). They recognised that, prior to their assertion, few authors had made the connection between complexity theory and action research. They note a few who had made passing references such as Kemmis and McTaggart (1988), Altrichter (1991) and Davis and Sumara (1997). Phelps and Hase applied some of the key postulates of complexity theory to the action research literature in order to demonstrate these aspects within their own work.

Davis and Sumara (2005) went on to extend the ideas presented by Phelps and Hase. They suggested that the discourse of complexity theory “offers pragmatic advice that has significant and immediate relevance to the ‘educational’ and ‘learning’ aspects of educational action research” (p. 453). Their view is “an action research project generates knowledge, which emerges not only from the phenomenon studied, but also in part from engagement with research processes” (p. 453). Davis and Sumara highlight the conceptual similarities between action research and complexity theory and suggest that one fits with the other to bring about the ‘pragmatics of transformation’. They focused on “the notion that complexity science is the study of learning systems and, as such, the discourse offers pragmatic advice that we believe
has significant and immediate relevance to the ‘educational’ and ‘learning’ aspects of educational action research” (p. 454). A significant point at which action research and complexity might meet is suggested in the way that complexity theorist have begun to emphasis the act of deliberately creating and nurturing complex systems. The link is that educational action researchers, as participants, are concerned with not only understanding the educational context but also affecting change within it.

Radford’s (2006) view of complexity theory and action research is that the educational action researcher is restricted by contemporary paradigms within schools and has tended to follow loosely scientific methodology that is reductionist in nature. On the other hand he suggests “understanding educational situations and events in terms of complexity theory seriously challenges” the view that action research in an educational setting can “work on the assumption that linear processes of balanced interaction between causes and effects enables the practitioner to make controlled interventions and observe and record the effects” (p. 263). If, as Radford suggests, action research is undertaken in this manner, then complexity theory is at odds with the process because “complexity theory leads us to view classroom events as subject to a multiplicity of variables that are non linear and dynamic in their interactions” (p. 263). Rather than link action research and complexity theory as complementary Radford suggests that action research is restricting the educational practitioner research and that viewing “schools as sites of complexity… it may be that some of the pressure is taken off practitioners as individuals and they are given more time and space to take a more holistic perspective on the strategic management of the educational service” (p. 277).

Sumara and Davis (2009) describe an action research project they undertook at Valleyview Elementary School, Florida, USA. During the project they noticed the emergence of complex actions and responses from the teachers and students based on their actions (as researcher and co-teacher). They conclude by stating, “educational action research suggests that research is always and already a site for learning, and it is thus that educational action research can be wedded to the complexivist interest in the study of ‘learning systems’” (p. 368). If one is to pursue action research from a complexity theory perspective then Sumara and Davis (2009) suggest, “it is important to consider not just the original concerns and the desired ends, but the immediate
conditions for collective action” (p. 368). They refer to “complex co-action” as an important aspect of educational research that can only emerge if the necessary conditions are constructed through the researchers attention to what is occurring during the research process and potentially, actively evoke these points of bifurcation.

Phelps and Graham (2010) used a three-year action research project that they worked on called Technology Together to further illustrate the “complementary potential between action research and complexity theory” (p. 184). Technology Together was an action research project undertaken between SCU and the Catholic Education Office, Lismore Diocese with funding from the Australian Research Council. The focus was to “investigate the effectiveness of a metacognitive approach (one focused on teachers’ attitudes, values and beliefs) in supporting teachers’ learning with and about technology” (p. 184). They propose that the links between complexity theory and action research can be made through the following assertions that action research:

- accepts the inherent unpredictability of open, non-linear systems
- is consistent with notions of adaptation to environment
- can evoke processes of bifurcation
- embraces reflective processes
- agent interaction is central in action research.
- action researchers are interested in feedforward and feedback
- action researchers are interested in ‘exceptions’ (p. 187)

Each of these points of convergence between action research and complexity theory were evident in the Technology Together project. What Phelps and Graham (2010) concluded was that there is a “complexity of factors influencing technology learning for teachers” (p. 195). In this case they perceived “action research as offering possibility and potential to actively and positively provoke change in understandings and practice. In other words, it can be a process that schools engage in to help them to understand and work with the complex dynamic of technology learning” (p. 195). Furthermore, they conclude by stating “action research is not always consistent in every context with understandings from complexity theory, nor perhaps even with the deeper philosophical underpinnings of action research itself” (p. 195) and that there a number of factors including the ontological, epistemological and philosophical
positioning of those involved in the research (as researcher, participant, and financial supporter) that may be the cause of these tensions.

More recently Wood and Butt (2014) presented a small-scale action research project utilising complexity theory as a theoretical foundation. By so doing they were able to “understand the nature of dynamic pedagogical change” (p. 676) that resulted from the application of action research methods as they applied the pragmatics of transformation, as described by Davis and Sumara (2005). Wood and Butt (2014) concluded that by combining action research and complexity theory they were able to develop “emergence orientated approach to action research as a counter to more reductionist approaches which are often used and advocated in educational settings by teachers” (p. 676).

While there has not been a significant amount of research undertaken to date that combines complexity theory and action research, a number of researchers have recognised the compatibility of the two (see Phelps & Hase, 2002; Davis & Sumara, 2005). Phelps and Hase (2002) identified that action research and complexity theory share a similar underlying philosophy - a pragmatic understanding that action had the potential to facilitate transformation. The role of the participant action researcher within an educational setting is often one of an actor rather than an observer. In this role the researcher has the potential to create the context in which complex systems might be nurtured, thus promoting the type of behaviour that is inherent in complexity theory and action research contexts. An important point raised by Radford (2006) was that classrooms, where much action research is undertaken, are complex systems with non-linear variables and dynamic interactions. This type of environment is not conducive to action research that may be designed in a linear cause and effect manner.

The research in this thesis has been designed consistent with the conventional cyclical nature of action research, namely planning, acting, reflecting and planning for the next cycle. Each of the contexts in which the research was undertaken were different to each other due to the complex variables of pre-service teacher educators and student perceptions and experiences, and the researcher participant involvement. By adopting a philosophical approach aligned with the main tenets of complexity theory I have endeavoured to account for the complex nature of the teaching and learning environment.
4.6 Research Methods

A mixed methods approach was employed in this research that has been described by Johnson and Onwuegbuzie (2004) as a “natural complement to traditional qualitative and quantitative research” (p. 14). They suggest that mixed methods is an “expansive and creative form of research” that can provide the researcher with “multiple approaches …rather than restricting or constraining the researcher’s choices” (p. 17). By using a mixed methods approach to data collection and analysis the researcher can create research instruments that gather both qualitative and quantitative data. A mixed methods approach also facilitates the inclusion of both qualitative and quantitative findings.

Lichtman (2012) states, “in qualitative research the process moves back and forth between data gathering/collection and data analysis rather than in a linear fashion from data collection to data analysis” (p. 15). This research was primarily opportunistic in selection of the research site, sampling and data collection processes. Patton (2002) states, “opportunistic, emergent sampling takes advantage of whatever unfolds as it unfolds” (p. 240). Allowing for the emergence of new leads is consistent with complexity theory and with the process of participatory action research, as the cycles of implementation and evaluation are effected through reflection on what has actually happened rather than what might have been pre-determined.

4.6.1 Sampling

The sampling method used in this research was purposeful as consistent with qualitative research. The research aim was to focus on pre-service teacher education and as such the sample was derived from a pre-service teacher education program. As a participant researcher that program was the one in which I was situated. The research aim was not to compare pre-service teacher education programs therefore the sampling was contained within the site at which I was a participant. Within the purposeful sampling was an opportunistic sampling approach. Patton (2002) recommends that opportunistic or emergent sampling allows the researcher to make “on-the-spot decisions …to take advantage of new opportunities during actual data collection” (p. 240). This approach was important for this research as there was a level of uncertainty about which pre-service teacher educators or students would use VWs in the first instance and whether they would continue to use VWs in order to conduct a number of research cycles.
In order to initiate a sample pre-service teacher educators were approached individually and invited to participate in this research. They were asked if they would be willing to introduce VWs in their units as part of an action research project that would require them to contribute to the design, planning, reflection and action of using VWs. The intention that a variety of pre-service teacher educators would be involved helped to facilitate a number of different perspectives on this research and to assist in the triangulation of the data across participants. Over the three-year period of the data collection six pre-service teacher educators were involved. Each of the pre-service teacher educators and the corresponding units were part of this research for varying lengths of time as the pre-service teacher educators either chose to no longer use VWs or were unable to due to their circumstances outside of this research. Two of the six units were included in all three-research cycles (i.e., three iterations of the same unit), one unit was included for two cycles and three units were included for one cycle. Section 4.7 describes each of the units.

The sample of student participants was drawn from each of the units of study in which VWs were introduced. The number of students exposed to VWs was relatively high (approximately 1500) however not all of the students were required to participate in activities or to be part of this research. A total of 578 students participated in VW activities (in workshops and in building) and 478 students provided data based on their written response to assessment tasks, surveys and interviews. Table 4.1 provides a breakdown of student participation. As such the initial sample was potentially high but the actual sample from which data could be collected was low. This resulted in intensity sampling occurring through the emergence of specific case studies. One specific case was an extreme or deviant case sampling. The student discussed in Chapter 7 was an exception that provides a rich insight into the factors that influence the level of readiness of pre-service teachers to introduce, develop and support innovative teaching-learning processes using VWs.

4.6.2 Data collection

Data were collected using interviews, surveys and student reflections (provided as part of written assessment activities). Observation of the pre-service teacher educators and students by the researcher, and reflections provided in less formal interactions from all of the participants, were utilised to check the formal responses. Participant feedback
provided via email and verbally, was also used to help check and formulate new responses to VWs and in the ongoing design of survey instruments and interview questions. The mixed methods used in collecting the data acted as a triangulation of methods (Patton, 2002).

Overall there were six pre-service teacher educators and approximately 1,500 students introduced to VWs through their participation in this research. Table 4.1 provides an overview of the response numbers with each item described more fully in Section 4.7.

<table>
<thead>
<tr>
<th>Units</th>
<th>Students</th>
<th>Pre-service teacher educators</th>
<th>Wrote about VWs</th>
<th>Participated in VW workshop</th>
<th>Used VW building tools</th>
<th>Survey responses</th>
<th>Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1,551</td>
<td>6</td>
<td>360</td>
<td>362</td>
<td>216</td>
<td>107</td>
<td>11</td>
</tr>
</tbody>
</table>

Four pre-service teacher educators were interviewed at the beginning and the end of each of the cycles they participated in. The interviews were semi-structured with consistently similar questions asked of each pre-service teacher educators at each stage. Some deviation in the questions was undertaken in response to the answers that were given at the time of the interview. Transcriptions of the interviews were given to the pre-service teacher educators to check the veracity of the content (member checking). The interview questions are presented in Appendix A. The two other pre-service teacher educators in this research that were not interviewed include Jane who was part of the pilot phase (Section 5.2) and did not participate in the data collection and myself. As the participant researcher I have included my responses to the set of interview questions as though I were being interviewed (Section 5.4).

Five students were interviewed based on their higher level of participation in the use of VWs than the rest of the students. Four of them were interviewed at the conclusion of their projects and one student was interviewed at two points in this research; after her first project and at the conclusion. The responses from the students were used to generate the factors that had influenced them to become more immersed in VWs while the survey data and students’ feedback generated data about the factors that had restricted the students’ engagement. These students were identified as able to form the basis of a case study given the extent to which they engaged with the VW activity, and the need to explore how these experiences influenced their approach to the
teaching and learning processes. The decision to not interview students who did not use the VWs was consistent with there being a high level of data already from this group gathered through the research instruments used within each of the Units and cycles. With the focus of the research being on whether the use of VWs could foster innovative teaching and learning processes, those who did not engage in the use of VWs were less likely to provide rich data on the influence of VWs in their approach to teaching and learning processes.

Four different surveys were created and administered to students. The surveys were designed to ascertain the students’ responses to the VW activities they had experienced, their perceptions of VWs and their response to the level of impact that VWs had on their perceptions of the teaching-learning process. The survey questions are presented in Appendix B. In some of the units there was a relatively low response rate. Table 4.2 outlines the focus of the surveys and the units within which they were located.

<table>
<thead>
<tr>
<th>Survey</th>
<th>Cycle</th>
<th>Unit</th>
<th>Focus</th>
<th>Student responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey 1</td>
<td>1/2/3</td>
<td>3</td>
<td>Knowledge of VWs and previous experience with VWs.</td>
<td>55</td>
</tr>
<tr>
<td>Survey 2</td>
<td>2</td>
<td>2/4/5</td>
<td>Factors that influenced the reasons they choose not to use VWs for an assignment option.</td>
<td>11</td>
</tr>
<tr>
<td>Survey 3</td>
<td>2</td>
<td>6</td>
<td>Response to using VWs for a role-play activity and the extent to which VWs influenced their understanding of the topic.</td>
<td>15</td>
</tr>
<tr>
<td>Survey 4</td>
<td>3</td>
<td>5</td>
<td>Influence of VWs on their approach to the teaching-learning process. Factors that influenced the choices they made in relation to their engagement in VWs.</td>
<td>26</td>
</tr>
</tbody>
</table>

4.6.3 Analysis

The first step in the analysis of the data was to develop a system for classifying and coding the data. In the first instance the data generated from the blog posts of Unit 3 was imported into NVivo. The decision to use NVivo was based on the assumption that it would provide the tools to highlight and classify the text in a manner that would return a rich picture of the students’ responses. However due to the ability to code every word, sentence or paragraph NVivo became unmanageable especially as the data grew. Therefore, the initial classification that was undertaken in NVivo was transferred to a slightly more manual process that involved pen and paper markups of transcripts and the input of numbers and responses into an electronic spreadsheet.
Content analysis was undertaken on the data, which Patton (2002) describes as involving “identifying, coding, categorizing, classifying, and labeling the primary patterns in the data” (p. 463). This process, initially, required looking for what was most significant in the interview, surveys and student reflections. This inductive analysis allowed for the emergence of patterns, themes and categories. Utilising an inductive analytical process is in keeping with action research and complexity theory as the researcher approaches the data without preconceived notions of what the data will reveal. Corbin and Strauss (1990) describe this as open-coding with the purpose being to “help the analyst gain new insights into the data by breaking through standard ways of thinking about (interpreting) phenomena reflected in the data” (p. 423). In order to limit subjectivity and bias when open-coding it is necessary to constantly question the criteria being applied to determine a category and to make comparisons between the data in each category.

The use of open-coding and inductive analysis is consistent with a grounded theory approach. However according to Dick (1999 cited in Dick, 2005) this is also common to action research. The main difference between grounded theory and action research is the position of the researcher within the context of the research in that an action researcher is often a participant in the research and is committed to the research outcome leading to change. Whereas grounded theory’s main focus is to “generate theories regarding social phenomena” (Lingard, Albert, & Levinson, 2008, p. 459). The grounded theorist becomes “immersed in the data” (Patton, 2002, p. 454) but not necessarily immersed in the process that is being researched as a participant researcher may be.

Once an inductive analysis was conducted on the initial set of data the categories were utilised in subsequent analysis in a more deductive process. What emerged was an analyst-constructed typology. Patton (2002) suggests that by “creating analyst-constructed typologies through inductive analysis, you take on the task of identifying and making explicit patterns that appear to exist but remain unperceived by the people studied” (p.459). As I was a participant researcher the concern that Patton raises in terms of the analyst-constructed typologies imposing meaning on participants “that better reflects the observers world than the world under study” (p. 460) is lessened.
Section 8.3 utilises the analyst-constructed typologies through the phases of engagement and level of readiness models.

In order to determine substantive significance of the data analysis Patton (2002) suggests that the researcher must in the first instance rely on “their own intelligence, experience and judgement; second, they should take seriously the responses of those who were studied or participated in the inquiry; and third …consider the responses and reactions of those who read and review the results” (p. 467). Patton calls this consensual validation when all three agree. Throughout this research, and as part of the action research methodology, the responses and reactions from each of these three levels of participant was considered and the feedback utilised to confirm or change the categories that were being applied. In this research the third level of respondent included the peer review of publications during candidature, as well as the expert advice of those supervising the thesis.

The back and forth between researcher, participant, reviewer and prior data results in a logical analysis. The process has the potential to create new typologies that may not be actually found in the data. The applying of a logical analysis with the discovery of findings has been called abduction by Levin-Rozalis (2000). Therefore, the use of inductive and deductive analysis with logical underpinnings might be one way to describe abduction (Denzin, 1978). Including one’s own logical assumptions to the data is particularly relevant to participatory action research. This allows for the participant researcher to insightfully incorporate their own experience.

Bassey (2001) states, “generalization in the form of prediction is what is usually wanted” (p. 12) by the user of research. In educational research and from a complexity theory perspective no two contexts will be the same making generalization difficult. However Bassey recommends that fuzzy predictions or generalisations are a solution. He claims that because educational research is about human beings it “inevitably embraces a multitude of variables” and “fuzzy predictions with best-estimates-of-trustworthiness may provide a powerful tool for researchers to communicate with potential users of research and also to develop a cumulative approach to the creation of educational theory” (p. 20).
In this research a combination of inductive, deductive and abductive analysis was undertaken as part of an action research meta-methodology and a complexity theory paradigm. A series of analyst-constructed typologies were constructed and tested through peer review, checking with participants (member checking) and cross-checking with the data. The analyst-constructed typologies include the development of the phases of realisation and engagement model (Section 8.4) and a checklist for evaluating VWs. The checklist for evaluating VWs was the initial analyst-constructed typology that was peer reviewed through publication in Jacka and Ellis (2011). The phases of realisation and engagement models were first peer reviewed in Jacka & Ellis (2012) and adapted after iterative testing occurred as part of this thesis.

4.7 The Macro-Cycles

The research consisted of three macro-cycles representing each of the calendar years (2011, 2012, 2103) and 11 micro-cycles representing each of the units of study. Figure 4.1 illustrates the Cycles and the Units that occurred within each macro- and micro-cycle.
Figure 4.1 The action research cycle applied to the macro- and micro-cycles in this research. Each macro-cycle has within it a number of micro-cycles. Two of the micro-cycles continued across three macro-cycles (Unit 2 and 3) and one micro-cycle continued over two of the macro-cycles (Unit 5).
4.7.1 Cycle one

Cycle 1 was a pilot study phase undertaken in 2011 across session one and two of the academic year. Two student cohorts were involved and three pre-service teacher educators. One student cohort was involved in both Unit 1 and Unit 2. The students in that cohort were in their second year of the Bachelor of Education (Primary) degree. The other cohort was part of the Bachelor of Education (Secondary) program. Table 4.3 shows the number of students who actively participated in VW activities. The highlighted numbers (bold and shaded) indicate those that were included as part of the quantified data analysis.

Table 4.3 Number of students participating in each Cycle 1 activity

<table>
<thead>
<tr>
<th>Research activity</th>
<th>Unit 1</th>
<th>Unit 2</th>
<th>Unit 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Created an educational resource in Second life</td>
<td>17</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Wrote about VWs as a part of an assessment task</td>
<td>0</td>
<td>10</td>
<td>108</td>
</tr>
<tr>
<td>Participated in a VW workshop in a computer lab</td>
<td>12</td>
<td>0</td>
<td>84</td>
</tr>
<tr>
<td>Participated in a VW workshop in Second Life</td>
<td>5</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Responded to Survey 1</td>
<td>0</td>
<td>0</td>
<td>22</td>
</tr>
</tbody>
</table>

*bold and shading indicate the numbers included in the quantified data analysis

4.7.2 Cycle two

Cycle 2 was undertaken in 2012 across session one and two of the academic year. Five micro-cycles (five different units) were involved and thus represent an intense period of data collection. Three of the micro-cycles were in session one (Unit 4, 5 and 2) and two were in session two (Unit 3 and 6). Each of the units was unique in their approach and as such a variety of data collection methods were used (Table 4.4). Changes in the activities and resources were made to units in Cycle 2 as a result of Cycle 1 and are described in Chapter 5. The number of students that participated in VWs is outlined in Table 4.4. In Cycle 2 four of the pre-service teacher educators were interviewed.

Table 4.4 Number of students participating in each Cycle 2 activity

<table>
<thead>
<tr>
<th>Research activity</th>
<th>Unit 2</th>
<th>Unit 3</th>
<th>Unit 4</th>
<th>Unit 5</th>
<th>Unit 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Created an educational resource in Second life</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Wrote about VWs as a part of an assignment</td>
<td>28</td>
<td>79</td>
<td>0</td>
<td>0</td>
<td>57</td>
</tr>
<tr>
<td>Participated in a workshop in a computer lab</td>
<td>35</td>
<td>52</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Participated in a workshop in Second Life</td>
<td>0</td>
<td>8</td>
<td>7</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Participated in a role-play in Second Life</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>57</td>
</tr>
<tr>
<td>Responded to Survey 1</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Responded to Survey 2</td>
<td>2</td>
<td>0</td>
<td>7</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Responded to Survey 3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Participated in a semi-structured interview</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

*bold and shading indicate the numbers included in the quantified data analysis
4.7.3 Cycle three

Cycle 3 was the concluding cycle undertaken in 2013 across session one and two of the academic year in which three micro-cycles occurred. Two of the micro-cycles were in session one (Units 2 and 5) and the remaining unit was in session two (Unit 3). All three units in Cycle 3 had been involved in at least one previous cycle. The cohorts in Unit 5 and Unit 2 had previously experienced VWs in Cycle 2 in Unit 2 and 6. Unit 3 involved a new cohort of students. Table 4.5 shows the number of students involved in VW activities in Cycle 3.

<table>
<thead>
<tr>
<th>Research activity</th>
<th>Unit 2</th>
<th>Unit 3</th>
<th>Unit 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Created an educational resource in Second life</td>
<td>0</td>
<td>0</td>
<td>27</td>
</tr>
<tr>
<td>Created an educational resource in SoaS</td>
<td>0</td>
<td>0</td>
<td>133</td>
</tr>
<tr>
<td>Created an educational resource in Minecraft</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Wrote about VWs as a part of an assignment</td>
<td>8</td>
<td>124</td>
<td>0</td>
</tr>
<tr>
<td>Participated in a workshop in a computer lab</td>
<td>20</td>
<td>63</td>
<td>0</td>
</tr>
<tr>
<td>Participated in a workshop in Second Life or JokaydiaGRID</td>
<td>0</td>
<td>11</td>
<td>38</td>
</tr>
<tr>
<td>Responded to Survey 1</td>
<td>0</td>
<td>23</td>
<td>0</td>
</tr>
<tr>
<td>Responded to Survey 4</td>
<td>0</td>
<td>0</td>
<td>26</td>
</tr>
</tbody>
</table>

*bold and shading indicate the numbers included in the quantified data analysis

4.8 The Micro-Cycles

This section provides an overview of the six units of study that were sites for the introduction of VWs and the collection of pre-service teacher educators and students’ responses. Each of the units represents a micro-cycle with some units involving more than one micro-cycle.

4.8.1 Unit one

Unit 1 was designed to introduce students to the curriculum area of Science and Technology for the primary classroom. The unit was run on three campuses, and in session one, 2011 involved 225 students.

The students were sent an introductory email describing this research and asking for participants to utilise VWs as part of one of their tutorial activities; 17 students volunteered. Twelve of the students participated in face-to-face workshops located in a computer lab at the Lismore campus. The other five students were located externally in Coffs Harbour (n=3) and the Gold Coast (n=2). These five students attended
separate workshops facilitated through the use of Second Life. I was the tutor who met with them virtually while they worked together from the same physical location. All 17 students attended a minimum of four hours of workshops over a two-week period. Table 4.6 details the number of students who participated in VW activities over the three cycles as part of Unit 1.

Table 4.6 Number of students who participated in VW activities in Unit 1

<table>
<thead>
<tr>
<th>Research activity</th>
<th>Cycle 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designed and created a VW environment in response to an activity to assist students to understand the design process in relation to sustainable design principles</td>
<td>17</td>
</tr>
<tr>
<td>Participated in two, two hour VW workshops in an on-campus computer lab</td>
<td>12</td>
</tr>
<tr>
<td>Participated in two, two hour VW workshops conducted in Second Life</td>
<td>5</td>
</tr>
</tbody>
</table>

4.8.2 Unit two

Unit 2 was designed to introduce pre-service teachers to Learning Technologies with a focus on technology in the early childhood, primary and secondary classroom. All Bachelor of Education students were required to undertake Unit 2. The unit was run on three campuses and over the three cycles there were approximately 548 students introduced to VWs. They were given the option to engage in the use of VWs in a variety of ways; by creating a digital resource, making a written comment in their portfolios, participating in workshops or responding to a survey. Table 4.7 details the number of students who participated in VW activities over the three cycles as part of Unit 2.

Table 4.7 Number of students who participated in VW activities in Unit 2

<table>
<thead>
<tr>
<th>Research activity</th>
<th>Cycle 1</th>
<th>Cycle 2</th>
<th>Cycle 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used the building tools in Second Life to create a VW environment suitable for use with a K-6 class</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wrote about VWs as a part of an assessment task</td>
<td>10</td>
<td>28</td>
<td>8</td>
</tr>
<tr>
<td>Participated in one, two hour VW workshops in one of the on-campus computer labs</td>
<td>0</td>
<td>35</td>
<td>20</td>
</tr>
<tr>
<td>Responded to Survey 2</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

In Cycle 1 the same cohort of students were enrolled in Unit 1 and Unit 2. These students were given the option to utilise VWs in one of their assignments and to reflect on the use of VWs in the classroom as part of their reflective portfolio. All students were provided with resources about VWs in education in the equivalent manner to other technology described in the content of Unit 2. In Cycle 1 students were not provided with any hands-on workshops instead they were offered the option
of contacting the researcher if they needed specific assistance to utilise the VW. One student chose to use Second Life to create a digital resource for her assignment. She is discussed in detail in Chapter 7.

In response to feedback from students in Cycle 1, hands-on workshops were made available to students in Cycle 2. The workshops were voluntary and a total of 30 students participated. The resources provided to the students were modified to include details about how to access VWs and why to use them in K-12 education. The option to use VWs to create a digital resource for one of their assignments was maintained. In Cycle 2 no students used VWs to create a digital resource. Students were also provided with the opportunity to reflect on their perceptions and/or experience of VWs in their portfolio. Thirty-five students made reference to VWs and these responses are discussed in Section 6.2.2.

In Cycle 3 major changes were made to Unit 2. The researcher redesigned the unit. A topic was created called Having Fun in which the use of VWs and Games Based Learning was the content focus. The assessment task no longer required a digital resource to be created. A choice of reflective scenarios was provided for the students to make comments on. Due to the redesign all of the students were required to engage with some content about VWs. However they were not required to make any reflective comments. In Cycle 3 eight students responded to the scenario focusing on VWs and their comments are analysed in Chapter 6.2.3.

4.8.3 Unit three

Unit 3 was designed to provide students with a broad understanding of curriculum, assessment and new media. The unit was broken down into three discreet modules focusing on each of these three areas. Within the New Media module all students enrolled in the Bachelor of Education (Secondary) were exposed to the use of VWs in education. The New Media module was written by the researcher. All of the students were required to write a reflective blog post about their perceptions and/or experience of VWs. Table 4.8 details the number of students who participated in VW activities over the three cycles as part of Unit 3.

Unit 3 was included in all three cycles of this research. For each cycle the students were provided with resources, a face-to-face lecture and hands-on workshops that discussed
the use of VWs in education. The changes made between each cycle built upon feedback and observations that the researcher gathered during and after each cycle. A thematic analysis and an analyst-constructed typology were created from 311 blog posts and 55 survey responses. Unit 3 is discussed in more detail in Section 5.4 and 6.3.

<table>
<thead>
<tr>
<th>Research activity</th>
<th>Cycle 1</th>
<th>Cycle 2</th>
<th>Cycle 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrote about VWs as a part of an assessment task in which they reflected on the</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>topic of VWs &amp; game based learning</td>
<td>108</td>
<td>79</td>
<td>124</td>
</tr>
<tr>
<td>Participated in one, two hour VW workshops in one of the on-campus computer labs</td>
<td>84</td>
<td>52</td>
<td>63</td>
</tr>
<tr>
<td>Participated in one, two hour VW workshops in either Second Life, JokaydiaGRID</td>
<td>12</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>or PLANE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responded to Survey 1</td>
<td>22</td>
<td>10</td>
<td>23</td>
</tr>
</tbody>
</table>

### 4.8.4 Unit four

Unit 4 was designed to facilitate the transition to teaching by all students enrolled in the Bachelor of Education (Primary). The unit was run on three campuses, and in session one, 2012 involved 173 students. The content of the unit was presented through four topics pertaining to contemporary issues in the K-6 classroom. One of the topics was Digital Cultures in Education in which VWs were introduced. One of the assessment activities was to write an essay reflecting on one of the four topics and to present their research in the form of a digital presentation. The students were given the option to use the VW of Second Life in which to do their presentation. Prior to the presentations all students were offered the opportunity to attend weekly workshops held in Second Life to help them become orientated to the VW space. Seven students attended the workshops. Three students used Second Life for their presentation with two of the students agreeing to be interviewed (Sections 6.4.3 and 6.4.4).

All students in Cycle 2 were asked to voluntarily complete the same online survey, including students in Unit 2, 4 and 5. Seven students from Unit 4 completed the survey. The questions were designed to ascertain why the students made the choices they did about the use of VWs for their assignments. They were also asked to reflect on the usefulness of the resources in order to influence the types of future resources being designed. Table 4.9 details the number of students who participated in VW activities in Unit 4 and an analysis of the data are presented in Chapter 6.4

99
Table 4.9 Number of students who participated in VW activities in Unit 4

<table>
<thead>
<tr>
<th>Research activity</th>
<th>Cycle 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used the building tools in Second Life to create a VW environment in which to present information on one of four set topics</td>
<td>3</td>
</tr>
<tr>
<td>Participated in one or more VW workshops in Second Life</td>
<td>7</td>
</tr>
<tr>
<td>Responded to Survey 2</td>
<td>7</td>
</tr>
<tr>
<td>Participated in a semi-structured interview</td>
<td>2</td>
</tr>
</tbody>
</table>

4.8.5 Unit five

Unit 5 was designed to prepare students to teach the subject Human Society and its Environments in primary school. All students in the second year of the Bachelor of Education (Primary) were required to undertake Unit 5. During the period of this research, Unit 5 occurred in both Cycle 2 and Cycle 3. Students were given the opportunity to create work in the VW, write about VWs, and participate in hands-on workshops. Two different surveys were administered in which there were two responses in Cycle 2 and 26 responses in Cycle 3. Table 4.10 details the number of students who participated in VW activities over the two cycles that Unit 5 was part of. An analysis of the pre-service teacher educators response is presented in Section 5.6 and student responses in Section 6.5. A case study of one student is presented in Chapter 7.

Table 4.10 Number of students who participated in VW activities in Unit 5

<table>
<thead>
<tr>
<th>Research activity</th>
<th>Cycle 2</th>
<th>Cycle 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Created an educational resource in Second Life for K-6 students</td>
<td>3</td>
<td>27</td>
</tr>
<tr>
<td>Created an educational resource in SoaS for K-6 students</td>
<td>0</td>
<td>133</td>
</tr>
<tr>
<td>Created an educational resource in Minecraft for K-6 students</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Participated in one or more VW workshops in Second Life</td>
<td>3</td>
<td>38</td>
</tr>
<tr>
<td>Responded to Survey 2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Responded to Survey 4</td>
<td>0</td>
<td>26</td>
</tr>
<tr>
<td>Participated in a semi-structured interview</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

The first iteration of Unit 5 occurred in Cycle 2. As part of one of the assignments the students were required to create a digital resource. They were provided with guidance to help orientate them to Second Life and information about how and why to use VWs in K-6 education. Weekly hands-on workshops conducted in Second Life were offered for students to attend in their own time outside of regular tutorials. These resources were the same for Unit 4, 5 and 2 all being run concurrently in Cycle 2.
In Cycle 2 the students were given the option to use Second Life to create their digital resource. Three students chose this option. All three students were physically located some distance from the researcher and the main pre-service teacher educator. They were supported in the building of their resource through one-on-one meetings in Second Life. The three students are discussed in Chapter 6.5.1 and Chapter 7.

For the second iteration of Unit 5 in Cycle 3 all students were required to use Second Life or SoaS to create a digital resource. The same resources were provided as for Cycle 2. An additional hands-on face-to-face workshop was provided, as was a further hands-on workshop in Second Life, presented by one of the students from Unit 5, Cycle 2. The reasons the pre-service teacher educators chose to make VWs compulsory in Cycle 3 are discussed in Section 5.7. The responses from the students are discussed in Section 6.6.

4.8.6 Unit six

Unit 6 was designed to introduce students to Early Childhood Education. All students in the first year of the Bachelor of Education (Early Childhood) were required to undertake Unit 6. This unit was part of this research in Cycle 2. The unit was run on three campuses, and in session two, 2012 involved 57 students. All students were required to participate in a role-play activity that was designed and presented in Second Life on the School of Education Research Island (SERI). At the end of Unit 6 an online and in class survey was distributed with four responses provided online and 11 returned in class. Table 4.11 details the number of students who participated in VW activities in Unit 6. The analysis of students’ responses is discussed in Section 6.7 and pre-service teacher educators responses in Section 5.8.

<table>
<thead>
<tr>
<th>Research activity</th>
<th>Cycle 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participated in a Role Play in Second Life</td>
<td>57</td>
</tr>
<tr>
<td>Participated in a VW workshop in a computer lab</td>
<td>12</td>
</tr>
<tr>
<td>Responded to Survey 3</td>
<td>15</td>
</tr>
</tbody>
</table>

Resources were provided to the students to help orientate them to the VW in terms of their own use and the potential for use in the early childhood setting. An Early Childhood Centre was created on the SERI. The intention was to utilise the ability of Second Life to provide a simulated space to role-play professional practice. The
practice could be undertaken on a number of occasions to assist the students to become confident in their practice.

The students had four weeks to prepare their response to a set scenario and to practice using the VW space to role-play the scenario. The role-play required them to either speak a script or type into the text chat. The role-play was recorded by the researcher and placed on the LMS for them to view during group tutorials for discussion. Over the four weeks the students were offered the opportunity to meet with the researcher in order to gain assistance in using Second Life.

4.9 The Virtual World Research Site

In the first year of this research a small parcel of land on the islands that SCU rented in Second Life was used in order to create content and introduce pre-service teacher educators and students to VWs. The limited access to space (in Second Life land terms) and resources (prim allocation) meant that there were restrictions to what could be offered to the pre-service teacher educators and students. As a result a small internal grant to support the rental and development of a bespoke education environment in Second Life was applied for, and received. Thus, in Cycles 2 and 3 SERI in Second Life was designed to research the impact that the use of VWs would have on pre-service teacher educators and students’ readiness to develop innovative teaching-learning processes.

The design for SERI was based on observations and conversations with pre-service teacher educators and students who had used VWs in the first year of this research in order to ascertain what would best support their introduction to VWs. Research was also conducted based on the literature and visiting other VW environments. The majority of pre-service teacher educators and students who were going to use SERI were new to VWs. With this in mind the features were intentionally designed to help new users to orientate themselves. They included being:

- Easy to find (all of the learning spaces were located along a straight path that begins at the orientation point)
- Easy to navigate (all of the learning spaces could be accessed by ‘walking’ with no need to fly or teleport)
• Easy to operate (all initial instructions were presented on boards.
  No need to click to access notecards) (Jacka & Ellis, 2012, p. 829)

SERI changed as the requirements of the pre-service teacher educators and students changed. Gradually more of the permanent spaces were removed to make room for more student builds. The four spaces that remained consistent were the landing spot, early childhood centre, interactive maths playground and the sandbox.

The landing spot was the first place that a new user would come to when arriving on SERI. At this place there was a series of instructional posters placed on static, flat boards. New users were able to read basic instructions relating to avatar skills without needing to visit other orientation islands. The landing spot and orientation area was placed just next to the sandbox and at the central part of an L shaped road (Figure 4.2). A welcome mat with a script embedded in was situated at the landing spot. The welcome mat sent email alerts about a new user arriving on the island facilitating the monitoring of these arrivals in order to enter the VW and provide support.

The sandbox was an important and central feature of SERI. The ability to create content by using the building tools in Second Life was one of the activities undertaken by students in this research. The sandbox offered a safe space in which to learn how to use the building tools and to experiment with the various elements of a VW (navigating, teleporting, avatar appearance, building, buying, importing and exporting). The SERI sandbox had the appearance of a beach on one level and a coral
reef on a level below the beach. Next to the sandbox there was a room that had free objects that pre-service teacher educators and students could use. The intention was to provide some resources that could be used without students needing to build everything from scratch and without needing to source the materials themselves.

An Early Childhood Centre was designed to be used by the pre-service teacher educators and students working in Early Childhood Education (children aged 0-8). The space had the look and feel of an Early Childhood Centre that might be found in the non-VW (Figure 4.3). Aspects included a colourful, open play area with artworks, toys and cushions, a space for pre-service teacher educators and parent meetings, a director’s office, storeroom, kitchen and toilet area. There was an outdoor playground to provide interactive play for the students to develop confidence in navigating and interacting with the VW. This area was used as part of the role-play activities in Unit 6, Cycle 2 (Section 6.6).

A pre-service teacher educators, prior to the commencement of this research, created an Interactive maths Playground. She was not involved in the delivery of any units of study in the School of Education but had a background in maths and an interest in VWs. She used the 3D building tools in Second Life to design an interactive environment (Figure 4.4). The intention was to provide examples of ways that complex maths concepts could be explored through highly visual 3D forms. Examples included; an area for exploring the graphs of cost, revenue and marginal functions for
business education, physical representations of interesting numbers, Pascal’s triangle, as well as a Tesseract and Escher’s relativity model.

Figure 4.4 The interactive maths playground. The entrance asks the visitor to move through the central space while only passing through each of the objects once.

In the third year of this research two islands in the VW of JokaydiaGRID were rented in order to research the impact that shifting the focus away from Second Life would have on pre-service teacher educators and students perceptions and experience. On these two islands (Arbennik Island 1 and 2) tours and workshops were conducted and the work that primary school children had created in SoaS was displayed (Figure 4.5). In 2012 a workshop as part of the VWs Best Practice in Education (VWBPE) conference was hosted on Arbennik Island in JokaydiaGRID and was attended by a number of international educators.

Figure 4.5 Arbennik Island in JokaydiaGRID showing some of the builds created by primary school children in SoaS. The dome on the left is a ladybug project and the buildings on the right are part of a project on local history in which the children created buildings in response to researching the local history of the village they live in.
Apart from the physical spaces designed and built in the VWs of Second Life, SoaS and JokaydiaGRID, activities and resources were created to introduce the pre-service teacher educators and students to VWs. Some of the activities and resources were designed to introduce VWs in a manner that did not require the students to be immersed in the VW environment. Each of the activities and resources are described in Chapter 5, 6 and 7 as part of the units in which they were situated. An overview is provided here:

**Immersive experiences that students engaged in:**

- Sustainable design project (Section 5.2.1, 7.3)
- Role play (Section 5.2.6, 6.6)
- Building VW teaching and learning resources (Section 5.2.1, 5.2.2, 5.2.5, 6.2.1, 6.5, 7.3, 7.4, 7.5)
- Exploring a VW as part of pre-service teacher educators led workshops (Section 5.2.1, 5.2.2, 5.2.3, 5.2.4, 5.2.5, 5.2.6)

**Experiences that did not require immersion in a VW:**

- Writing a reflection on the role of VWs in education (Section 5.4, 5.5, 6.2.2, 6.2.3, 6.3.2)
- Watching machinimas of VW environments (Section 5.2.1, 5.2.3, 5.2.4, 5.2.5, 5.2.6)
- VW resources embedded in LMS unit information (all units)

**4.10 Summary**

In this chapter the philosophical alignment with complexity theory and the use of action research as a meta-methodology has been discussed. The role that action research has in educational research and the capacity for it to assist in the understanding of processes of change in education was evaluated in the context of this research. An overview of the processes and the research cycles were presented. Each macro- and micro-cycle was described to provide a descriptive detail of the research methods used in order to gather the responses of pre-service teacher educators and students. The following three chapters present the data that was gathered from the pre-service teacher educators, the students and a case study of one student.
Chapter 5  Pre-service Teacher Educators' Responses and Reflections

This chapter describes the input that pre-service teacher educators had in the implementation of the VWs in each of their units, as well as their responses and reflections, before and after, the implementation process. As outlined in Section 4.7.3 I was the pre-service teacher educator involved in teaching Unit 3, and the data associated with this unit is drawn from my own reflections and critical analysis of my own experiences. At the conclusion of the chapter changes that were made in each of the cycles based on the pre-service teacher educators input and responses are discussed.

5.1  Introduction

Over the three cycles of this research six pre-service teacher educators were involved. I represent one of the pre-service teacher educators as the designer and lecturer for one of the topics in Unit 3. I also worked with all of the pre-service teacher educators in the development and delivery of the VW activities in their units. My experience is articulated as part of the analysis throughout this and other chapters. Of the five other pre-service teacher educators, four were interviewed. The pre-service teacher educator who was not interviewed is represented in Unit 1 as part of the pilot phase. The other four pre-service teacher educators were involved over varying lengths of time: Unit 2 (3 cycles); Unit 5 (2 cycles); Unit 6 (1 cycle); and Unit 4 (1 cycle). Unless otherwise referenced all text in quotations in this chapter is from the interviews conducted with the pre-service teacher educators. They have been identified through the use of pseudonyms.

5.2  Unit one - Jane

Jane designed and delivered Unit 1 and was the first pre-service teacher educator to agree to the inclusion of a VW activity as part of this research. She had anticipated that she would use the VW in subsequent iterations, however an unforeseen redesign of the unit (unrelated to this research project or to the use of VWs) precluded the future use of VWs. Jane had never used VWs before but she felt that it would provide an opportunity for students to undertake a traditional tutorial activity, of building a
sustainable design project, in a more authentic space. The focus of Unit 1 was on the curriculum area of Science and Technology for primary school. One of the workshop activities undertaken in Unit 1 was the exploration of sustainable design through the creation of a model using the types of craft materials regularly found in a primary school classroom (such as pipe cleaners, cardboard, wool and paint).

With the introduction of VWs the students were given the opportunity to create their model in Second Life using shapes and textures that simulated a range of complex equipment and resources in relation to sustainable design (such as solar panels, wind turbines, wood, tin, vegetation and their own imagined versions of future sustainable design); thus presenting a more authentic and potentially more transferable model of a sustainable design project. The students were able to create and access objects that simulated sustainable design, experiment with their placement, proportion and functionality in a way that was not possible with the craft materials. They were also able to collaborate with other pre-service teacher educators and students across SCU campuses.

Prior to the tutorials a space on one of the SCU Second Life islands was developed into an example of sustainable design, with the construction of a sustainable building that included simulations of solar panels, open spaces, rainwater tanks and vegetable gardens. The space was used as a meeting area in which tutorials were conducted with the students to discuss the concepts of design principles and sustainability. The first tutorial was spent exploring the basics of orientation in the VW (creating an avatar and navigation). Students discussed design principles as they explored some of the 3D objects that I had created to help illustrate the concept of design principles. In the second tutorial the students were instructed in basic building techniques (selecting and manipulating prims – the primitive shapes that all objects in Second Life are made from, choosing textures and purchasing objects in the marketplace). They were then required, in groups, to create sustainable design structures. They were not expected to spend additional time other than the allocated tutorial times.

The non-VW tutorials in Unit 1 were designed to be hands-on as the students’ explored activities that could be undertaken by primary school students in the curriculum area of Science and Technology. Jane had a background in graphic design, technology and science, as such, VWs provided her with an opportunity to bring together these areas of interest and skill. A key motivation for Jane to embrace VWs was her desire to explore
innovative technologies as well as to extend the creative possibilities and problem solving skills of the students. A discussion of creativity, VWs and education in the context of Unit 1 is published in Jacka, Logan, and Ellis (2011).

Jane and I decided to implement a VW activity that would highlight the VW affordance of being able to do something that could only be done in the non-VW at a much higher cost and greater amount of time. In a short period of time (two 2hr tutorial sessions) the students were asked to build a sustainable design project that could be walked through using simulated materials in Second Life. At the early stage of this research experimentation occurred to test the level of what could be achieved by the students, the pre-service teacher educators and the VW. The literature suggested that most novice VW users are given a significant amount of lead-time before they are expected to create objects or environments. However, the experiences from Unit 1 suggested that the students were very quickly able to negotiate the requirements of the VW and the building tools. All four groups produced very creative work that demonstrated futuristic ideas about sustainable design. The students did not need extensive skill-based teaching to be able to construct objects that replicated their ideas about sustainable design. They engaged in experiential learning as they negotiated with the tools in Second Life to turn their sustainable design ideas into realistic simulations that could be interacted with and tested in the VW.

Due to the short time frame it was not feasible to spend time teaching the students how to build in the VW before allowing them to build their actual product. Instead the students learnt how to use the tools of the VW by interacting with the VW interface and actively experimenting with tools and options. Experiences of the students in the tutorials revealed that they were able to create work in Second Life with limited instruction and limited time. This observation influenced the choices that were made about the teaching-learning processes used in future iterations when students were going to began creating in VWs.

5.3 Unit two - Beth

Beth was involved with this research through all three cycles as the main pre-service teacher educator who delivered Unit 2. She was interviewed twice; pre and post her involvement. Throughout this research, Beth and I engaged in numerous
conversations and email interactions reflecting on our perceptions about how well the students were responding to the VW concepts and activities. Based on our ongoing reflections we refined the ways we were implementing VWs. Prior to this research Beth had no experience with VWs and over the three cycles she spent a total of approximately 15 hours in Second Life.

Unit 2 was focused on Learning Technologies for primary school. In Cycle 1 and 2 there was a small amount of content about VWs as part of the topic on online learning. VWs were also offered as an option in one of the assessment items to develop a digital resource. In previous years the resource was focused on the creation of a website. With the inclusion of VWs the students were encouraged (although not required) to create a VW resource. The second assessment item was a portfolio in which the students reflected on their past, present and future use of technology. They had the opportunity in the portfolio to include VWs as a technology that they were interested in. In Cycle 3, after a rewrite of Unit 2, a whole topic was devoted to VWs and games based learning. Rather than creating a digital resource or a portfolio students were required to work through weekly online activities. The newly developed topic Having Fun – Game Based Learning and VWs included two activities. The first asked students to visit the VWs Second Life, JokaydiaGRID, PLANE or SoaS. The second invited them to comment on a classroom scenario that involved the inclusion of game based learning. The students were encouraged (although not required) to engage with these activities.

At the beginning of the first interview Beth stated that she considered her philosophy of teaching and learning to be constructivist. She felt that students should construct their own learning and that this was not a linear process. She also felt that it was important for her students to develop skills in personal reflection and to be given the time and encouragement to undertake reflection of their practice as teachers. By providing the opportunity for reflection Beth felt that students would be able to extend how they were responding to assessment activities. She believed that students had “a busy schedule and were mostly concerned with completing assignments in the most time efficient manner” rather than in a manner that extended their knowledge and skills.

Beth believed that in order for students to be innovative in their use of technology they needed time, space, motivation and skills. She felt that students would not move
beyond only doing what was required to pass the unit unless they had enough skills to stop them being stressed about using technology. The natural progression for a student being that they first work at what they need to do to pass the unit and then, the more motivated ones, move on to trying something more challenging. The result of the students progressing beyond basic requirement is “they don’t know there is the potential to do it differently until they are in the process of using the technology”.

Being able to adapt their pedagogy was one of the points that Beth felt was important if students were going to fully utilise innovative technology. She had observed in one of the VW hands-on workshops that the teacher no longer had to “be sitting in front of the class to teach the class”. She watched as the students worked to problem solve and reflected that the students “ask someone to help them figure it out and then once they’ve learnt it, they share it with someone else”. Beth was able to see that the process the students engaged in provided them with “more opportunity for collaboration, creativity and a different pedagogy, one where they’re accepting that their students don’t need to be taught everything from the teacher”.

While identifying as a constructivist Beth reflected that most of her teaching was very teacher directed. She described her preferred method of teaching as one in which she gave the students questions to answer that are directed by her. Beth felt that the VW had the potential to be more of “an open-ended task where they go in, they explore, they share and they create” and as such it had greater potential than a project or a web-based task, to be student-centred. Her own “notions of learning” were being challenged by the use of the VW as “the concept of creating a really engaging learning environment really appealed to” her. However, Beth was “daunted and unsure” about what that type of learning environment looks like but she thought that it “would have elements of compulsory thinking and planning and link very clearly to an area of the curriculum”. All of these experiences that Beth had while using the VW and observing students in the VW led her to believe that she would consider different ways to use VWs in the future.

One of the reasons Beth had initially decided to include VWs in Unit 2 was that she felt it offered an opportunity to provide the students with an experience of a technology that was “happening in the real world of teaching and that the students need to be prepared for because they’re going into a different educational world to the
one that we have prepared them for before”. She believed that the students needed “different skills to the skills that we used to teach, let’s say 10 years ago”. She described the types of skills previously taught as “basic types of skills where you learn how to word process and you learn how to save this and are stepped through a process”. Beth felt that the focus now should be on “designing and creating with more of an emphasis on creative problem-solving” because children in the classroom were already using VWs and other multi-modal texts such as “importing video and sound, using websites and interacting and playing and then designing their own games”. As such teachers need to “use more of the online environment such as VWs in school” and if her students have “never experienced something in the VW they’re going to find it difficult to think outside the pen and paper approach that is mostly dominating and has dominated the classroom”.

Beth went on to describe her perceptions of school children and the divide between what is being taught in teacher education and the needs of 21st century learners:

I just think that kids are in a different world and we are being a bit slow. Kids are willing to and are not afraid to voice their opinions and to create something in a VW. Then they will say that ‘this is my design’ and they don’t lose anything. Whereas when they’re in a classroom and they’re given a task they have to negotiate a whole range of elements and they do lose… I don’t know if they lose momentum to own their own learning but I think that I recognised that they were doing it, I wasn’t teaching it, they were doing it.

Letting go of being the teacher was something she reflected on throughout her interviews. She noticed that the students appeared to be playing in the VW and she felt that was quite important. She stated, “giving students an opportunity to play with the technology, it doesn’t matter what it is, just having that ability to be able to engage with it as if they are a child” was important and beneficial. Such play allowed the students to interact with the technology without the constraints that are often brought to technology by adults, and in particular teachers.

Beth described a number of barriers that she believed hindered the students’ progress with the use of VWs:
• time - “time to them is more valuable to be spent on doing their assessments versus doing something to play and enjoy”
• limited understanding - “they need a bit more experience in it to understand the potential”
• seeing relevance - “when they see examples it does seem to make it more concrete”
• a lack of access - “if they don’t have their own computer or Internet connection it can be very difficult for them”

In particular, she felt that first year students were dealing with a lot of new material, as many of them were new to university and to the field of education. Beth described the introduction of an innovative technology such as VWs as a “bit of a hard bar” for this cohort. Her suggestion was that VWs would be more appropriate for the students who were already “au fait with the computer labs and the way that everything works”.

Beth also acknowledged that, despite Unit 2 being specifically focused on technology she hadn’t encouraged the use of VWs to the extent that she could have. She felt that the students were being exposed to VWs in other units and, as such, felt that she didn’t need to provide more opportunities in that particular technology. When asked about this in Cycle 3 she stated that she “didn’t push the use of VWs because the students were doing it in Unit 5”. Beth had observed that most of the students in her unit were doing VWs in Unit 5 and as such they were less interested in choosing to also do it as a part of her unit. Although she did report that the students were interested in discussing VWs as part of their face-to-face tutorials as they relayed the technical problems they were having as part of their Unit 5 project.

Beth provided some suggestions about how to get more pre-service teacher educators involved in using VWs such as having regular meetings with a specific purpose “like mini conferences or something that related to their units”. She stated, “for many lecturers… unless it is related to what they are doing directly and it’s got a purpose” they won’t put in the time and effort. Beth thought that the pre-service teacher educators needed to provide the students with set VW activities that had to be completed. Making the tasks a requirement was one of the ways that she felt would support pre-service teacher educators as they could be sure that the effort they put into
developing and supporting the use of VWs would be rewarded by students actually doing the task.

Beth admitted that her own perceptions about the value of VWs in education had changed over the three cycles. She described four experiences that had a positive impact on her perceptions. The first was when one of the students presented her assignment for Unit 2, Cycle 1 and discussed how she would use the VW with a primary school maths class showing the space in Second Life that she had built. The second one was when Beth attended the workshops in which the students were interacting in Second Life in Unit 2, Cycle 2. After watching the students she commented “they were doing it, I wasn’t teaching it” and that this was “really challenging my notions of learning and the concept of creating a really engaging learning environment really appeals to me”. Her third pivotal experience was seeing the work that primary school children had created through the activities that one of the students, Gaby, and I had been doing in local primary schools (as discussed in Chapter 7). The fourth was watching two TED talks - one by Jane McGonigal *Gaming can make a better world* and another by Conrad Wolfram *Teaching kids real math with computers*.

Despite finding the VW experiences “fascinating and interesting”, Beth claimed that a combination of a lack of time and a lack of clear purpose hindered her ability to delve more deeply. The reasons that Beth gave for not attending more VW sessions was that she felt “time poor” and with no real purpose for using the VW had limited her capacity to be motivated about extra time. She had no extrinsic motivators, as I was the one undertaking the role of the expert when the students required assistance, unlike with other technologies in which she felt she needed the skills in order to assist the students. In Cycle 2 she did attend the three workshops, led by me, conducted during regular tutorial times on campus. By so doing she witnessed the responses that the students had to the VW and she made comments about the change in her perceptions about the capacity for VWs to change the teaching-learning process. Having Beth observe the manner in which I conducted these workshops was very important in beginning to introduce innovative teaching-learning processes. I was able to model one of the ways in which I believe teaching technology is effective and
receive feedback from a peer. She was able to reflect on how she might normally conduct these types of workshops and observe a different approach.

Over the period of this research the use of iPads in education became much more widespread. SCU invested in several class sets and Beth was involved in the integration of them as the main technology lecturer. She had clearly adopted iPads and spent time finding ways to use them in her teaching when she had only taken a limited interest in VWs. Beth claimed that iPads were easier to access than VWs and that the University had invested in iPads and they should be used. This would indicate that motivating factors in the adoption of new technology are the ease of access put in place by the institution and directives from the management in the institution to utilise a certain technology.

The adoption of VWs in Unit 2 was supported but not entirely integrated. In Cycle 3 I was asked to rewrite Unit 2, which provided me with the opportunity to include a topic dedicated to VWs and Game Based Learning. This was one of 10 topics focussing on a range of technology in education. As I was not the pre-service teacher educators who would be delivering the unit I chose not to integrate the VW as a space in which activities could be provided on a regular basis. The shift towards more fully integrating VWs in Unit 2 represented the acceptance of VWs as a technology that the students needed some experience with. The way in which the students responded to the VW topic is discussed in Section 6.2.3.

Beth’s reflection on her participation in the use of VWs described how she had first been engaged with introducing VWs by “having a bit of a look around and interacting with students in there”. That initial process “taught the students that they didn’t have to be experts” and it showed her that “some students were already used to using VWs”. In the second cycle she found that she “petered a little bit away from it. Not really because of a lack of interest but because of the focus of the units being on all the different sorts of other activities”. After cycle three Beth confirmed that the overall experience had helped her to see the value in VWs in any subject area with the caveat “if you use it really well”. In terms of pre-service teacher education Beth believed that VWs did have a role to play in creating “deep learning for the students and children” however she firmly believed that pre-service teachers needed to be confident enough to create the right learning activities that linked the VW to the curriculum.
5.4 Unit three - Lisa

I was the main pre-service teacher educator for the new media module as part of Unit 3. This module was part of the three macro-cycles of research and was undertaken by all Bachelor of Education (Secondary) students. The focus of Unit 3 was to provide an introduction to curriculum, assessment and new media and, as part of the new media module, VWs were included as a topic. Furthermore one of the compulsory assessment items was to write a reflective blog based on perceptions and experiences of VWs. I designed and delivered the content, resources, tutorial and lectures. This included the use of Second Life, JokaydiaGRID, SoaS and PLANE to talk about the use of VWs, visit educational spaces and practice building techniques. While I designed the topic in Unit 3 it was only a small section of the unit as a whole. The rest of the unit was designed, administered and taught by other pre-service teacher educators. There was no link between the three modules in Unit 3, with no capacity to include VWs on a regular weekly basis. The administrative design of the unit meant that students were only introduced to VWs in one week of the unit and, while encouraged to undertake more interaction, they were not required to immerse themselves in the VW.

My personal philosophy of teaching and learning has always been underpinned by a belief that students learn by doing and will be more motivated to learn if tasks are designed that are authentic and relevant to them. I consider myself a constructivist who has shifted the manner in which I approach my role from one that used to be designing highly scaffolded tasks to one that is more based in designing opportunities in which students can explore a concept. This approach is often more easily done in a primary or secondary school classroom than in higher education as adult students enter into learning with pre-existing ideas and expectations about what a university education should entail. The tightly structured format of university curriculum also tends to dictate the length of time that can be spent on any one particular concept, unlike in a primary or secondary school where concepts may overlap more easily.

I have always been fascinated by the fact that in pre-service teacher education we are modelling that which we are teaching about yet to a different audience; that is, we are teaching about teaching. For me this dictates to some extent the manner in which we present materials. One of the reasons I became motivated about investigating VWs
was because I believed that working in an entirely new learning space would be like starting with a clean slate. I felt that students would have to come to the space without the pre-existing ideas about a classroom. Somehow the VW would give the students and I licence to experiment and to try out new ways to experience learning.

What I found from teaching using VWs, prior to this research, was that students still imposed their pre-existing ideas about what they should be learning at university and how they should be learning it. In Jacka and Ellis (2010) we describe the response from the students in my first experiences of using Second Life with students studying to be secondary school visual arts teachers. They revealed their prejudices about technology, certain types of technology and the role of technology in a visual arts curriculum. Despite, what I felt was a high level of support and the development of interesting VW activities, 50 per cent of the students resisted the use of Second Life and the staff in charge of administering the unit decided to discontinue the use of VWs in that unit.

I was perplexed but not discouraged from continuing to pursue the use of VWs in education. As a result my PhD topic emerged. Undertaking this PhD has provided me with the opportunity to explore VWs with a number of pre-service teacher educators and students that I would not have been able to do otherwise. I have been able to test a variety of ways in which VWs could be introduced and the responses from each of the stakeholders. If I had simply continued to only use VWs in the units that I teach I would not have gained the breadth of insight that I have been able to. I would have continued to be working within a silo of one small part of the School of Education in which students have a brief introduction to VWs with only my perspective on why they are relevant.

In Cycle 1 I trialled two different types of tutorial delivery; one in which I was located in the on-campus lab with the students and one in which I was located within the VW of Second Life with the students. In the first mode, working in the computer lab, assistance was provided to the students by looking over their shoulder and observing the choices they were making as they moved and clicked the mouse and typed on the keyboard. In the second mode, conducting the tutorial from within Second Life, judgments were made based on what the student said or any visual cues such as seeing an object move or disappear, in the VW. Instruction was given by talking the student
through any processes that they may have difficulties with. The result of working in the VW and relying on students to request assistance meant that intervention occurred later than in the computer lab. This allowed the students’ greater amounts of time to problem solve their own process than might happen in the face-to-face setting.

As a result of my experience in Cycle 1 I tried in future cycles to locate myself in the VW rather than conduct face-to-face computer lab workshops. This was not always possible as students often requested face-to-face workshops. When I did conduct workshops in a computer lab I aimed to be both physically present in the room but also have access to a computer where I was present in the VW. I was thus able to interact with students through my avatar. This in world and out of world model of teaching marks a significant shift in the teaching-learning process as I attempted to accommodate different cohorts of students. There is the potential to link cohorts of students who are in a physical non-VW room together with other cohorts of students through their combined presence in the VW. If there is only one person acting as the teacher in this situation (as in my case) the role is more difficult than if there were two or more teacher/experts, allowing one to remain in the VW and one to work with the students in the non-VW.

5.5 Unit four - Anne

Anne was the main pre-service teacher educator who delivered Unit 4. She was interested in exploring VWs as a way to extend one of the topics – Digital Cultures. All fourth year Bachelor of Education (Primary) students undertook Unit 4 in Cycle 2. The focus of the unit was on preparing students to move from being university students to teachers in a primary school classroom. One of the assessment items in Unit 4 was to research, write and present a research paper discussing a contemporary issue in education, as provided by the unit lecturer. In previous years all students presented their paper face-to-face during tutorial times to their peers. With the inclusion of VWs the students were encouraged to utilise Second Life to present their paper.

In the first lecture for the unit Anne introduced the idea of VWs in education as she retold the story of how she first used Second Life to attend a lecture given by an academic in the UK. Anne was enthusiastic about the inclusion of VWs although she
described herself as a less than confident user of technology. Both Anne and I produced resources and provided support to facilitate the students’ choice of VWs. We provided regular meetings in Second Life to talk about the use of VWs, visits to educational spaces and to assist the practice of building techniques.

Anne’s research has always involved a theoretical framework grounded in critical pedagogy and critical theory. She believes that education has the capacity to be socially transformative and complex. Her approach is to “try to explore some of the complexities without necessarily paralysing the students and to work with them in ways that are meaningful and helpful so they can think about their own learning and also their future practice”.

In discussing the students she works with in pre-service teacher education she pointed to the work of Honan (2004) who uses the term “bricoleur” to describe teacher’s work and how they bring together a variety of sources, as and when they need them. She also mentioned Swan (1995) and his use of the phrase ‘subjective warrant’. The phrase is prevalent in the literature around physical education and was coined by Lortie and Clement (1975) and popularised by Dewar and Lawson (1984) to refer to “an individual’s perceptions of the skills and abilities necessary for entry into, and performance of work in a specific occupation” (p. 15).

Anne felt that students made individual choices about “what it is they want to know” and that these choices were very varied. When asked if she felt that she was aware of that when preparing to teach students she stated that she tries to be but finds it difficult to know if she is being successful. Anne pointed to barriers that affected her capacity to be as responsive to students as she would like to be. She described these barriers as “the kind of structures in which we work such as the time frames and other expectations”. Anne felt that these were unique to higher education and that her working environment would be different if she was a teacher in K-12 education.

Working in higher education meant that she felt torn between being a good teacher and being a good researcher. She also felt that the structure, timetabling and the physical space in which she worked did not support flexibility. I asked her to imagine her ideal teaching environment, to which she responded that she would “like longer sessions, more hours, better rooms and facilities. I’d like a state-of-the-art classroom
learning space that has all sorts of different possibilities, including access to technology and different spaces for group work”.

Anne owned a range of technological devices but she described herself as not very experienced or confident with technology. Her motivation for trying new technology such as VWs was founded in her experience with the iPad that “changed her life”. She thought that part of the reason that the iPad was so useful to her was that she “travelled so much and needed to have things that are portable and can connect”. Beth had also found that using the iPad for tasks such as marking students’ work had transformed the task into something “more enjoyable”.

Her motivation for using VWs in Unit 4 was based on her own fascination and curiosity. She stated that she was “interested in educational outcomes and I’m interested in what technologies have got to offer education and I’d be silly not to wonder about that and be curious about”. In her field of physical education and health education Anne felt that the VW had the potential to create different spaces to portray and discuss health issues with children that was not all related to risk. She also felt that the VW might exacerbate some of the risk discourse “because there’s bodies and all sorts of crazy stuff but it might be that it can be subverted in a VW. It can be critiqued. For me that’s what sparked my interest in VWs as a pedagogical space”.

Her own lack of skill and ability were some of the barriers to her being able to realise the potential. Anne felt that this lack of skill “got in the way” and if she had more time and “became more familiar and really immersed” herself she felt that she could “really capitalise on the potential that’s there”. She was sorry that she didn’t find the time because she realised “it was such a fabulous opportunity to think through the possibilities and I was really impressed that some of the students did take it on and that they did present in there”. Regardless of her lack of time spent using the VW, and the limited uptake by students, she commented that she still had “really high hopes for it and I really think it has such enormous potential around learning and for learning”.

In relation to the work that the students produced she felt that the reasons the students produced very basic builds that replicated non-VW presentations was because it was their “first time in and also being assessed and of course the assessment didn’t really reflect or didn’t really encourage risk in that space”. She felt that the assessment was
designed with “generic assessment criteria across all assignments” that made it “difficult for them to take advantage of that space in the way that they could have”. Anne had initially imagined that the students could extend the use of the VW to present their ideas in more complex visual ways and while she believed that doing the presentation “in a virtual world was exciting for them to experience and to try, it was nowhere near what [she] imagined was possible in that space”.

When she reflected on what she might have done differently to encourage the students to be more engaged and to extend the use of the VW Anne suggested, “if students had been able to view a range of different possibilities, that might have helped them think about or re-think how they engaged with the space”. In order to do this Anne felt that we probably needed to embed VWs into the unit more than we did. This included changing the criteria for the assessment to encourage the students to use VWs instead of choosing what might have appeared to them to be an easier option:

Students really just wanted to do the least amount of work to get through so they were never going to embrace having to spend extra time doing stuff. I wonder whether if you took it out of assessment and actually did your classes in there whether that would work better, so it would become a more normalised space where you actually spend the time.

While Anne could see that embedding VWs into the unit might have had more impact on the students she was restricted by the limited time frame allocated to each section of the unit. VWs were one part of a three-week module in which the students were required to cover a range of topics:

I was trying to engage them with new ways of thinking about education and politics and their liberalism and how that’s infusing curriculum debates. So I was trying to do all of that as well as think about how technology can provide us with a way of re-thinking or reconfiguring their beliefs, all in three weeks. It was a pretty big ask.

The institutional barriers extended beyond just the way that units and topics are timetabled. Anne described the negative discourse that she felt occurred in the institution around the introduction of VWs. From her theoretical position she saw this
as being the “conditions of possibility” as described by Deleuze (1988). She felt that in the University “the conditions are not friendly conditions for this sort of innovative work” with VWs. This type of hostility towards innovation was generated by the “students who just thought it was ridiculous” and the pre-service teacher educators “who were hostile”. Overcoming this negativity that generates a feedback loop as it is perpetuated through perceptions rather than first-hand experiences makes it “very hard to be innovative in an institution and in education in general”.

Despite these barriers she felt that it was “absolutely imperative that we try these things; I think we’d just completely give up if we can’t”. She went on to describe why she felt it was important to use innovative technology and innovative teaching-learning processes:

I don’t think we can abandon all hope. Rather it gives you even more passion, more reason to push back against it. So I just think I still hold out so much hope for this space and for technology in general to reconfigure my field. But I’m not quite sure how to realise that and one of the reasons is time and one of the reasons is money, but I think you’ve just got to keep tracking on, don’t you?

Her final reflection on her own experience revealed the VW was a very foreign environment to her in which she experienced some strange things. However, she recognised that the disorientating experience of VWs had the potential to provide an educational experience outside of what might have been initially designed:

I honestly couldn’t sit down and couldn’t even get myself into a lecture theatre and I think I got lost one time and ended up in a morgue. Then some strange person and some other bloke approached me, I had all sorts of trouble trying to find places and things. But even just that experience has educative potential.

I can see how the virtual world offers a new way to think about learning and to do learning. But as I said I haven’t had the time to even begin to realise that. So it remains like a hope and I’m very optimistic. I can still see it as a way of reconfiguring learning.
5.6 Unit five - Jon

Jon was the main pre-service teacher educator in Unit 5. He was very interested in trying new technology and had a history of implementing technology in his teaching. All third year Bachelor of Education (Primary) students undertook Unit 5. The focus of the unit was on the curriculum area of Human Society and its Environment (HSIE) — what might be traditionally called Social Studies. One of the assessment items in Unit 5 was the development of a digital resource to complement a lesson sequence. In previous years the resource was focused on the creation of a PowerPoint slide show. In Cycle 2 the students were encouraged to create the VW resource in Second Life or SoaS. In Cycle 3 all students were required to use either Second Life or SoaS.

Jon claimed that his philosophy of teaching and learning was what he termed a “weak form of social constructivism” and more of a basic critical realist. One of his areas of interest was in ontology and epistemology and before he began using VWs he expressed an uneasiness that VWs may in some way shift or unravel his current philosophical position. He brought with him the belief that “the things that we construct knowledge about, they’re real, they’re extent, they’re mind independent and they’re external to us”. He felt that this placed him outside or on the periphery of “a lot of educational philosophies especially in tertiary education”.

Before becoming part of this research Jon had visited a VW one or two times many years before. His initial motivation for using VWs in Unit 5 was two-fold. He wanted to experiment with ways he could be a co-learner with his students and he wanted to try a new technology that might be more challenging to him than other recent technological developments:

I believe that when you are trying to affect degrees of construct change, the huge power differentials between the students and me aren’t necessarily useful. You want to be a co-struggler. Solidarity I think is a better word but solidarity doesn’t imply complete equality, it implies the willingness of one person to assume the struggles and the situations of another. That would be my construction of co-learning with the students.
His other main motivation was to provide himself with a new technology that would spark his own interest. Jon felt that Unit 5 did have a technological focus using software and hardware such as “Google Earth custom mapping and GPS for geography and the main assignment requires them to make an electronic resource”. He felt that there was a lot more he could be doing with technology but felt limited by the “mechanics of being able to mark it and disseminate it across tutors”. One of the reasons he gave for not making VWs a compulsory part of the assignment in Cycle 2 was that he felt unsure about how to assess what the students would do in the VW.

Jon reflected on his uncertainties about introducing VWs in Unit 5 that included his preference to be able to enter the space as an observer. He compared the experience to how he interacts with discussion boards and forums about topics he is interested in. Jon tends to read the conversations and after “about 6 months or so” he feels “brave enough to ask a question”. He was also concerned about whether there was any crime in Second Life and some of the encounters he and the students might come across.

After the first interview and before he had experienced the VW he described a shift in these perceptions:

So real things happen, they are real interactions, they have real effects and they have effects outside that world. So if that’s the case then why isn’t it treated just like the real tutorial situation and the real assignment situation whereby I control what I want them to do by the assessment criteria that I set.

As a way to encourage students to voluntarily undertake the VW activities Jon and I presented a question and answer session during one of the regular face-to-face lectures. He asked me questions that he felt were concerns that students might have about using the VW based on their perceptions and experiences to which I provided answers. They questions were framed in a way that asked what advice I would give to the student who is:

- keen and wants to do this and needs to get the skills quickly
- interested but doesn’t have the time right now
- skeptical because they think that VWs is a fad and doesn’t want to waste their time
• concerned because they don’t want to put a large piece of
  software on their computer and slow their computer down
• concerned because they have heard that horrible things happen in
  Second Life and it’s not a safe place for children or adults

Jon and his tutors worked actively to encourage the students to use VWs. They
attended one of the VW tours to an environment with obvious connections to content
being delivered in Unit 5. They included a Machinima of the tour in their face-to-face
tutorials and included it as a resource for discussion. Jon made announcements to the
students about VWs and placed the online resources on the LMS. They felt that they
had done what they could, beyond making the use of VWs compulsory.

At the end of Unit 5, Cycle 2 he reflected on the experience of VWs by saying that he
was very excited by the potential that he thought VWs could have for the HSIE
teacher. Jon stated that he would not have moved beyond his initial barriers without
my encouragement. The point at which he realised that VWs offered a new learning
experience was when he started coming to the workshops in Second life while the
students were learning how to build simple forms. During these sessions he observed,
“the learning process unfolds so that you get to see what the tool can actually do”.

His experience, despite only three students taking up the option to use VWs in their
assignment, led to VWs being made a compulsory part of Unit 5, Cycle 3. He gave
three reasons for making it compulsory in Cycle 3:

1. It’s real powerful learning that is happening now and for our
   students who are currently enrolled to graduate without knowing
   what it is at all would be to under equip them
2. I wanted to put the students in a situation where they genuinely
   have to take a risk with a learning process
3. It’s fun, it’s different. I’ve been doing this unit for a while and I
   wanted a change

One of the factors motivating his inclusion of VWs in Cycle 3 was the work that one
of the students, Gaby, had been doing in local primary schools using VWs (as
discussed in detail in Chapter 7). Jon described Gaby’s work as “powerful learning
that is happening now”. In Cycle 2 Gaby was one of the three students who used VWs
in Unit 5 to create a digital resource. In Cycle 3 she presented a lecture in Unit 5 to which she brought some of the primary school students to talk about what they had been doing in VWs. She also conducted two workshops in Second Life to teach the pre-service teachers how to build.

After one of the workshops conducted by Gaby, Jon described his experience:

Last night at the workshop in Second Life I was standing off to the side watching while you had everyone down on the beach coaching them. There was a magical moment when, all of a sudden, boxes started to appear all over the sand. Classic.

At this point he had received positive feedback from the students:

My email has overflowed with messages of excitement and thanks from students who were there at the workshop, and from students who didn’t go, but have already heard about it from their mates! I feel a distinct groundswell coming on.

The second reason he gave for making VWs compulsory was to challenge the students to take genuine risks. He felt that at university the risk has been taken out of assessment and that students are not rewarded for risk taking:

We talk about life long learning and engaging in learning processes and taking risks but when I look at my students doing assignments their whole being is orientated towards ameliorating or reducing any risk associated with that learning task because they perceive that any risk will potentially result in a lower mark.

He perceived that students believe the way to gain a higher grade was to follow exactly what he, as the pre-service teacher educators marking their work, tells them to do. He had observed that the students who receive high grades were the ones who present “completely novel ideas”. They are often “completely outside what I had thought I would want from that assessment task and yet they met all the criteria at a far higher level”.

Jon was surprised about the students who were most successful with the task. He said that it wasn’t the “techy students” but rather “it was the students who were able to
conceptualise the task as a teaching/planning exercise, rather than a tech task”. He described how the “young students that think they are techy because they are on Facebook umpteen hours a day, does not mean they will automatically be good at constructing a worthy learning space in Second Life”. Many of the students who complained were in this category and laid blame at what they perceived as a lack of technical support from the pre-service teacher educators.

The complaints about lack of support perplexed Jon as he made note that a number of opportunities were provided to the students but they chose not to take them up:

> We held five or six in world support tutorials, and held a face-to-face tutorial early in the session to ensure that everyone could log on and get started. But no one attended these! They only wanted to start learning about how to install Second Life two weeks before the due date. So all the support we organised was ill-attended. Then they complained that there was no support and that was when we were repeatedly telling them that this was not the sort of assignment you could do at the last minute.

Jon had anticipated, prior to commencing the VW activities, that he would receive complaints and concerns from the students. When he reflected on these he felt that they were likely to be no different to the concerns he usually receives:

> There will be students in this cohort who absolutely freak out, struggle, disengage with the task and might fail it but we would have had that anyway with a normal task. They might be different students but there would still be students who freak out, can’t do it and disengage.

At the end of the unit in Cycle 3 Jon reflected on his experience and the feedback he received from the students. He realised that it was impossible to view the student cohort as homogeneous and he described them as “completely fragmented in terms of learning needs with this task”. He stated, “some loved it, then really loved it, some hated it, then loved it, some loved it, then hated it, some just hated it, then hated me”. Despite those four reasons showing an equal number of positive (those who loved it) and negative (those who hated it) reactions Jon decided to return to making the VW a voluntary part of the next iteration of Unit 5 (after the conclusion of this research).
Jon expressed a genuine understanding that the VW could provide a different teaching-learning experience for himself and the students. However the barrier that Jon encountered, including a lack of time, skill and experience with VWs meant that, like most of the other pre-service teacher educators, he struggled to know what to do with the VW. Before he started using the VW Jon made the comment that it would “be a terrible tragedy if all Second Life ended up being used for was an electronic replication of a tutorial”. While Second Life did not become an electronic replication of a tutorial it was under utilised by both Jon and the students. However the expectations of Jon and myself may have been too high for these initial experiences. In hindsight the students demonstrated a capacity to create a variety of builds from simple boards with words on to more sophisticated simulations of experiences relevant to the themes of the unit. The work that the students produced is described in Section 6.5.

Jon’s choice not to continue with a compulsory aspect of VWs in Unit 5 highlighted that the processes we undertook to introduce the VW and our expectations of the outcomes were higher than could be achieved. What I learnt from Unit 5 was that certain aspects of the delivery were successful and could be built upon for future iterations. This included offering the use of VWs as another way that students could respond to assessment tasks. Thus accommodating students who are highly motivated or who have an interest in emerging technologies. In order to require all students to utilise VWs a more concerted approach towards scaffolding the skills and providing explicit models of how VWs could be used needed to be provided as a compulsory part of the unit. Furthermore the design of the assessment criteria may need to have a change in focus so that the students felt that the effort that they put in to learning how to use the VW was also given some recognition.

5.7 Unit six - Alison

Alison was the main pre-service teacher educator in Unit 6. She was an early childhood educator who believed in the importance of relationships and making connections with students. She agreed to include VWs to enhance the role-play experience for the students and to include another level of technology. All first year students in Bachelor of Education (Early Childhood) undertook Unit 6. The focus of the unit was on introducing students to the foundation principles and practices of early
childhood education. One of the assessment items in Unit 6 involved the role-play of early childhood scenarios set by the pre-service teacher educator. With the inclusion of VWs the students were required to use Second Life to undertake the role-play in a purpose built early childhood centre on SERI.

Alison described her philosophy of teaching and learning as relying “very strongly upon a relationships approach”. She felt that if a connection can be made “with the students then you’re more likely to assist their learning and encourage them to be engaged”. To this end she valued the face-to-face tutorials as a time in which she could connect with the students, test their knowledge and check for their understanding from the lectures. Alison also believed that reflective practice was important and she tried to encourage the students to engage in being reflective about their own knowledge and practices. She felt that at times it was difficult to impart her own philosophy to the students when she also had to rely on tutors at other campuses to interact with the students in ways that may not align with her own philosophy.

Alison was motivated to introduce VWs in Unit 6 because she felt that the students should know about what technology is being used in education so they could “start to build up the skills to learn how to engage with” the technologies. She felt that if the students knew about VWs then “they’ve got the option to make a decision” about engaging with them or not. She could see that VWs “may well go in a direction that we can never have imagined right now” similar to how other technology has emerged such as the Internet and companies like Google.

She was in the process of writing a number of units of work for external delivery. Through this process she reflected that she believed it was important for students to have the opportunity to meet face-to-face. Alison felt that the one thing that “is lacking through distance is the opportunity to engage and learn from your peers”. She expressed that students missed out on knowledge passed between peers when working in digital formats and “the discussions are not quite the same as face-to-face for student to student contact and learning”.

Despite her reservations about the use of electronic formats she encouraged the students to use Second Life to develop their role-play scenarios. Hands-on workshops were provided on one of the campuses and were attended by all students and Alison.
Other workshops in Second Life were scheduled for pre-service teacher educators and students to attend at times convenient for them. After the role-play activity was completed she received feedback from the student cohort including positive and negative responses (see Chapter 6 for a full discussion of the students’ responses).

The negative responses influenced her decision not to continue with the use of VWs in subsequent iterations of Unit 6. She felt what had influenced the students was their perceived lack of support in terms of pre-service teacher educators assistance and technical capabilities of the computer labs on two of the three campuses. She summarised what she felt were the barriers for students:

- **Access** – “If you haven’t got a good server and if you’re at home and you’re only on dial up you can’t do it”
- **Time** – “We really needed to spend the time getting everything sorted out and we just didn’t have the time”
- **Will to engage** – “So they have to have a will to engage. If you don’t have that will then it’s going to be hard work for you”

Alison’s personal experience using the VW was one of unease using an avatar. She related the use of the avatar with role-play and she has “never been one for a role-play. I’ve always shied away from role-play as a person and for me it doesn’t fit. I don’t feel comfortable with them at all”. She also described her perceptions of VWs based in the popular press:

I’ve read novels where people get gobbled up by Second Life and you hear about people where their life is consumed in front of the screen. I need to be able to get away from those overarching popular images to fully appreciate it. I needed to see it more clearly as an educational tool.

Despite her personal feelings of unease and the negative feedback from some of the students she was able to conceptualise how she would like to use VWs in the future. She could imagine an exemplar child care centre, feeling that the one we were using in Second Life (that had been built specifically for Unit 6) looked “quite stereotypical and it would be nice to go to the realms of possibilities that could be done as a centre of excellence for childcare”. She also listed what she might need to do to become more comfortable with the use of VWs. This included learning more about the
educational possibilities as well as the functions and capabilities of VWs. She felt restricted in her capacity to do this because she needed more “work time allocated to develop skills and resources”.

Alison was the one pre-service teacher educators who expressed that she would like there to be more pre-service teacher educators using VWs in order to make her feel more comfortable. She wanted to be able to have discussions with her peers without feeling like she was doing something that was on the fringe. Alison’s feelings link to what Anne suggested as having the conditions for possibility in which the pre-service teacher educators and students are generating positive not negative discourse when the topic of VWs arises informally or professionally.

Despite her decision not to continue to use VWs and the negative feedback received from some students Anne still believed that students needed to engage with these types of technology “because we are at this point in time electronically and digitally now and we are not going to stay where we are”. Alison’s main motivation was “the students need to keep abreast of what’s happening” and she felt that it was part of her responsibility as a pre-service teacher educator to be sharing “potential pedagogical tools for their teaching in the future”.

The use of Second Life to undertake a role-play appeared, at the outset as a perfect way to engage the students in VWs. Alison could see how the VW provided the opportunity for the students to perform a role-play in an authentic environment. In order to support the successful use of VWs as many resources and structures to facilitate a supportive introduction to VWs were put in place. By this stage a number of barriers that other pre-service teacher educators and students had experienced had been observed and attempts were made to mitigate these with this unit. What I learnt was that even when the use of the VW is a compulsory part of an assignment, students still make choices not to attend sessions that are designed to assist them. I offered a choice of times in which students could individually meet me in Second Life and be guided through the process. I also offered the same option to the pre-service teacher educators, as well as regular meeting times for all of the pre-service teacher educators to come together to meet and discuss what they were doing or what they thought. The range of factors that influence both pre-service teacher educators and students acted together to make the experience for Alison one that she did not wish to repeat. She did
want to continue to provide the students with some knowledge of VWs but she no longer wanted to require their use for the role-play activity.

5.8 Changes Between the Macro-Cycles

The pre-service teacher educators responses influenced the changes that were made to the introduction, development and support of VWs in each of the cycles. My experience, as the researcher and pre-service teacher educator, included a high level of reflection on the responses that pre-service teacher educators and students were making before, during and after their introduction and use of VWs. The changes were often in response to barriers that pre-service teacher educators or students were experiencing that was limiting their ability to move into a deeper level of action in relation to creating VW teaching and learning resources. The pre-service teacher educators were able to consider innovative teaching-learning processes but were less able to implement them while the majority of the students were experiencing barriers to initial use.

In Cycle 1 the three units in which we introduced VWs allocated only a small part to the use of VWs and students were given the voluntary option to engage with VWs. In Unit 1 the students had two, two-hour tutorials. In Unit 2 they had no workshops and were asked to contact me if they needed help. In Unit 3 the students were required to attend one, two-hour tutorial in Second Life. They were provided with resources such as information about VWs in education and links to instructions for getting started however the actual hands-on assistance to support their initial experiences was limited. From my experience in Cycle 1 it appeared that the pre-service teacher educators and students needed a dedicated and continuous series of experiences in the VW to get over what Carr et al., (2010) describe as the VW pain barrier.

In response to the barrier of time a series of weekly meetings in Second Life were offered, to which pre-service teacher educators and students could attend. At these meetings a range of people came together including pre-service teacher educators (from novice to highly experienced) and students as well as other VW educators from outside of the University. Providing weekly meetings highlighted the importance of regular immersion in the VW in order to move on to more sophisticated uses. The
students who voluntarily chose to utilise the VW for activities within their units were all regular attendees at these meetings.

Another barrier that was observed in Cycle 1 was the negative perceptions that students had towards Second Life. One of the main concerns was that students felt that Second Life was not suitable for K-12 children. We tried to address these concerns through the conversations and resources provided to the students. We were largely unsuccessful as the concerns continued to arise. As a result the focus was shifted away from Second Life as the main VW. In Cycle 2 examples and experiences were provided in Second Life, PLANE, JokaydiaGRID and SoaS. The concerns began to diminish and in Cycle 3 the use of and reference to Second Life was minimised. By Cycle 3 Gaby and I had produced a considerable amount of examples of K-6 students using SoaS, which allowed me to provide authentic examples to the pre-service teacher educators and students. The move away from Second Life had a significant impact on the types of responses that pre-service teacher educators and students were providing. The other side to shifting the use to a less stable platform than Second Life, such as SoaS, was that pre-service teacher educators and students were more likely to experience technical problems. However the shift from Second Life meant that they started to look more closely at how they would use VWs in education rather than if they would use it.

The feedback from the pre-service teacher educators in Cycle 2 was that they felt that the students were reluctant to voluntarily chose to use VWs. Jon, in particular, became very keen to get more students to engage more deeply with VWs and he chose to make the use mandatory in Cycle 3. Making the use mandatory, as part of an assessment task, presented a number of issues that both Jon and I thought we had covered before the unit commenced. However the level of negative student feedback, in relation to the issues they encountered, was heightened due to the placement in the high stakes environment of an assessment task. On reflection the leap from a voluntary task to a mandatory assessment task with only a small change in the delivery and support of the use of VWs resulted in a less than satisfactory outcome for all involved. What this change demonstrated was the need to work incrementally to adopt an across the board use of VWs with dedicated VW activities to introduce, develop and support pre-service teacher educators and students knowledge, skills and understanding. Finding a balance
between providing an introduction to VWs as part of an already dense workload of content and achieving the potential benefits that comes from a prolonged and integrated use proved to be extremely difficult.

5.9 Conclusion

Overall the pre-service teacher educators were supportive of the use of VWs and worked with me to include VWs in their units. They faced a number of barriers that included restrictions to the structure and timetabling of their units, the expectations of students and the amount of time they felt they could dedicate to learning how and why to use VWs. They were motivated by their desire to be good teachers who were preparing their students to work with 21st century children who require an engaging learning experience that is complex, authentic and student-centred. The pre-service teacher educators took a risk by including VWs in an institutional context that was focussed on other technology and not always able to provide the level of support that is required to best facilitate the use of VWs. They were also in a position where any negative student feedback about their units can have a significant impact on what and how they teach in future iterations.

I acted as the central pre-service teacher educator who was the expert in VWs and as such influenced the level of motivation that the other pre-service teacher educators had about becoming experts themselves. My passion for VWs in education drove most of the actions in relation to situating VWs within the units and gaining support from the institution, pre-service teacher educators and students. I was able to play a role within the units for the duration of this research but I was not able to develop a sustainable practice in which the pre-service teacher educators became self-sufficient and committed to continue to develop VWs activities.

This chapter has described the responses that the pre-service teacher educators had towards the introduction of VWs. Each of the units was described and the feedback received from the pre-service teacher educators through interviews and email correspondence was included. The learning that occurred from the feedback was utilised to further develop the support of the use of VWs and in turn the development of innovative teaching-learning processes. I have described my own experience and what I learnt as a pre-service teacher educator working with the other pre-service
teacher educators and students in each of the units. My learning comes from an initial analysis of what occurred and the responses from the pre-service teacher educators. Each of these points of reflection then influenced the subsequent development of strategies to support the implementation of innovative teaching-learning processes through the use of VWs. The data in this chapter are analysed further as part of the discussion in Chapter 8 and Chapter 9.
Chapter 6 Pre-service Teachers' Responses and Reflections

This chapter presents the data collected from students in five of the six units involved in this research. Unit 1 is not included as it was prior to ethics approval and the students were not formally approached for comment. Data associated with each of the units is considered separately, and within each section data is further categorised by the research activities that the students responded to. A summary is made synthesising the key themes that emerged from the students’ responses across all of the units.

6.1 Introduction

Over the three cycles of this research approximately 1500 students were introduced to VWs. While the number of students exposed to VWs was relatively high not all students were required to participate in VW activities or to be part of the research. Of those 1500 students 228 participated in workshops, 216 used VWs as a creation tool, 357 wrote about VWs, 107 responded to surveys, and 4 were interviewed. The varying response rates were influenced by the level of access that was available to gather data from the students within the time frames in which the activities were undertaken.

6.2 Unit Two

Unit 2 was part of all 3 cycles of research. The students were provided with resources about VWs through lectures, tutorials and online materials. They were also offered the opportunity to explore a variety of VWs as part of a hands-on workshop that included activities to help the students to navigate, build and explore in the VW. In Cycle 1 and 2 students were given the option to use VWs as part of an assessment item to create a digital teaching and learning resource. In Cycle 3 they were invited to provide a written response to a pre-determined VW scenario.

In Section 4.7.2 a detailed description was provided about the activities that the students undertook in Unit 2, including the number of students involved. The student responses discussed in the following section were gathered from their reflective portfolios (n=33), online discussion board (n=8) and online survey (n=2). A brief description is provided of Gaby, who was the one student that created work in Cycle 1 of Unit 2. A more detailed description and analysis of Gaby is presented in Chapter 7.
6.2.2 Portfolio responses

In Cycle 1 and Cycle 2 students were required to create a reflective portfolio to illustrate their engagement with a variety of different technologies which could be used in the classroom, including VWs. Students made choices about the technologies they wished to discuss based on the ones they decided would be the most useful for them in the classroom. As such their response to these technologies were generally written to reflect how they would use the technology resulting in more positive responses. The students were not required to include VWs as one of the technologies they wished to discuss. Over the two cycles 33 students made written responses about VWs; six students in Cycle 1 and 27 in Cycle 2. Three themes emerged from the students’ responses:

1. personal response to VWs
2. perceptions about their future students and VWs
3. perceptions of VWs in education

Table 6.1 shows the sub-themes within each of the three themes and the number of students whose reflections illustrated the theme. Eighty-five per cent of the students made a statement that included more than one of the sub-themes.

The student data revealed that they reflected on a small number of personal reactions to VWs including their desire to refine their technical skills (n=1), wanting to know more about VWs in education (n=3) and the feeling that it was important to have an understanding of the technology that their future students are already using (n=3).

One of the students indicated that “the whole concept of VWs” was very new to her but she felt that as she was striving “to be a confident and knowledgeable technology teacher” she was aware of the need for her to be “up to date”. She cited this as the reason she was motivated to “persist with the task of learning about VWs and their use within educational settings” (Student 1, 2012).

The need to be able to cater for their future students was the most significant factor expressed in the portfolio responses. The perception that the VW would be highly engaging to students was the most consistently cited. The main reason for this perception was that the VW presents similar attributes to the digital games that many
children play. One of the students identified “the ability to put the enjoyment, that the large majority of children in the current society get from playing online games, into the curriculum can have children extremely eager to learn” (Student 3, 2012).

Table 6.1 Thematic responses from the portfolios

<table>
<thead>
<tr>
<th>Theme</th>
<th>Sub-theme</th>
<th>Number of student responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Their personal response was that</td>
<td>• they would like to know more</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>• they need to be current in terms of technology in the classroom</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>• their skills could be refined</td>
<td>1</td>
</tr>
<tr>
<td>They perceived that their future students would</td>
<td>• be engaged</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>• develop collaboration skills</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>• be active participants (design, construct, create)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>• have an increased ability to express themselves through an avatar</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>• develop lifelong learning skills</td>
<td>1</td>
</tr>
<tr>
<td>They perceived that VWs in education could</td>
<td>• provide opportunities to do things that were impossible, too expensive or too risky to do in a non-VW classroom</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>• support higher order thinking skills</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>• promote contemporary approaches to teaching and learning</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>• transform pedagogy</td>
<td>0</td>
</tr>
</tbody>
</table>

The students were most interested in VWs being able to provide the opportunity to offer experiences that could not otherwise be undertaken in the regular classroom due to expense or danger. They described experiences such as exploring “the depths of the ocean or inside volcanoes to gather a more developed understanding that is impossible in the real world, all within an educational setting” (Student 2, 2012). Another student expressed how they felt that VWs were an alternative to traditional models of teaching:

I feel that there is only so much students can absorb from a chalk-and-talk teaching method and that programs which immerse students in interactive learning experiences can really add a limitless advantage to their education because they are experiencing the information, not just remembering it. (Student 3, 2012)
The implications for the teaching-learning process were mentioned by a small number of students with comments like “VWs such as Sim-on-a-Stick or game based activities, enables the pedagogy to be transformed, as it lets students explore the environment in which they are involved in, and take control over their own learning, involving higher levels of motivation” (Student 5, 2012). This would indicate that the students who are reflecting on VWs were realising that the types of activities that best promote the affordances of the environment are those that take a student-centred approach.

Overall the portfolio responses provided some insight into the reaction that students had to VWs. These students had not used VWs as a creation tool. They had explored the VW and then reflected on how they might use them in their future classrooms. The portfolio responses revealed that the students could see the benefit of using VWs without actually using them to develop or create their own learning spaces.

6.2.3 Scenario response

In Cycle 3 the requirements of Unit 2 changed and a one-week topic dedicated to VWs and game based learning was introduced. As part of the assessment the students were given the option of responding to three out of ten scenarios (one for each of the 10 topics in the unit). The scenario asked the students to consider what they would do if they had a class of children with mixed abilities and learning styles who they had been working with for a number of terms. A teacher in the school suggests that they try games in the classroom as a new approach. They need to find a game that they think will be appropriate for the class and describe how they will implement it and what they expect the response to be from the students including the possible learning outcomes.

Eight students responded to the VWs and game based learning scenario. The games chosen were Minecraft (n=5), Whyville (n=1), Nation States (n=1) and World of Warcraft (n=1). All students responded by stating that they expected that their future students would respond positively to the use of the chosen game in the classroom:

As this would be a new approach to teaching I would expect the students to respond favourably. The possible learning outcomes would be improved problem solving skills, negotiation, judgment, analysis, strategic thinking, communication skills and networking and would foster
non linear thinking patterns, improved attention, vision and cognition, narrative skills and transmedia navigation (Student LT25, 2013)

The students identified six key learning outcomes including collaboration (n=5), creativity (n=5), team work (n=4), leadership (n=3), respect and understanding of others (n=3), and problem solving skills (n=2). The following comment reflects the linking of a number of these outcomes and the teacher adopting different teaching-learning processes in relation to Minecraft:

Students also learn to connect with others through the use of Minecraft. Using online games helps students collaborate with others and interact socially and even deal conflicts and negotiate resolutions. Friendships are developed with peers and even the teaching staff. I think students would respond to Minecraft in a positive way. They are able to unite their education and fun, which makes learning entertaining and provides them with a better learning environment. All this thanks to Minecraft and teachers who are willing to try something a little bit different. (Student LT28, 2013)

Some of the students described a change in their perceptions about VWs and their potential in the classroom. One of the students reflected on how, at first, she “thought this to be just another silly time wasting game of guns and war” but was surprised when she “found the structure of building and creative planning quite addictive”. She expressed that she “would never have experienced this site in the past” and had only done so because of its inclusion in Unit 2. She felt that she was now equipped with a “new learning tool”.

The scenario responses demonstrated that once students had engaged with the VW resources and considered their use in the primary classroom they were willing to accept that VWs had a role to play in education. Students who had chosen to respond to the task provided the responses and, as might be expected, they generally focussed on the positive potential for VWs with minimal concern for the barriers.
6.2.1 Gaby

In Cycle 1, Gaby was the only student who used Second Life to create a digital teaching and learning resource. Her story is discussed in detail in Chapter 7, as she became an exemplar of the use of VWs in primary school education. She was the only student who chose to use Second Life in Unit 2, Cycle 1 and she received unprecedented one-on-one support; although this opportunity was offered to all students. Gaby and I would meet to have informal discussions in Second Life in spaces such as the campfire (Figure 6.1).

![Figure 6.1](image)

**Figure 6.1** Gaby and Lisa meeting informally by the campfire on SERI to discuss Gaby’s Second Life projects. This represents one of the different environments being used in which to develop innovative teaching-learning processes and to shift the teacher-student relationship.

When Gaby wanted to try out an idea we would visit other spaces in Second Life where similar ideas or builds had been created. I would send her journal articles or websites about the work that other educators were doing. What I learnt from working with Gaby was that I could facilitate in a manner that was rewarding to me as a teacher; as I took more of a mentoring role. I could be responsive via email and in-world meetings that occurred informally and as required. I could make suggestions that she would explore and provide feedback, based on my experience, about what worked and what didn’t. She became part of the community of practice in which other educators were exploring VWs. Through her avatar she was able to interact with
experts who in the non-VW may have considered her simply in terms of her status as an undergraduate student.

6.3 Unit Three

Unit 3 was the unit in which I was the lecturer and it was included in the three cycles of research. The students were provided with resources about VWs through lectures, tutorials and online materials. They were also provided with opportunities to explore a variety of VWs through guided workshops in navigation, building and educationally focussed tours. In all three cycles the students were required to write a short blog post reflecting on their response to VWs in education. Over the three cycles there were 359 students enrolled; 55 online survey responses were received and 311 blog posts concerning VWs were recorded.

6.3.1 Survey 1

Survey 1 was designed for the students in Unit 3 to acknowledge their prior experience with VWs and whether they thought that VWs had a role to play in the K-12 classroom. Approximately 18 per cent (n=56) of all the students enrolled in Unit 3 over the three cycles, responded to the voluntary survey that was embedded in the resources for the unit on the LMS.

Of those who responded 85 per cent (n=48) used social networking applications and 23 per cent (n=13) played computer games. Familiarity with the term VWs and what a VW is was relatively high at 78 per cent (n=44). Sixteen per cent (n=9) were familiar with the term VW but not familiar with what a VW actually was and 2 per cent (n=1) indicated that they were not familiar with either the term VW or what one actually was. These response rates indicate that the students overall had a high level of awareness about VWs. The survey was designed to be undertaken before the students had engaged with any of the teaching materials and these figures should indicate whether their exposure to VWs as part of the unit was a new experience for them.

Over the three cycles the ratio between those who had a familiarity with VWs and those that did not remained consistent. This indicates that the inclusion of VWs in the program at SCU was not a significant factor and that students were coming to the program with prior knowledge of VWs.
In response to whether they could see the possibilities for VWs in the classroom 60 per cent (n=34) indicated that they could see the possibilities, 32 per cent (n=18) were unsure and 3.5 per cent (n=2) indicated that they couldn’t see the possibilities. These figures show that while the students were aware of VWs the educational potential for VWs was less evident to them. This is not unusual given that the students’ prior experience is most likely to have been in using VWs for entertainment. More specifically the students expressed that they were “not sure if VWs could be used to address curriculum requirements in classrooms” (Student 36, Unit 3, 2013) and that they were concerned about how to “control the learning environment” (Student 48, Unit 3, 2013). The intention in the delivery of the unit was to address these concerns and to provide the students with guidance about these aspects of VWs use in education. The blog posts that the students were required to write after they had engaged with the learning materials indicated whether the students had progressed in their perceptions about the educational purpose of VWs.

6.3.2 Blog post responses

Unit 3 provided the largest number of written responses from all of the students in this research. As part of an assessment activity each student was required to write a minimum of 300 words reflecting on the topic of VWs in education. Over the 3 cycles there were 311 responses; 108 in Cycle 1, 79 in Cycle 2 and 124 in Cycle 3.

At the conclusion of Cycle 1 the initial 108 responses were analysed and four themes emerged. These themes were used to create a phases of realisation model (Jacka & Ellis, 2011). Each of the phases represented a point at which the student was describing their capacity to realise the potential to use VWs in education. As the cycles progressed the students’ responses were mapped into each of the phases resulting in an extended model to include five phases and being renamed to reflect more accurately what the phases were representing. They became the phases of engagement. In the following section a brief overview of the phases of realisation is presented. The expanded model (phases of engagement) is discussed Section 8.3.

The initial phases of realisation model was based on the analysis of the blog posts that judged the extent to which the student expressed their willingness to engage with VWs as a technology for use in education. Table 6.2 provides a list of the key indicators that
emerged from their blog posts. Based on the reflections that the students provided the students were placed within one of the four phases. The numbers in the right hand columns show the actual number of students who were in the phases for each cycle.

Table 6.2 Number of students in each phase of realisation across the three cycles

<table>
<thead>
<tr>
<th>Phase</th>
<th>Indicators – espoused views of students</th>
<th>Number of students</th>
</tr>
</thead>
</table>
| **Pre-realisation** | • Could not see the benefit of using VWs  
• Would not use VWs                                           | Cycle 1  | Cycle 2  | Cycle 3 |
|              |                                                                                                  | 19       | 9         | 9       |
| **Realisation** | • Could see the benefit of using VWs  
• Stated a number of barriers that would restrict their actual use of VWs  
• Unlikely to use VWs  
• Demonstrated a conflict in perceived benefit versus barriers | 56       | 29       | 44      |
| **Replication** | • Could see the benefit of using VWs  
• Likely to use VWs  
• Some barriers may still exist  
• Described the use of VWs with traditional teaching-learning processes | 21       | 18       | 31      |
| **Reimagining** | • Excited about the use of VWs  
• Most likely to initiate the use of VWs  
• Described the use of VWs with innovative teaching-learning processes  
• Minimal or no barriers. If barriers were discussed solutions were offered | 12       | 23       | 40      |

There was a decrease in the number of students who were in the pre-realisation phase from Cycle 1 to Cycle 3 and an increase in those on the reimagining phase. A number of factors potentially influenced this change. One possible explanation was the change of delivery in the face-to-face lecture and tutorials. Second Life was the main VW being used however, in Cycle 2 and 3, a number of other VWs were incorporated, including ones that the students perceived to be more appropriate for education (such as SoaS, JokaydiaGRID, PLANE and Minecraft). The tutorial requirements were changed so that students were given the option of entering the VW and provided with a variety of VWs to choose from. In Cycle 2 and Cycle 3 students were provided with more examples of how VWs were being used in primary schools due to the work that had begun by some of the students from Cycle 1. In Cycle 3 Gaby, who had been
using VWs in local primary schools, took on the role as one of the tutors and spoke with the students about her experiences.

In the earlier phases (pre-realisation and realisation) the barriers were the significant reason why the student would not contemplate the use of VWs. In the later phases (replication and reimagining) the barriers were often acknowledged along with possible solutions therefore presenting less of a reason for not progressing with their use of VWs. In order to understand more about what factors were influencing the students’ use and acceptance of VWs in education barriers were identified from the data. Four themes emerged which were then broken down into a further 15 sub-themes. Table 6.3 presents these themes and the percentage of responses that described the barriers within the specified cycle.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Students expressed barriers</th>
<th>Cycle 1</th>
<th>Cycle 2</th>
<th>Cycle 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Their personal experience was they</td>
<td>• were not on task in the tutorial</td>
<td>5</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>• felt uncomfortable or annoyed</td>
<td>13</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>• did not have the technical skills</td>
<td>5</td>
<td>14</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>• did not have access to the required level of technology</td>
<td>6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>They perceived their future students</td>
<td>• will not be on task</td>
<td>20</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• will lose face-to-face social skills</td>
<td>2</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• will not have the technical skills</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>• will not have access to the required level of technology</td>
<td>5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>They perceived VWs as</td>
<td>• not safe</td>
<td>11</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• addictive</td>
<td>3</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>• time consuming</td>
<td>5</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>They perceived VWs in the classroom</td>
<td>• must link to educational outcomes and objectives</td>
<td>5</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>• need to be scaffolded</td>
<td>6</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>• will take too much class time</td>
<td>7</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>• will take time away from non computer activities</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Total number of students in each cycle</td>
<td></td>
<td>108</td>
<td>79</td>
<td>124</td>
</tr>
</tbody>
</table>

A comparison across the three cycles revealed that the focus of the barriers changed. In particular, the personal barriers lessened. Students’ personal experience revealed
concerns about being able to stay on task, their personal comfort levels in a VW as well as the level of technical skills and access to technology that they had. A common concern expressed by students in Cycle 1 was that Second Life was “too distracting” and they found it difficult to “stay on task”. One student reflected that they personally “find it difficult to concentrate” when they are at a computer as there is the “temptation to check email or go on Facebook”. They felt that Second Life would add to the temptations and would encourage students “to fool around and dance rather than do the tasks. They would want to customise their avatar, thus taking up valuable class time” (Student 34, Cycle 1). At this point the student was linking their personal response to computer experiences, such as using Second Life, to what they imagined their future students would do. Their concerns were heightened by what they perceived as a classroom resource that would disrupt learning rather than enhance it.

The students were presented with research that had been undertaken demonstrating positive results that VWs can have when used in a K-12 classroom. However, the students who were at the lower end of the phases of realisation made comments such as “there was a suggestion that social skills may benefit from online games such as the Sims or World of Warcraft. To me this seems silly as social skills require interactions between people, face-to-face not through avatars” (Student 161, Cycle 2).

Only a small number of students believed that their future students would not have the required technical skills or access to the technology. This presented as a barrier as they felt that they would be required to teach their students how to use the VW. One student described it in terms of “the extra technology skills and abilities the students would have to learn to undertake a lesson using VWs could ultimately unravel the idea” (Student 104, Cycle 1). The follow on barrier from feeling the need to teach the students how to use VWs was the time they perceived this would require. In so doing they felt that it “would take up a lot of teaching time, for the students to be able to work their way around the VW, before they even are ready to think about what they are actually meant to be doing” (Student 37, Cycle 1). A further barrier in relation to time was the structure of the K-12 timetable in which the students perceived they would be required to deliver a certain amount of content. One student described their experience as “the school that I am currently doing practicum has 35 minute periods meaning that
most of the lesson would be logging on to the VW and before they could even start the task it would be time to shut down the laptops again” (Student 278, Cycle 3).

Students whose curriculum area was primarily practical in nature (such as physical education, music and visual arts) consistently referred to what they believed to be an over use of technology in the classroom and their desire not to add to it. One physical education student claimed “students are on technology enough during the day and PDHPE is about living active lifestyles so involving them in activities where they are up and discussing the topic seems to be better than them typing away on the computer” (Student 278, Cycle 3). A visual arts student expressed that she could not “see how having a virtual learning space within the visual arts classroom would be an improvement to the students learning especially in stage 4 and 5 where the majority of the class time is practical” (Student 348, Cycle 3). The visual art student displayed her belief that art practice is based in primarily non-technology based media. One of the music students also showed that their thinking about what constituted music practice was based in an approach that did required musical performance to be experienced in real-time and space; as they reflected “I am mindful of the fact that some things like witnessing and participating in live performance can only be experienced in real-time and space” (Student 337, Cycle 3).

The students who had perceptions that VWs did not have a role to play in their curriculum area were defining their approach to teaching based on their current experiences, either as a student or as a pre-service teacher. As pre-service teachers they were understandably concerned with being able to link activities with the educational outcomes prescribed in state and national syllabus documents. One student from the curriculum area of English described how computer games had “some value, as long as they are specifically adjusted to directly link to required outcomes” but that she could not see how “creating a VW directly links to learning” (Student 166, Cycle 2). The use of digital games that are marketed specifically at education have become fairly common in classrooms however the use of a VW such as SoaS requires a higher level of conceptualisation by the teacher to apply it to specific syllabus outcomes.

The level of confidence in the use of technology and specifically the use of VWs was cited as one of the barriers. This also reflects the students’ perceptions about how they
are going to introduce technology in the classroom. If the student believes that the technology must be taught to the students by the teacher then they need to rely on their personal skill level. This approach to the teaching-learning process is evident in the comment made by one of the students that “online interaction requires plenty of scaffolding. This is particularly the case for students who do not have technology as a strength” (Student 26, Cycle 1). They elaborated that teachers themselves will need to be “quite confident in the program they are implementing in order for them to provide adequate scaffolding” (Student 26, Cycle 1).

A small number of the barriers were referred to as positive affordances in some instances of the data. These included - students being off-task (due to the engaging and entertaining nature of the VW), cyber-safety and a loss of social skills (due to not engaging face-to-face). For example, one student described how the VW could keep students engaged as it was “a powerful tool that would motivate the students to stay on task” (Student 342, Cycle 3). Another student felt, in direct contradiction to some of the comments that cited concerns over control, that the VW allowed the teacher to “introduce a controlled learning environment, where the parameters of the task are clear and specific, therefore allowing students to focus more directly on individual learning and development of critical thinking skills” (Student 287, Cycle 3). Some of the students described how cyber-safety could be taught by using the VW to role-play scenarios and to test boundaries in a safe environment.

One of the affordances of VWs is the capacity to meet in the same space and engage in a shared experience. While this raised safety concerns for some students others recognised that this presented a range of opportunities that many of their future students do not currently have. As one student observed “VWs are opening up so many doors and opportunities for people to access educational tools first hand from all over the world. It eliminates the cost and travel time associated with going out and attending these events in person” (Student 65, Cycle 1).

Regardless of whether a student described factors that placed them in pre-realisation or reimagining phases there was consistent recognition that VWs would be highly engaging for students in K-12 education. For those at the lower end of the phases, engagement was a distraction and at the higher end it was the main affordance. Many of the students
reflected that they needed to become more familiar with VWs and how to use them because of the interests of their future students and the need to engage them in learning.

The game like features of the VWs the students were introduced to in Unit 3 and the association between games and VWs meant that students were consistently referring to the VWs as being fun. In some instances the connection between fun and learning was seen as a negative in that being fun meant that they could not be learning something that should be serious. However some students connected fun with learning and increasing the engagement of their future students that would in turn foster a positive learning environment:

The benefits of using VWs for educational purposes include being able to target and develop particular skills, promoting teamwork and problem solving and getting students to use their initiative and be independent thinkers in order to create something…and you can’t forget how much awesome fun it would be for the students! (Student 155, Cycle 2)

The same student provided advice to teachers, saying “it seems to me that what we as teachers need to do is think creatively and just be open to integrating new and unfamiliar methods into our pedagogy”. These types of comments highlighted that some students were able to link the need to utilise different teaching-learning processes to that which they were currently being taught or observing in classrooms. They believed that in order to fully utilise the VW in a way that transformed the learning experience for their future students that they would need to be open to change.

6.4 Unit Four

Unit 4 was part of Cycle 2 only. The students were provided with resources and experiences in the use of VWs through lectures, discussions, online instructions, video examples and hands-on workshops conducted in Second Life. The level to which the students engaged with the resources was voluntary. The students were given the option to use VWs as part of an assessment item (presenting their issues paper in Second Life). Seven students participated in VW workshops and seven responded to the voluntary survey. Three of the students presented their assessment in Second Life; two of these students agreed to be interviewed.
Survey 2 was designed to ascertain why some of the students had chosen not to use Second Life as part of their assessment tasks in Unit 4. Students in Unit 2 and Unit 5, during Cycle 2, were also asked to complete survey 2. These three units (two, four and five) were delivered concurrently and the students were given access to the same resources and support in relation to VWs. There was a very low response rate across all of the units (Unit 2, n=2; Unit 4, n=7; Unit 5, n=2) to create a combined response rate of 11 students. The following analysis of survey 2 data has combined the responses from all three units.

The students were asked to nominate the main factor that influenced why they did not use VWs for their assessment tasks. From the responses there were four main factors:

1. the amount of time they believed it would require (n=5)
2. factors related to the technology (n=4)
3. the level of perceived difficulty (n=2)
4. the relevance they believed it had for education (n=1)

The factors relating to technology included a “dislike of Second Life” to their belief that their “Internet connection wouldn’t be able to run it”. Only one comment made a connection to not “seeing the point in using something I won’t use in the classroom”.

The next level of the survey asked them to indicate the factor that would encourage them to use VWs in the future. These responses were varied and included if:

1. they had more time (n=3)
2. they were required too (as an assessment item) (n=3)
3. their peers were using it (n=1)
4. there were workshops to help them (n=1)
5. they had more ideas about how to use it in the classroom (n=1)

The most consistent factor from both questions was that the students felt that a high level of time commitment was required and they had decided that the time they would need to invest in learning to use the VW was not going to be well spent. While the response rate to the survey was very low, there was also a low response rate in the
actual uptake of use of the VW. This would indicate that the students across the three units in Cycle 2 were of the consensus that the effort required to investigate and utilise VWs was not going to be rewarded with any short term gains (e.g., through assessment grades).

The third question in survey 2 asked the students to rate how useful they found the resources that had been specifically made to assist them to utilise and understand VWs for education. Table 6.4 presents the number of students who responded to each resource in terms of level of usefulness.

**Table 6.4 Responses by students to the level of usefulness of each VW resource**

<table>
<thead>
<tr>
<th>Level of usefulness</th>
<th>Video</th>
<th>Website</th>
<th>Tours</th>
<th>Presentations</th>
<th>Workshops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely useful</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Quite useful</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Neither</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Quite unuseful</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Extremely unuseful</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Didn't access</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>8</strong></td>
<td><strong>7</strong></td>
<td><strong>9</strong></td>
<td><strong>11</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

The most significant figure in Table 6.4 is the high number of those who did not access the resources. This data changed my initial presumption that providing a guided introduction to VWs supported by resources would result in students’ uptake of the VW technology. What became apparent was that the factors that influence whether students use VWs were varied and were, therefore, difficult to predict or to address prior to utilisation.

**6.4.3 Helen**

Helen was one of three students who used Second Life to present their research paper. She was a mature age student in her final year of study who had primary school aged children of her own. In her opening interview statement she expressed how using the VW had “been such a fantastic way to see how you can shift your pedagogies and be inclusive of this digital world that our kids are in and it was fun”.

The experience that Helen had with VWs boosted her confidence with technology and her engagement with university. She described that she had “been at Uni 6 years now
and this has been fun. I thought creating a wiki and a website was fun, but this was really cool”. She had perceived that using the VW was going to be a challenge and that was one of the reasons she chose to use it. Once she had completed the project she was able to reflect on her achievement as being “the biggest milestone for me. And from here I want to go further with my use of technology”. She believed “a lot of teachers stay away from the use of VWs because they think it’s hard” although her experience was that “each week we got here and we enjoyed it so much and we’d be buzzing talking about it with each other”.

Helen displayed a high level of interest in learning as much as she could about VWs. She attended all of the weekly meetings that were held in Second Life as well as one of the sessions at the VWBPE conference:

I was in a lecture in a medieval theatre with people coming in and an academic from the US talking about the future of digital cultures and VWs and I was actually interacting in that. I asked him a question and he answered me. You know I wouldn’t have had the chance to do that without VWs and I definitely think this is the way of the future.

Helen’s VW experience did have an impact on her approach to the teaching-learning process. She was particularly aware how engaging the VW could be for children and the way that using an avatar could liberate children from the structure of the regular classroom. She stated, “some kids do well in role-play in the real world but there are some kids who would enjoy it more as an avatar. There is a kind of detachment using the avatar, a sense of knowing it is them but also knowing that it isn’t”. Helen also felt that the way that technology is being used in the K-6 classroom is not as useful or exciting as she felt it could be. Her feeling was that providing the K-6 child with opportunities to create characters in a VW so that they “could play out the information that they have been researching” would be a more affective and engaging use of technology.

Helen also thought that there was a role for children to play in educating parents about VWs and different ways of learning. She described how the VW promotes a student-centred approach to the teaching-learning process and can be “a great way for the children to share their knowledge with their parents”. Helen expressed her delight that VWs could be part of a change in teaching-learning processes that included allowing
the students to be the teacher. Based on the limited time that Helen spent in the VW and the fact that she was at the end of her four-year degree it is unlikely that VWs, in itself, changed her approach to teaching and learning. Rather, she had developed a belief that teaching could be more student-centred over the course of her studies and the VW offered her a way to implement more student-centred practices.

Most importantly was the comment that Helen made about teachers “just sticking to what they know and that’s all they do with it and then the technology use becomes just as mundane as a worksheet”. She had observed that teachers were often afraid to try new things and she felt that a lot of the issues about digital cultures in the classroom arise because of the teachers’ reluctance to take risks. She believed that she had been equipped with some of the skills needed to implement innovative technology and innovative teaching-learning processes.

6.4.4 Martha

Martha was a younger student who was looking for the quickest and easiest option in which to complete the assignment. During her interview she expressed dread about having to use technology stating that she “despised that technology subject where we had to make the WebQuest and that big assignment. I was so overwhelmed with that and I really, really struggled”. Before she chose to use Second Life she had attempted each of the other digital options and found they were not working for her. Martha was surprised how “fun and so, so easy” Second Life was and that it only took her “a one hour session and I felt really confident and it took me 40 minutes to put those boards up and that’s it”.

Martha compared the use of VWs to the way that she had observed teachers using computers in schools where she had undertaken her practicum:

Every time the class had a computer lesson they either did dance map typing or some other typing game. I asked my mentor teacher if she minded if I tried to teach them something new and she said I shouldn’t bother because they won’t get it.

She felt that this was a typical response to the use of new technologies as she had also tried to suggest that the children use the computer to type up some stories and the teacher’s response was “it will take them forever to type and it will just be a
shambles”. On the other hand she had observed a class in which the children presented a speech by typing their text into a program in which an avatar spoke the speech back to them. Martha witnessed that the children found this highly engaging and constantly returned to listen to their speech. She felt that VWs had a similar level of engagement for K-6 children.

When asked to reflect on whether the use of Second Life had changed her approach to the teaching-learning process she stated that it had and that she wanted to use VWs more in the future. However when describing how she would use VWs she was at an early stage of replicating what was already possible in the non-VW. She provided the example of how she had attended a lecture from home and she felt that “if everyone just came into Second Life, they don’t have to navigate, they just have to be in the lecture theatre and they can sit there and listen”. Her experience of the VW was entering the space, talking to a few of her classmates, creating a few basic prims and placing images on the prims.

While Helen and Martha both used Second Life to present their research papers they did not exploit the potential of the VW. They replicated what they could do in the non-VW. They created a series of PowerPoint slides and attached them to either flat boards or cubes and placed them on SERI. The only difference between what they did in Second Life and what they might have done in a non-VW presentation was that a number of people were able to attend from different physical locations and the students could talk from notes without it appearing that they were doing so because they presented through their avatars.

The data from both surveys and interviews indicated that the students either wanted to challenge themselves and explore VWs or they wanted to use a technology that they perceived would be easy. The main choice for the assignment was Xtranormal moviemaker, which offered an easy option, as it simply required the students to type in text that was then read by the characters. Their presentation could be reviewed and remade until the student was happy with the result and some of the students had seen a similar tool used in the K-6 classroom. In choosing to use Second Life the students needed to be willing to create an avatar, enter the VW, navigate the space (movement and sound), have an Internet connection and technology that would support the VW, then present their work in real time to an audience. The three students who used
Second Life did so because they were motivated by the challenge (n=2) or were up to the last option having failed with the other choices (n=1). During the delivery of the unit a further five students had attended the weekly meetings but decided not to use Second Life for their assignments. As such they gained skills and ideas in the use of VWs that they may have taken into their future classrooms (yet is outside of the scope of this research to ascertain).

6.5 Unit Five

Unit 5 was included in Cycle 2 and Cycle 3. The students were provided with resources and experiences to help them explore and understand the use of VWs in education. The level to which the students engaged with the resources was voluntary. In Cycle 2 the students were given the option to use VWs as part of an assessment (creating a digital learning resource). In Cycle 3 the students were required to use either Second Life or SoaS to create a digital resource. The student responses were gathered from two online surveys (survey 2 and survey 4), one in Cycle 2 (n=2) and one in Cycle 3 (n=26) and interviews (n=2).

6.5.1 Heather

Heather was one of three students who used Second Life in which to produce a digital resource. She based her work on the theme of the Freedom Rides in Australia in the 1960s. Heather built a space on a platform above the SERI that consisted mostly of boards with images and information on (Figure 6.2 and 6.3). A significant feature of her build was the 3D swimming pool that she had bought on the Second Life marketplace. The pool was a symbol in the actual events surrounding the Freedom Rides in Australia, as at the time Indigenous people were excluded from the use of public pools in some towns and the Freedom Ride journey included protests at a number of public swimming pools in regional towns.

Heather was encouraged and supported by her friend, Gaby, to use VWs for the assignment in Unit 5. When Gaby first used VWs in Unit 1, Cycle 1 Heather chose not to, even though she was also part of that cohort. She expressed regret about not trying VWs in Unit 1, Cycle 1, saying “when Gaby started doing it she said ‘come
and do it with me’ and I said ‘I don’t want to do it’ but I should have. I would’ve been a professional at it by now as well”.

Figure 6.2. The view of Heather’s build from above showing the box shape that she worked within above SERI in Second Life.

Figure 6.3. Heather's freedom rides build showing the pool and the information boards. This build illustrates the level at which a first time builder can create a learning environment.
In hindsight, Heather had seen that Gaby had achieved quite a lot of kudos and professional experience by pursuing VWs. Heather went on to explain that she was unsure why she lacked the initial motivation to use VWs suggesting “maybe I was just being lazy and it was in the too hard basket but now I can see how valuable it is and how easy it is once you know how to do everything”. She felt that the work that Gaby had been doing with the children at one of the local primary schools, and the projects Gaby had made for various assignments at the University, had motivated her to give it a go this time. She was able to “definitely see how children will like it and how I could use this in my classroom”.

Heather was unsure whether her approach to the teaching-learning process had changed because of her use of the VW. Instead she described herself as “a very hands-on learner. I don’t like lectures at all. It’s not how I learn - it just goes over my head” and she felt that the VW catered for her style of learning. Because of her style of learning she believes that she already teaches in a “physical hands-on way rather than just being the teacher spitting out information and the kids writing it down”. She could see from her use of VWs that incorporating them in the classroom would fit with the way she likes to teach and to learn.

Heather was asked why she felt that more students did not use Second Life for their assignment. She suggested that it just looked too hard to the other students especially when they saw the examples of VW builds done in Second Life and by Gaby. She expressed that the moment in which she felt ready to try using VWs was after the lecture in which I spoke to Jon about possible student concerns (Section 5.6). This had helped her to realise that the barriers could be overcome. She provided some suggestions about how students could be supported to use VWs in the future:

- Face to face on campus workshops
- Showing simple work created in the VW
- Having someone on campus that you could ask for help from
- A step by step guide
- Creating avatars for people
- Making everyone do it together
Despite her espousing that her own teaching and learning preferences were based in an experiential model her suggestions mirror a very traditional teacher-directed approach to introducing technology. Heather’s use of the VW was also very traditional in her approach. This may be due to her unfamiliarity with the environment and how to best utilise the building tools. She created what is often considered a museum like environment (Swartz, 2009), one in which the avatar interacts with information on boards and inanimate objects.

6.5.2 Cassie

Cassie also used Second Life to create a digital resource in Unit 5, Cycle 2. Her initial experience with technology was one of trepidation: “when I think about the advancements in classroom technology I feel nervous. Because I haven’t utilised it I automatically feel that I won’t be able to implement it in my lessons”. However, she made conscious decisions to overcome any lack of skill or knowledge she felt she had, as she wanted “to change and become a role model for future students in their use of technology”. For Cassie, the use of technology represented a significant challenge but she was motivated to do so because she believed “taking the risk to play with foreign technology” would enable her “to have the confidence to utilise it and to maximize the learning of my students”.

Cassie used the building tools in Second Life to develop VW learning environments in Unit 1, Cycle 1 and Unit 5, Cycle 2. She was part of the group of students who volunteered to use Second Life to build a sustainable design project in Unit 1 (Section 5.2) and she worked individually to create a VW digital resource for Unit 5. For the digital resource she designed and built a VW learning space inspired by the book My Place by Nadia Wheatley. My Place tells the story of one particular location in Sydney as it changes over time from when the Indigenous people inhabited the land through to the 1980s when the story was written. The book is a popular text in Australian schools and there are online resources to support educational engagement with the text, including a website and TV show produced by the Australian Broadcasting Corporation (ABC).

The digital resource that Cassie built was designed on a piece of virtual land allocated to her in Second Life on the SERI. She decided to build four spaces that K-6 students
could interact with when visiting the VW. The spaces were (a) a house from the early 1900s, (b) a house from the 1940s (c) a schoolroom from the 1920s and (d) a series of boards with information about the characters in the book (Figure 6.4). In the lesson sequence that she developed to include the VW digital resource, she explains that the use of the VW environment would be one where the K-6 students would come and be able to experience a simulation of what it was like in Australia in the 1900s.

Figure 6.4  Cassie’s build in Second Life showing what it was like to live in Australia in the 1800s. This represents a build undertaken by a student who has had one prior experience building in Second Life. She combined objects from the Second Life marketplace as well as developing her own objects and placed them in a way that facilitated a simulation rather than simply a series of informational boards.

Cassie was intrinsically motivated to utilise Second Life in Unit 1 and Unit 5 because she wanted to try out the extra options that were offered to her during all of her units. In relation to VWs she stated that she “was interested to see what it was and how it worked”. Cassie also perceived that VWs “could be a great teaching tool to explore because many kids already engage with programs like this at home so it won’t be long until it starting to be used in schools for learning”. Her outlook was based on her personal desire or intrinsic motivation to gain as many skills as possible as well as a desire to be able to respond to her future students.

One of the main barriers that Cassie encountered were the technological requirements to access Second Life. She did not always have access to the Internet and generally worked in Second Life from computers at the University. She recalled that her
“computer couldn't 'cope' with using Second Life and that only a few tutors knew about VWs” making it difficult to get assistance if she needed it in a face-to-face context. Most of the assistance she received was from me when we would meet in Second Life, as Cassie was physically located at the Gold Coast campus while I was in Lismore (an hour and a half away). Despite the limited access she had to tutors who could help her face-to-face she did feel “the tutors were always understanding if [she] used it in an assignment”.

The reasons she felt that other students did not use Second Life in Unit 5 was because “they didn't really know what it was or how to use it”. She thought that the other students might have “been scared or worried about learning something new”, although she reflected on the fact that it was not unusual to learn new things at university, “at Uni, you are learning new things every day, so I’m not sure why they didn’t want to try VWs”. She felt that the barriers for other students were so great that the only way to get them to use VWs was to make it part of an assignment. She compared the fact that, as students, they are required to use a range of technologies such as websites and blogs so she was perplexed as to why VWs could not also be compulsory.

After using Second Life in Unit 5, Cycle 2, Cassie had gained enough confidence and interest in the use of VWs to implement SoaS in a primary school setting. She developed an independent research project, as part of one of her final year units of study that introduced SoaS to a group of four primary school students. She chose SoaS for her project because “it was such a new concept that not many people know about and people are apprehensive towards it”. She also thought it would “be good to look at it more closely and actually use it in a school” in order to develop her understanding of SoaS for future use.

The research project task was designed so that the pre-service teacher can take on the role of an educational researcher. They were encouraged to investigate an area of personal and professional significance. Cassie investigated whether the use of SoaS could increase engagement in the K-6 classroom. From her research she concluded “SoaS has the potential to engage and enhance teaching and learning in the classroom”. She also found that there were a range of perceptions from teachers and students about VWs and the potential for its use in the classroom for learning outcomes. These perceptions included that SoaS was a very engaging tool to use with children, that it
could be easily linked to a variety of content areas and that it was a challenge for the teachers in terms of learning the skills required to use it. The students on the other hand found the use of SoaS very enjoyable and had very few technical issues.

While she was given permission to use SoaS in one of the local primary schools for her independent research project she still found there were a number of barriers. Most notably was the fact “none of the teachers were really interested in it and wouldn't assist me with it”. This made it more difficult for her as she was a pre-service teacher on a practicum placement. She found once she finished this research project it was difficult for her to do any more work using SoaS as the firewall restrictions in place on the school network meant she needed to use her own laptop, not connected to the Internet. This was possible with a small number of students (as in her research project) but made up scaling to a whole class less feasible.

Cassie graduated in 2013 and started work in a public primary school in the Sydney area. She had not used VWs in her teaching as she found the workload for a beginning teacher was too burdensome. She described her experience as needing to spend her time “getting her head around other things”. However she had seen a number of opportunities where in the future she would be able to use VWs and that the project she had created for Unit 5 could be easily integrated.

Despite the fact that she still believes that VWs would be useful in her classroom her main barrier at the moment is the “lack of support from other staff”. She feels that as she is “not very knowledgeable in the school computer systems” she would need someone to assist her and she was not “sure if there would be any teachers willing to do that”. She has already observed that she is one of the few teachers in the school using technology as she states “I am one of the only teachers at my school that integrates iPads into learning”. What Cassie’s comments reveal is that she has the level of confidence that might be expected of beginning teachers in relation to technology, in that she will use ready made tools such as iPads, but feels that anything more technical in terms of networks or dealing with the idiosyncrasies of Department of Education computers would require extra assistance. She is also in a position within the school, as a beginning teacher, where the social dynamics and hierarchy influences how well she would be supported to introduce a new technology.
Overall Cassie felt that her introduction to VWs at SCU had affected her approach to the teaching-learning process. Cassie believed that her confidence level with technology had increased and she believes that if she hadn't used VWs she wouldn’t have been as open to other new technologies such as iPads that she is now using in her “daily teaching routine”.

The fact that she was introduced to VWs as part of her teacher training and that she had used VWs in two instances had meant that she was more aware of where she could integrate VWs into the curriculum. She believed the use of VWs to be a valuable skill because she felt “more aware of how to cater for differing learning styles especially in regards to utilising the VWs that kids interact with at home and understanding how that impacts on how they learn”. Cassie also felt that she was “likely to use VWs again, probably when I am better able to cope with teaching”.

6.5.3 Survey 4

In Unit 5, Cycle 3 all of the students were required to use the VW as a small part of their response to one of their assessment tasks. Students were encouraged to utilise SoaS and, as such, they built work and supplied screen shots of the spaces as part of their assignments. Some students used Second Life either because they didn’t have access to the correct operating system to run SoaS or they had a preference for Second Life. The students who used Second Life were allocated a small plot of land on the SERI. They were able to request assistance from the tutors, Gaby or I. Part of the introduction to the use of VWs included Gaby presenting one of the lectures with three of her primary school students. She also conducted two workshops in Second Life to initiate and support the use of the VW.

As the use of VWs in Unit 5 was specifically designed to enhance the choices students made in relation to a lesson sequence a survey was designed to ascertain to what extent the use of the VW had affected the pedagogical choices that the students made. The questions are outlined in Appendix B. Twenty-four students responded to the survey. Twenty-two were female and two were male. Nine had used a VW before and 16 had not. The types of VWs they had previously used included SoaS, Second Life and games on PlayStation and Wii.
SoaS (n=19) was more widely used for the assignment than Second Life (n=5). The main reason that students chose to use Second Life was because they only had access to a computer with the MacOS and as such could not run SoaS. The students who were not restricted by the operating system indicated that the reason they used SoaS was because they thought it would be easier (n=6), that it would be most useful for education (n=4) or that they wanted to try it (n=4).

Students were asked to indicate how they felt before they started the assignment. Of the 23 responses 12 expressed some concern about using the VW for their assignment, four were completely uninterested, five were interested and three were eager. The high level of concern was based partly in the students feeling that they normally did well in assignments and due to their unfamiliarity with VWs felt they might be disadvantaged in this instance.

They also rated to what extent their perceptions of VWs in education had changed while undertaking their assignment. Responses were fairly evenly distributed between those who indicated that their perceptions hadn’t changed (n=9), those that were more neutral (n=7) and those that felt they had changed (n=8). Of the nine whose perceptions hadn’t changed, five had remained the same because they stated they already could see the potential for VWs. The other four either made no comment (n=1) or stated that they found it time consuming (n=2) or had too many issues with the program (n=1). The seven responses that were more neutral all indicated that they could see how VWs would be beneficial in the classroom. The students cited reasons such as student engagement (n=2), fun (n=1) and creativity (n=1). Of the eight respondents who indicated that their perceptions had changed, one had become more positive since his initial comments “it would be something beneficial, but it seems like a lot of work and without the knowledge too confusing. I wouldn't use it unless forced in the classroom”. The other seven responses ranged from stating that they could “see what a valuable tool it can be in the classroom but before I wouldn't have looked at it all” to believing “VWs should be implemented as a key component in most lessons”.

One of the questions asked about how the use of the VW influenced the type of lesson sequence that they designed for the assignment. Eleven responses indicated that the VW did not influence the design and that they simply added the VW in to the lesson sequence without fully utilising the capacity of the VW. Of the eleven responses two
expressed that being required to include the VW had a negative effect on their lesson sequence. One of the students felt that they were “more worried about getting that part of the assignment done as that was what everyone seemed to be focusing on as the main component” even though it was only a very small part of the actual assessment.

The other nine responses indicated that the VW was added into their sequence after they had designed their lessons. One student stated that they “made the lesson plans and after that decided what to do in the virtual world”. Another response showed that they were aware that they were not using the VW as effectively as they could as they “used it in a very plain way with not much interaction involved”. They felt that they needed “more time to play around with it and to become more confident with it first before I would utilise it frequently”.

There were nine responses that indicated that the use of the VW had influenced the design of their lesson sequence. Reasons given were that the VW provided engaging, stimulating, creative ways to enhance their lessons:

I felt it was a great stimulus for the students and a great way to engage younger children. I aimed my unit of work at Stage 1 and Second Life gave me the opportunity to introduce a topic in an interesting way. I have a child this age and showed him what I made; he instantly engaged with the room and started telling me about it, which was exactly what I wanted.

Asked whether they would like the opportunity to undertake other University assignments and activities using VWs the responses were Yes (n=5), No (n=7), Maybe (n=10), Yes but not Second Life (n=1), Yes but not SoaS (n=1).

Further feedback was requested to assist in future iterations of the use of VWs. Students were asked what some of the ways they believed that the use of VWs could be facilitated at the University. Their responses provided some insight into the factors that had affected their ability to utilise VWs:

- being shown how to use the VW in workshops led by experienced tutors (n=21)
- having more time (n=15)
- having more resources (n=3)
• better access to technology at University (n=2)
• better access to technology at home (n=1)
• if the VW was easier to use (n=1)
• provide examples of use within K-6 settings (n=1)

The students were asked to state what barriers might prevent them from using VWs in their future teaching. Ten of the students indicated that they would need to increase their knowledge and confidence in using VWs before they used it in the classroom. Other responses included if the school has the technological capabilities (n=4), if other teachers are using it (n=2), if it becomes easier to use (n=2).

Ten students chose to make an open response to VWs in education. The comments were collated thematically and revealed that eight students had a mixed response, expressing both positive and negative comments, one made just a negative comment and one made just a positive comment. Nine of the responses attributed responsibility for their experience back to the actions of either the VW or the pre-service teacher educators.

The negative responses to the VW included that fact that they were part of an assignment (n=3), that they were difficult to use (n=3), they required too much time (n=8) and that there wasn’t enough support provided to teach them how to use it in a face-to-face workshop setting (n=4). In contrast one of the positive comments stated, “I’m really glad I had the opportunity to interact with VWs. The support from the lecturer was vital”.

Overall, the responses were similar to responses being given in other units and with other cohorts of students. Some students found the perceived demands in relation to time and technical requirements too burdensome and this reflected on their perceptions of the usefulness of VWs. The students who applied the VW to the educational setting in a way that enhanced the learning experience were more likely to respond in a positive way. As all students were required to use VWs in Unit 5, Cycle 3 there was added tension about the VW being included in assessment. At the outset of Cycle 3 Jon and I felt that some of the students would be more reticent due to the assessment component. However, we also believed that this would provide extrinsic motivation that would facilitate the students to consider the use of VWs. Jon decided
that he was willing to accept negative student feedback in order to provide the students with an experience that they would not otherwise choose to take. Unfortunately the student feedback at the end of Cycle 3 resulted in VWs not being made compulsory in the following iterations of the unit (after the conclusion of this research).

6.6 Unit Six

Unit 6 was part of Cycle 2 only. The students were provided with resources to help them become familiar with VWs and to understand how VWs could be used in the K-6 classroom. They were also given the option to attend workshops on campus and in the VW to familiarise themselves with how to use the VW. The level to which they engaged with the resources and workshops was voluntary. They were required to use VWs as part of an assessment item (presenting a role-play of a scenario in Second Life). There were 57 students enrolled in Unit 6, all of whom undertook the compulsory role-play activity. The student responses presented in this section were gathered from a survey that was administered in class (n=11) and online (n=4).

In previous years students had been required to undertake a role-play activity and present the scenario, face-to-face, to the class during tutorials. The lecturer, who chose the types of situations that an early childhood educator might encounter in their workplace, set the scenarios. Their peers gave feedback in relation to how effectively they responded to the scenarios. In Unit 6, Cycle 2, all of the students were required to use Second Life to act out their role-play. This was screen-recorded and played back during the on-campus tutorials in which their peers provided feedback.

6.6.1 Survey 3

The survey designed for Unit 6 asked the students to reflect on how the use of Second Life influenced their response and understanding of the early-childhood scenario. Overall the responses to the survey could be divided between a positive response (n=4), negative response (n=6) and those who responded with both negative and positive comments (n=5).

Some of the ways that the students could see the benefit of using the VW was that it was a “more interesting way to do the assignment” and they were “able to visualise the scenario better”. The same student felt that it “reduced their anxieties by not
having to present information only in class”. In general, the positive responses recognised the potential for using role-play in the VW. They believed that it “provided a more real life context including the use of everyday speech and body placement”. One student stated that they were able to really put themselves in “the shoes of my character in the scenario” which resulted in them feeling that they “gained a deeper understanding by looking at it from this perspective”.

The students were given the opportunity to design the space in which they undertook the role-play and one comment was that this enhanced the experience by being able to “add in your centre’s philosophy, the early years learning framework, and other items that you feel will be good”. This allowed the students to undertake this task in a way that they would not normally be able to in a non-VW setting. The students could chose the clothes they would wear, the colour of the walls, the furniture, the toys, and books as well as the placement of these items.

One of the students also highlighted the convenience of being able to meet in Second Life to practice and perform the assignment task. She said “all the members of our group were parents and so being able to access Second Life and work together later in the evening worked very well for us”.

The comments that conveyed a negative response reflected concerns that were either personal or technical. Those of a personal nature focussed on the student’s lack of confidence, “fear of the unknown” and the time it consumed or the lack of time they had to develop the skills. Other personal issues included the perception that Second Life was potentially addictive and that it had a tendency to display “pornographic images”.

The technology itself presented problems for some students who had difficulties because the computers at one of the SCU campuses did not have the Second Life viewer installed or because they had a slow Internet connection at home. While this led to frustration it did not stop the students from participating. They found ways to work around these barriers such as using their own computers on campus or accessing Second Life when at a location with appropriate Internet connections. Due to the activity being linked to an assessment task the level of frustration experienced was heightened and resulted in some students feeling disadvantaged.

One student found the task of writing content into a role-play conversation difficult
and would have preferred to write an essay. This student would normally receive high
grades when presenting an assignment in a more traditional mode and felt
disadvantaged due to the technology requirements and expressed their frustration
about “having to spend time trying to get Second Life to work, and learning how to
use it”. Another student gave advice about what they felt needed to happen in the
future if VWs were to be part of an assignment:

If we were to undertake another assignment using VWs, I think it
would be advantageous to have class time to work together and learn
how to navigate the VW and the avatars. Although Lisa was a great
help, I think that more time would be necessary to fully understand
how to use the world and then spend more time on doing the research
and writing for the assignment.

This comment makes similar claims as those of students in other units involved in the
research; that of a lack of time. In general the students felt that they were
underprepared to fully understand and utilise VWs for whatever task they were asked
to use it with. The students in Unit 6 were asked whether they would like the
opportunity to use VWs again in a University assignment. This question provided
some insight into the response that the students had to VWs with approximately one
third each stating that they would like to use VWs again, they wouldn’t like to use it
and that they might like to use it. The response indicates that there are clearly those
who have a positive perception or experience of VWs and those who have a negative
one. The interesting group are those in the middle who are unsure. What this might
reveal is that the students realise the potential for the use of VWs and feel that with
some of the barriers removed (their lack of skills, technical requirements, time to
develop a better understanding) they would be willing to utilise VWs in the future.

6.7 Summary

The data presented in this chapter were gathered from blog posts (n=311), portfolio
reflections (n=33), scenario responses (n=8), four different surveys (n=56, 11, 15 and
24) and interviews (n=5). Each of these instruments was designed to gather different
aspects of the student’s experience as relevant to the unit in which they were enrolled
and the cycle in which they were situated. When the data were analysed it provided
insight into the factors that affected the students (a) motivation to engage with VWs, (b) perceptions about VWs, (c) experiences with VWs, (d) the affect that the VW had on their teaching-learning processes and (e) the barriers they encountered.

The blog posts provided data from the largest number of students and as such themes emerged that facilitated the design of a phases of realisation model and later, phases of engagement. This framework is discussed in more detail in Section 8.3, 9.2.1.1 and 9.2.3.1. In Cycle 1 the students mentioned a number of barriers that were impacting on their capacity to realise that VWs had a role in education. Eighteen per cent of the students expressed the view that they could not see any benefit in using VWs and that they would not use them in education. A further 52 per cent made comments that indicated that they would not use VWs in education due to the high level of barriers they perceived. In response to this level of reluctance to engage with VWs in Cycle 1, the way in which the content was delivered changed for Cycle 2. As a result, the percentage of students who were highly resistant dropped to 11 per cent and 37 per cent in Cycle 2. Further changes were made between Cycle 2 and Cycle 3 resulting in a drop to seven per cent and 35 per cent.

The main changes were made in response to the barriers that students expressed. Analysis of the data revealed that there were four themes related to the student’s:

1. personal experience
2. perceptions about their future students
3. experience or perceptions of VWs
4. experience or perceptions of VWs in education

Table 6.2 in Section 6.3.2 provided a breakdown of these themes that reveal the factors that influenced the students. Survey 2 that was administered in Cycle 2 to students in Units 2, 4 and 5 specifically asked students why they did not use a VW for one of their assessment tasks. The data from this survey, while only a small number, assisted in the triangulation of the barrier data from the blog posts. The reasons that the students provided included; the amount of time they believed it would require of them to use the VW (personal factor), factors related to the technology (experience or perception of the VW), and the relevance they believed it had for education (experience or perception of the VW in education).
The six students who were interviewed had all used the VWs in at least one instance to create content for an assignment. The data collected from the interviews also served to triangulate the barriers as they were asked about the barriers they had to overcome and the barriers they felt impacted on other students. They all mentioned time as a factor. Time presented itself in a variety of ways including the lack of time that students felt they had in which to complete tasks due to their studies, work and home life. Including VWs in assignment tasks meant that students were required to learn how to use a technology that was completely new to most of them. No extra time was allocated for the students to do this and as a result the students had to allocate the time. The students who were interviewed allocated the time to learn how to use VWs. Their responses reveal some of the factors that distinguish them, as those who were motivated to spend extra time on learning about VWs, from those who were not motivated. These factors are expanded upon in Section 8.2 and 9.2.2.1.

6.8 Conclusion

Overall the responses from the students revealed that many factors influenced the manner in which the students would respond to VWs. The students emerged as one element of a complex system in which those around them, as well as their own pre-existing perceptions, experiences, knowledge and skills, influenced their responses. The inclusion of a disruptive technology such as VWs impacted on students in a variety of ways; some students rejected outright the possibility of using VWs while others took to the challenge of utilising the affordances of the VW. The following chapter tells the story of one student who embraced VWs during this research and has continued to use them as part of her teaching in K-6 schools, becoming a leader and mentor to other teachers.
Chapter 7 Case Study

In this chapter a case study is presented of Gaby who was one of the students who first volunteered to use VWs as part of this research and went on to become an exemplar in the use of VWs as part of her teaching and learning. Her teaching practice is now recognised as innovative by her colleagues and her description of how that occurred highlights the capacity of the VW to act as a catalyst. The chapter charts her journey with VWs, starting with the first three projects that she undertook using VWs, and concluding with her reflections on how VWs have influenced her teaching-learning processes.

7.1 Introduction

At the beginning of 2011 VWs were first introduced to students in the Bachelor of Education (Primary) program. Of the 17 students involved in the first activity in Unit 1, Cycle 1, Gaby was one student who continued to use VWs throughout the rest of her studies and into her work as a teacher. After Unit 1 she included VWs in another 10 units, either through creating work or in referencing work in curriculum design, essays or discussions. In 2012 and 2013, while still a student, Gaby volunteered at a local primary school and introduced VWs to the pre-service teacher educators and students. In 2014 she had graduated and began working as a teacher in four different K-6 schools as their technology teacher providing projects that utilised blogs and VWs.

Gaby was a mature age student who, before studying at SCU, had worked for 12 years in Early Childhood Education (without a university qualification). She describes herself as somebody who “never really spent a lot of time on the computer” and certainly “had never played video games”. She did “a bit of web surfing and emailing” and had just started to use computers more with the commencement of her university studies. Her son, who was by now a young adult, had been home schooled by Gaby and her husband for most of his education, as well as attending a Steiner school and a local public school.

Gaby had also worked at a Steiner school and acknowledged Steiner education as one of the reasons why she didn’t use much technology before coming to university:

For the majority of my child’s education we had followed the Steiner school philosophy, so technology really didn’t feature a lot in our
We did a lot of stuff outside. I especially didn’t spend a lot of time with computers and my son wasn’t playing video games because that was part of the Steiner philosophy.

Table 7.1 The VW projects that Gaby created and the professional development she was invited to provide to pre-service teacher educators and pre-service teachers.

<table>
<thead>
<tr>
<th>Stage of enrolment</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projects created at SCU</td>
<td>2nd yr student</td>
<td>3rd yr student</td>
<td>4th yr student</td>
</tr>
<tr>
<td>Sustainable Design (Unit 1, Cycle 1)</td>
<td>●</td>
<td>● World Food Aid (Unit 5, Cycle 2)</td>
<td></td>
</tr>
<tr>
<td>Interactive Maths Space (Unit 2, Cycle 1)</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Projects created at K-6 schools</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School One</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Term 1 yr5 Weather (science) and Global Connections (HSIE)</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Term 2 yr5 the Gold Rush (HSIE)</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Term 3 Identity (PDHPE)</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Term 4 yr3/4 Body Systems (science)</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Term 4 yr 5 Antarctic (HSIE)</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School Two</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Term 3 yr 3 Japan (HSIE)</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School Three</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Term 4 Whole school project in a small rural multi-age school focus on the Olympics.</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional development delivery and support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invited to present at PLANE conference online and in person in Sydney</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supported students at SCU by providing workshops in Second Life</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presented a lecture in Unit 5, Cycle 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invited to present professional development workshops in Sydney as part of PLANE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invited to present professional development for teachers at two other primary schools</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
On March 8, 2011 Gaby replied to an email I had sent requesting volunteers to use VWs in Unit 1, Cycle 1. Her reply marks the beginning of what she calls her learning journey with VWs and provides a small insight into the type of student she was:

Hi Lisa I would very much like to be involved with this project as it would stretch my IT skills and complement my learning technologies unit. I have reasonable IT skills but I’m a quick learner. I did join Second Life but was unable to download onto my Dell laptop and my iPad is tricky. Anyway I will use the uni computers. I hope I get in or am suitable. (email correspondence, 2011)

Her initial perception about VWs was that she didn’t know anything about them and that they hadn’t entered her consciousness until she received the email to request volunteer participation in this research in Unit 1. Table 7.1 provides an overview of the projects that Gaby undertook from 2011 to 2014.

### 7.2 Sustainable Design Project

The first project that Gaby undertook using VWs was part of the Science and Technology unit (Section 4.7.1) and involved designing and building a structure that embodied sustainable design principles. Traditionally, this project, had been realised using craft materials, for this iteration students were provided with the support to build in Second Life. The intention was that students could simulate real or imagined sustainable solutions for their design creating a more authentic outcome than previously achievable. The students worked in groups based on the number of volunteers at each of the three physical University campuses. Gaby formed a group with the two other students who volunteered at the campus where she was located. They were located remotely from me and all the support was provided solely through Second Life.

This group of students successfully created a “sustainable strawberry farm in a glasshouse”. They had decided this would be a simulation of a working farm that could make money for the imagined “annual island party”. In order to complete the build they spent time separately sourcing materials and objects as well as building specific parts. The other two students were more confident users of VWs than Gaby as they had played video games for many years. As such they did most of the building while Gaby did a lot of sourcing of materials through the Second Life marketplace.
The final product (Figure 7.1) included: a framework based on basic prims textured to simulate glass and solar panelling; strawberry plants; tools, eco toilet, picnic table, beanbags, floating table, wind turbines and signs. The signs were constructed using PowerPoint and Paint applications, converted to a jpeg image, uploaded to their inventory and applied to boards made from prims.

![Figure 7.1 Sustainable strawberry farm created by Gaby's group in Unit 1, Cycle 1. While this was the first project created by all three of the group in Second Life two of the group had experience in VWs as game players.](image)

Gaby listed a number of factors that imposed limitations on what they felt they were able to achieve with this initial project:

1. Personal experience with Second Life
2. Access to computers that effectively run Second Life
3. Amount of class allocated time to build in Second Life
4. Amount of allocated space and prims to build within Second Life
5. Amount of time to work effectively as a group
6. Knowledge of building materials
7. Reliability and quality of their Internet connections
8. Money to purchase objects from the Second Life marketplace
Gaby’s group created their own set of criteria by which they wished their project to be deemed a success. The activity had been set by the lecturer as an authentic task, one in which the student had to imagine they would be presenting their designs to a client. As such the criteria for the VW Strawberry Farm included:

1. The glasshouse will be constructed from sustainably managed resources that have a low environmental impact.
2. It will be designed with sensitivity to the surrounding area and in consultation with the respective stakeholders.
3. Emphasis will be placed on cultural implications that the traditional landowners of the island may identify.
4. All power will be collected through solar and hydropower sources and this will also power the cool room and ‘transporter’ for able bodied and wheelchair access to the different levels.
5. A compost toilet will be built with disability access.
6. An eco garden will be designed on the upper level that will incorporate strawberries and flowers suitable for sale.
7. The lower level will be utilised as the workshop and sale space.
8. Signage will be created outside the building.
9. The successful harvesting should result in sufficient funds being created to help fund the end of year island party.
10. Landscaping and final touches will occur over the month of April and the glasshouse should be fully functional by May 2011.

Finally the group reflected on the process of designing and building the strawberry farm in Second Life by saying:

We are all in agreement that it has been a fantastic experience and really emphasised the power of collaborative learning through all stages of the project. We had never worked together as a group before but quickly recognised our strengths, were willing to listen to each other and discuss strategies and prepared to put in the extra hours to enable us to create the best possible result within the time frame. It was also discovered, through the learning journey, that this project’s
educational implications linked many of the KLAs particularly math, science, HSIE and English.

The sustainable design project represented a shift for Gaby into embracing technology at a higher level than she had previously done. She took a risk as she felt that she wouldn’t be very good at VWs and that she “would be dead wood in the group”. Her reflection on how she approaches these types of challenges reveals a great deal about why one student might be more motivated to engage with VWs than another:

I really thought that I might not know how to do this. But I took a chance. I do put my hand up for new learning and to do new stuff and being at University has really empowered me to do that. Although I have always been open to new stuff, I did think I would be dreadful at this.

Gaby’s realisation that she didn’t have the skills initially to use the VW was one of the reasons she chose to take up the opportunity. She felt at the time “perhaps this could give me a skill and give me some learning in using computers”. She had perceived that other students (especially the younger students) would be able to use technology in this way and, as such, she felt she “needed to develop these skills”. She later realised that not all younger students did have the technology skills that she imagined. She was someone who embraced a challenge and said that she “primarily undertook the project to see if I could actually do the project, especially being such an unskilled computer user, unlike the younger students”.

The sustainable design project was very successful on a number of levels and was voted by the rest of the cohort as the best project. Of the three students Gaby was the only one to continue to use VWs despite the fact that the other two members were more confident in both their use of technology and VWs. In Cycle 1 Gaby had the opportunity to use VWs again when she enrolled in Unit 2.

### 7.3 Interactive Maths Space

In Unit 2, Cycle 1 Gaby responded to the invitation to utilise VWs for an assessment task. She was the only student to do so and, as such, received one-on-one tuition from me. Gaby was given an open brief about how she wanted to use VWs to display her knowledge of the application of technology in a classroom. She chose to redesign a
maths task she had developed for another unit to show how this activity could include the affordances of a VW.

The interactive maths space that she designed was for primary school children aged 10 to 12 years old. The original maths task included data collection and Gaby felt that she could utilise the VW to develop an engaging space in which to collect data. While Gaby created the interactive maths space in Second Life her hypothetical primary school class would be required to use an Open Sim environment if in a real school due to firewall restrictions in NSW Department of Education schools and age restrictions imposed by Second Life.

Gaby’s initial idea was to create a space specifically for teaching and learning maths concepts, but which also “allowed for creative expression and removal from real life constraints”. She felt that she was “constructing a narrative” so that the students’ avatars could “explore, engage with, and develop their own learning within a creative and dynamic environment”. The space was populated with math’s objects and images such as graph paper, calculators and various shapes as well as a giraffe, flying parrot and ‘wagon wheel’ chocolate bars to create a sense of fun.

To fully utilize the VW she attempted to design the learning experience to occur wholly within the VW. Display boards were built with a variety of external media attached to them, including Google docs, spreadsheets, websites, videos and blogs. A variety of graphical representations of maths concepts were created or bought for the children’s avatars to use including; spheres, cones, prisms, calculators, stackable blocks and so forth. By leaving these resources in the space for the children to use Gaby hoped that they would develop a sense of ownership of the VW environment as they went from passive to active learning and engaged with the resources provided.

Gaby decided it was important for her to have a sound theoretical understanding of why she was using a VW for her teaching. As she found research papers, blogs and videos she started to create display boards in the VW to convey the information. She then realised that the VW space she was making was for two audiences: the academics that would visit the space and mark her work; and the primary school children for whom she was designing the maths learning experience. Her solution was to divide the VW space into two sections. One side of the room had theoretical
content placed on boards and linked to external documents that charted her progress through a blog, presented her rationale and lesson plans. The other side of the room had boards that contained information for the primary school children to access with instructions and links to spreadsheets for data collection.

The VW interactive maths space was designed for a class of primary school children (aged 10-12) that would include diverse abilities and learning styles. To accommodate all children Gaby designed two quests that could be accessed by the children when they entered the VW interactive maths space. The quests were designed for two different levels of complexity. Level one was a data collection quest and level two was a data collecting, analysing and graphing quest. Both quests made use of the VW environments that exist as part of the SCU islands. Gaby placed two coloured spheres inside two tall conical shapes at the entrance of the learning environment. The children would receive a notecard, when they clicked on the spheres that outlined the maths quest (Figure 7.2). By obtaining a notecard the children could keep the instructions in their inventory and look at them as they moved around the VW collecting data for the maths quest. The children were asked to find various objects and collect data about them such as trees, kangaroos, trucks, paintings in particular rooms and so forth. Once the children had collected the data they would return to the VW interactive maths space and input the data into spreadsheets that were accessed via Google docs on media boards.

Gaby felt that by utilising a quest model she would be tapping into the children’s sense of meaningful work through game play rather than being given what was essentially a typical maths activity. Her quest tasks were designed to “challenge and to increase critical thinking collaboratively with team mates which then supports exploratory problem based learning, scaffolding to deeper understanding and synthesis of concepts”. Her hope for the students was that by providing them with “the freedom to convey their learning and discoveries in a visual manner” they would “realise that mathematics has form, is creative and expressive”. As a result of using the VW for the maths quests she believed that the students would have a greater chance of success and ownership.
Figure 7.2  Gaby’s interactive maths space showing the note card that is given when the avatar choses one of the inverted cones as their quest. In this image pre-service teacher educators and students are visiting the space when Gaby presented her work for assessment.

As the project developed it became clear to her that the design and layout of the space was as important as the design of the VW learning experience. Her skills developed in object placement for avatar movement in much the same way as an interior designer places furniture in a room or a teacher arranges tables and chairs:

Object placement was fundamental as it was expected that once student avatars arrived in world they would be able to easily navigate the space provided. Therefore much time was spent viewing the classroom from various angles, levels, heights and distances. Textures and colours were changed and objects added, edited or removed.

Her technology competency increased dramatically as she developed a variety of VW skills – building in 3D, Linden Scripting Language (computer coding in Second Life), creating note cards, finding and saving textures for use on objects and creating linked external media, such as websites, to VW objects. Most of these skills she developed by either experimentation, research (websites and forums), attending workshops in Second Life or asking me.
I chose to not give too many instructions or directions as I felt that Gaby would benefit most if she found resources through existing networks of VW users. I let Gaby decide what level of involvement she wanted from me. After an initial meeting, where we discussed the possibilities for the assessment task, we met on a more informal basis. I would drop in to the VW to see if Gaby was working and if she needed any help. Gaby, who was highly self-directed, spent many hours teleporting to different islands on the VW to gather ideas for building. Over a short period of time Gaby displayed high levels of engagement and independent learning. As this happened I offered her more resources such as the Second Life Educators List (SLED) that provided her with links and resources directly related to education and VWs, as well as literature pertaining to education in VWs.

Gaby spent two intensive weeks working on the development of her interactive maths space. She expressed great satisfaction and a strong sense of achievement after presenting her work to pre-service teacher educators and students. Interestingly she was not concerned with her final grade but simply wanted to have her maths lecturer’s avatar walk in and see the potential for using VWs for teaching and learning. Many of the attendees at her presentation had never entered a VW before and it was an opportunity for Gaby to not only show her work but also demonstrate what could be achieved in a VW.

At the end of the session Gaby reported that the opportunity to participate in an assessment task in the VW provided her with a personalised learning experience:

> By allowing my assessment tasks to be modified to include VWs, I was able to make a traditional 'dry' assessment task become engaging and, as a result, this gave me success with the unit. I can categorically state that the creative and critical thinking demanded through VW assessment tasks has greatly increased my confidence, commitment and enjoyment with both my choice of degree and university.

### 7.4 From Second Life to Sim-on-a-Stick

As a result of utilising VWs in Unit 1 and 2 (Cycle 1) Gaby developed an intense interest in VWs and how she could apply them to both her studies and to the K-6 classroom. She did a great deal of self-directed research both by experimenting in the VW and through reading articles and books that were beginning to emerge as VWs
gained more prominence in education. She recognised that Second Life was a great resource for teachers and, although she would not be able to take K-6 students into Second Life, she realised that the skills she was learning could be transferred to other VWs. She trusted that if the VW was being introduced to her as part of her university studies that it must have some relevance to her future as a teacher:

The more I understood about VWs I realised that Second Life was just one part of it and I certainly wouldn’t be taking my students into Second Life but I used to take screenshots in Second Life and then show the kids in class what some of the possibilities were. That way they would get inspired by the spaces and then recreate stuff in SoaS.

In 2012 Gaby volunteered at a local primary school to help with technology use in the classroom. She initially intended to assist the pre-service teacher educators and students to develop a school blog. She had chosen blogs because she perceived that it was not possible to use VWs in a public primary school. Some of the issues at that time were: Second Life was not suitable; networked VWs were blocked by the security restrictions; and, the level of technology in the schools was very low. At this point she had only used the VW of Second Life and was not aware of SoaS. In order to facilitate the use of VWs in the primary school I suggested that she try SoaS even though it had been untested in public primary schools in NSW.

### 7.5 Sim-on-a-Stick in the K-6 classroom

Over the Christmas holidays of 2011/2012 and before the start of term one (late January, 2012) Gaby and I worked together to test SoaS in a variety of situations. The initial download and set up worked on the Windows OS of our personal computers. Gaby proceeded to test it on the computers in the University labs and finally in a NSW Department of Education school where she would be working. A number of teachers watched as she trialled it on the school computers and, as a result, asked her if she would come and work with their classes using SoaS.

Both Gaby and I were excited that SoaS was working in the school environment, however we were also reticent that, due to a number of variables in the school environment; updates to computer systems, replacement of computers at any moment, and the centralised control of the network from Sydney (800 kms away), the
environment could change very quickly. SoaS is open source software that is in a state of development and is prone to variables across various systems. We were aware that the IT system in Department of Education schools is subject to variations that are outside of the control of the teacher. However, the school principal, Gaby and I were willing to take the risk and were open to be flexible if at some time SoaS presented us with technology problems.

Over the 11 weeks of term one 2012, Gaby worked with 22 students aged between 10 to 12 and one classroom teacher to integrate SoaS as part of their regular school work. The initial set up was quite labour-intensive for Gaby as she loaded SoaS onto 22 individual USB flash drives and produced information for parents to inform them about what she was doing and why it was educational.

Gaby and I discussed the teaching-learning process that she might take when introducing VWs to the children. In her first lesson with the class she gave a short introduction to SoaS, explaining about building and showing students the use of tension, gravity, wind, 3D geometric solids, co-ordinates, textures, movement and terraforming. The children were then given the opportunity to explore and experiment with the building tools. Her blog entry for this first experience shows the depth at which the children were immediately immersed and learning in a variety of ways, with minimal instruction from Gaby (the teacher):

It was amazing to watch the depth of engagement, learning, problem solving and collaboration that the students displayed. One child was creating buildings, lining up objects (prims) and creating a sewerage system. Another child immediately edited his avatar and worked out how to twist and apply textures. One girl thoughtfully selected her shapes and manipulated them by hollowing and shearing; she also chose to build underwater. Another girl had created trees, grasslands and changed her avatars hair colour to black and commenced building and terraforming the land. One child was building a walkway around one island. He had to work out how he could connect his prims and ensure they were all the same height so that he did not have to fly from one level to another. He also colour coded each prim so he could see that the edges connected and there were no gaps to fall into. She
stretched and made her prims ‘phantom’ which meant you could walk, run or fly through them. She was also able to make them flexible so that they moved. Wow! The principal dropped in to see what they had been doing and loved all the work they had completed…somehow the children didn’t realise that they had been working!

Gaby spent one day a week with the children and, depending on how motivated the children were, they spent approximately one to four hours a week working in their VW. To support the children building in the VW Gaby showed them builds from Second Life. She would visit spaces in Second Life and take screen shots that the children would discuss as to how the spaces had been built and how they could do similar things in SoaS. For example, she showed still images from a build called the ‘Eye of the Storm’ created in Second Life by an experienced builder where the experience of being in a storm was created by surrounding the user’s avatar in a tunnel in which an animation of a storm was projected on all surfaces. As a result of viewing this build, some of the children who were responding to the theme of weather designed a series of five tunnels each becoming increasingly stormy in the imagery (Figure 7.3).

Figure 7.3 The children's response to weather in SoaS. Each of the cylinder represents the weather becoming more stormy. The avatar walks through each of the tunnels to become immersed in the stormy imagery. The arrows indicate the direction that the avatar needs to move in.
Gaby also offered a time for the children to use VWs during lunchtime once a week. This provided those children who were not in the designated VW class an opportunity to participate. It also increased the time that Gaby was able to spend with them. The lunchtime club proved very successful as Gaby reported in her blog, “every computer was being used by students who were exploring and problem solving as they worked through the application. I am always amazed at how engaged the students are and this is their lunchtime…awesome!”

The initial use of SoaS in the school resulted in the children responding to a theme related either to the curriculum area of HSIE or science. The class was divided into five groups, with approximately four children in each. Two of the groups worked on a science project about weather and the other three worked on a Global Connections project for HSIE. For the first part of the term the children worked just on their own USB flash drive with no other avatars able to enter their space. Once they had developed their ideas and completed the main part of their building they were given the opportunity to put their work in a multi-user space. The multi-user SoaS space was developed on an external hard drive and I personally delivered the hard drive to the school and spent a day with the class.

The VW environment created by two of the groups of children was designed to represent a Nairobi village where some of the children were from. The Nairobi children included many aspects of their own culture, including huts and a mosque. They quickly became recognised as the experts, in terms of the content and the technology, as they helped other children. Subsequently, these VW builds were used by Gaby as part of an assignment she did at university and the children’s builds were uploaded into Second Life. In doing this, a wider audience was able to view the children’s builds and the children were able to see (through a machinima) that their work had value outside of their own classroom.

The other three groups focused on weather as part of the science unit. They designed a tsunami, earthquake and a storm. The tsunami was created using a cylinder placed next to a beach and the earthquake group utilised the ability to terra-form the land and manipulate the ground to look like an earthquake. While the weather projects were not animated (as is possible with more advanced building skills) the intention was quite clear and provided representations of their knowledge. The children were
intensely proud of their work. One child from the Tsunami group commented, “I love Sim-on-a-Stick because there are endless possibilities to what you can do. You can defy the laws of physics”.

The teacher and the principal were extremely supportive of the use of SoaS and were able to see that the children were engaged in learning. However, Gaby felt that it was important to be able to link what the children had been doing to the NSW syllabus outcomes. Therefore, at the end of the term Gaby observed and identified a number of syllabus outcomes in the work that the children had created in SoaS and during the process of creation. She reported these outcomes to the teacher who was then able to develop clear justifications for the use of VWs in terms that match the educational requirements of the Department of Education.

One of the strengths of Gaby’s work was her capacity and willingness to link the VW learning experiences to the specified syllabus outcomes. By so doing she has been able to justify and support her activities with VWs to a number of teachers, principals and parents. She has been able to “back up any project that I do by showing where I am meeting the outcomes. I know the syllabus very well and how they are learning and using the meta-language that you hear when the kids are working in VWs building and creating”.

What Gaby most observed was that the children were developing 21st century skills of thinking critically, presenting logically, communicating, making decisions, being rigorous, understanding content and context and persuading. Children who had been struggling with class work were eagerly spending lunch and recess working on their buildings in the VW. In a very short period of time they developed skills to help them build and navigate the VW and to become experts in something that was valued by their peers, their teacher and their principal. The confidence that the non-English speaking background children developed as they became the experts about the content and design for the Nairobi village was particularly noteworthy. They advised the other children on what was authentic in terms of the Nairobi village as they replicated aspects of their own culture. The sense of pride they were able to display to the rest of the class permeated the transference of acceptance and understanding throughout the class and truly exemplified the HSIE theme they were studying - Global Connections.
Gaby’s project was significant in that she was able to use a VW (SoaS) in a public primary school environment, overcoming issues associated with the school’s Local Area Network (LAN). Another important element in Gaby’s work was that the students were engaged in content creation with minimal to no teaching about how to use the VW. Using SoaS gave this group of children the opportunity to discover ways to communicate ideas and be engaged in learning that they previously had not encountered. This provided evidence of the ease of use of SoaS, and its potential for engagement of the children and the school community. As a result SoaS continued to be used by this class and a number of other classes within this school. The flow on effect of the successful implementation of SoaS meant that pre-service teacher educators at the University more readily sought to also integrate VVs into the pre-service teacher programs.

At the same time that Gaby was introducing SoaS to children at a local primary school she was undertaking an assessment task as part of Unit 5, Cycle 1 (Section 6.5). The unit of work that she built a VW environment for was based on the World Food Aid program. In Second Life she built a simulation of a Nairobi village complete with chickens, vegetable, schoolhouse, mosque, village huts and information boards (Figure 7.4). She also included some of the work that the children had built in SoaS.
Gaby’s Nairobi Village build in Second Life showing the mosque in the background that was built by one of the primary school children in SoaS and imported in Second Life.

7.6 Gaby’s Journey

Gaby came to SCU as a mature age student who was intrinsically motivated to work hard and achieve high grades while at university. She was very focussed on becoming the best teacher that she could be. She also had high expectations about what it meant to be at university and the types of learning experiences that she would be given the opportunity to partake in. She described herself as highly creative and someone who liked a challenge. From my observations of Gaby and in conversation with other pre-service teacher educators in the School of Education it was clear that Gaby was already confident in many aspects of being a teacher; having spent 12 years as an untrained teacher’s aide in an early childhood setting.

The pre-existing skill set and mindset that Gaby brought to her studies meant that she approached the challenge of trying VWs with a level of enthusiasm that assisted her to overcome many of the barriers. She confessed that she felt that her technology skills were low and that she was sure that she would “be very bad” at using the VW. However she volunteered to undertake the VW activity in Unit 1, Cycle 1 because she saw it as an opportunity to improve her skills and to learn skills that she felt were relevant to her future students. Her altruistic view of her role as a teacher is clear when she states:

I can’t not do something just because I’m not comfortable with it because it’s about my students in the class. It’s about what I have to learn to give my students the best opportunities and experiences and skills. It’s about how I can best help them to build on their skills and to be creative and problem solve.

The chain of events that assisted Gaby to continue to engage with VWs helps to highlight the factors that can both help and hinder a student’s acceptance and use of VWs. The first instance of use was as part of a small group. The other two members of the group were young men who were both highly skilled in the use of technology and played 3D VW computer games. In this setting Gaby was able to utilise the skills of the other two to learn more about how to build and navigate in the VW while also supporting them with her skills in the design of learning experiences. The result was
the delivery of a highly successful VW build that served the function of simulating a sustainable strawberry farm. After this initial experience Gaby felt confident enough to volunteer for another opportunity to utilise VWs. During her second experience she was the only student to volunteer, leading to her receive one-on-one tuition. This rather unusual opportunity for a student at university meant that her skills and ideas were supported through any initial barriers. She acknowledges that the individual mentorship was crucial as we spent many hours problem solving together. She described the relationship as “a team effort” and that without my support she didn’t think she “would’ve succeeded very well”.

The next stage for Gaby was when she started to utilise VWs in the primary school setting. When she first undertook this task I helped her problem solve any technical problems as well as supporting her in the teaching-learning processes that she had begun to initiate. I provided mentorship to her. Apart from the support she received from me, the pre-service teacher educators and principal in the primary school also supported her. Gaby was fortunate at this point to have chosen to work voluntarily in a school with a principal who trusted Gaby as a teacher and was supportive of new technology. Gaby stressed, “without the support of the principal in the first school I wouldn’t have been able to do the VW work”. She said that she felt “very lucky to have had such supportive principals at all the schools I have worked in”. Gaby was able to identify turning points in which staff at the primary schools would be convinced that using the VWs was extremely positive for the children. One of the first moments was while I was at one of the schools helping:

When you came and we were trying to get the multiuser to work, all the African refugee kids were helping and then we did running races around the athletics track. Seeing their excitement was fantastic and then I went and got the Principal. He was just blown away and we were all very excited. The kids were so happy. It was actually real. We actually got it to work. If SoaS hadn’t started at the school then none of this would have happened. That was the catalyst.

The ultimate part of the success for Gaby was the response from the children. As she states, “if it hadn’t have worked with the children, if they hadn’t been so engaged and excited and learning, then I wouldn’t have been able to continue using it and there
wouldn’t have been any reason to”. She described how she witnessed the children “accomplish something they thought they’d never do” and that she had done the same thing when she used VWs at university; “accomplish something I never thought I could”.

Gaby’s propensity to promote the work of the students led her to creating a school blog in which she wrote about the students using VWs. The blog provided information about VWs to educators around the world who were also looking to use VWs in their schools. Consequently, Gaby became known as a leader in the field of VWs in education and has been invited to present at conferences, symposiums and professional development workshops. She has observed that there are teachers who would like to use VWs but are unsure how they would get started. Gaby felt that the teachers she had interacted with all want to be shown how to use the VW and not many of them “want to spend the time working out the issues or how to actually implement them into their lessons”.

Gaby reflected on her journey by saying that she “had a lot of satisfaction out of building that very first project and now I’m asked to present at conferences and workshops to show other teachers and that’s all because I answered that first email you sent”. What made her answer the first invitation to use VWs appears to be her own pre-existing growth mindset and desire to learn something new and challenging. The chain of events that followed helped to support her in the journey through to her professional use of VWs and a teaching practice that celebrates complex, authentic and student-centred teaching-learning processes.

7.7 Gaby’s Teaching-Learning Processes

Since 2011 Gaby has utilised VWs in a variety of contexts both as a student responding to assignments at University and as a teacher creating VW activities for children. Over this time her pedagogy has been “enriched” through her use of VWs. She believes that using VWs, particularly with children in the classroom, has added “depth and scope” to the way she approaches teaching-learning processes. The activities that she has designed revolve around the students, their context and interests while still linking to syllabus outcomes.

The behaviour that the students demonstrate in the VW has affected the types of activities that Gaby implements in both the VW and non-VW world. She has found
that in the VW she is able to give them freedom to take risks that they would not usually be able to in the non-VW. In multi-user spaces such as Minecraft or multi-user SoaS the children interact with each other as avatars without the teacher present (in the VW), they are permitted to create large scale structures that defy non-VW physics, they can take their avatars on adventures that include travelling (teleporting, flying, walking or other form of transport) for virtual “miles and miles” and they can manipulate the land into mountains, valleys, rivers and oceans. To the children these VW spaces are real world spaces and the manner in which they interact with each other and their environment has translated to interactions in the non-VW. From Gaby’s observations of the children in the VW she has changed the way she approaches her design of non-VW activities and the freedom that she allows the children in the classroom. The following comment encapsulates Gaby’s attitude towards the children:

I think observing the students being adventurous and going for miles and miles and then coming back again it’s almost like letting them go in the wild. It’s empowering because even though they are sitting there behind the computer their mind is in that avatar, in that space that they are working in. I can see that they have immersed themselves and that they are doing work without an adult, they are keeping each other on track. I think I am more trusting in the class situation now and I let them go off and do things because I can see how they handle themselves in an open space.

An example of Gaby changing the way in which she approached the teaching-learning process was with a class of children who were considered challenging to most teachers. She set them a project in Minecraft that required them to create a simulation of the place that they live. The level of engagement that the children had through doing this activity in the VW demonstrated to Gaby that they “acted with purpose and I could see they were doing the right thing and they could accomplish something that was more demanding”. She proceeded to set them other non-VW tasks that up until then they had not been given due to other teachers considering it too difficult for them, such as “group work and some rotating tasks such as a news report, a large map and a riddle challenge”. Utilising the VW and having success with the children meant that Gaby developed a relationship with them that translated into Gaby reframing her
expectations of the children. She stated, “their actions in the VW meant I had different expectations of their ability to accomplish tasks”.

Gaby had a philosophy about teaching-learning processes that it is “organic” and should be flexible and responsive to the context, teacher and learner. This is one of the reasons she believes that she was drawn to utilise VWs. The VW provided a non-traditional learning environment (as a user and a creator) and an alternative way to respond to assessment tasks that was interactive, visual and creative.

7.8 Conclusion

Gaby was the only student during this research who consistently undertook independent work using VWs and, as such, she received significant individual attention. She also received praise from the pre-service teacher educators and was used as an exemplary student when VWs were discussed at SCU. Despite my encouragement of other students to engage in a similar way, no one followed Gaby’s path. The more experienced Gaby became the less the other students identified with her as some of the students made comments about not being able to achieve the same level of expertise that Gaby displayed in the VW environments she built. A friend of Gaby’s lamented that it wasn’t as hard as she had first thought saying that she should have tried to use VWs in Unit 1 because she could “see how valuable it is and how quite easy it is once you know how to do everything”.

Gaby continued to gain personal satisfaction and professional recognition because of her use of VW. Why Gaby chose to engage with VWs to this extent may be attributable to many factors including: her previous work in education, the group of students she first worked with, her own motivation to achieve and to be the “best teacher she could be”. She was unclear as to what made her different from other students except that she was intrinsically motivated to engage in a challenge and believed that she could learn new skills by taking risks. What was clear from Gaby responding to the first project in Unit 1, Cycle 1 was that the introduction of VWs in the pre-service teacher program at SCU set Gaby on a journey that has been invaluable to her, and to the students she has taught, is currently teaching and will teach in the future, as well as the teachers she now interacts with through her local, national and international networks.
Chapter 8 Themes

In this chapter four themes are discussed that emerged from the pre-service teacher educators' and students’ response to the inclusion of VWs in their units. Firstly, the teaching-learning processes that they exhibited in relation to the use of VWs are discussed. Then the barriers that influenced the level to which they engaged with VWs, is presented with five barriers detailed. Two models are proposed by which the pre-service teacher educators and students can be positioned in terms of their level of engagement with, and readiness to utilise, VWs as part of an innovative approach to their teaching-learning processes. Finally, a perception/experience matrix is presented upon which the participants and the model are plotted.

8.1 Introduction

From the analysis of the data, a number of themes emerged that included those that have been previously identified in the literature relating to the introduction of technology in pre-service teacher education. Barriers to adoption, integration and innovation by teachers and pre-service teachers are consistently cited throughout the literature (Baskin & Williams, 2006; Bitner & Bitner, 2002; Cuban, 1993; Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2013; Gill & Dalgarno, 2008; Gulbahar, 2008; Prestridge, 2012; Wang, 2002). The data in this research revealed barriers that are common to other forms of technology (such as time and access), as well as those that were unique to VWs (visceral responses), pre-service teachers (perceptions of K-12 classroom) and pre-service teacher educators (negative student feedback). Level of engagement emerged as an overarching theme in this research. Building on this theme, this research proposes a model based on patterns that emerged from the data, which can be utilised to understand the levels to which pre-service teacher educators and students engage with VWs and utilise VWs for innovative teaching-learning processes. Finally, the perceptions and experiences, as a way to explain the complexity of the decisions that the participants made, is illustrated through the development of a matrix in which a participant or group of participants can be situated.
8.2 The Teaching-Learning Processes

There has been a steady rise in the adoption of constructivist teaching philosophy and practice amongst teachers and teacher educators in order to cater for today’s learners (Richardson, 2003). The basic premise of constructivist teaching practice is “instruction should focus on providing tools and environments for helping learners interpret the multiple perspectives of the world in creating their own world view” (Jonassen, 1991, p. 62). However, there can be difficulties when translating constructivist learning theory into a constructivist teaching practice (Richardson, 1997). One interpretation of constructivism has led to highly scaffolded and facilitated learning experiences in which the teacher is central to the process. Davis and Sumara (2012) have been critical of this approach and suggest that the result has been the opposite of the initial intention in that learning is made easy for students instead of more challenging.

8.2.1 Pre-service teachers

In general, the pre-service teacher program at SCU favours the constructivist philosophy as the preferable approach to the design of learning activities for the classroom. Students are encouraged to act as a facilitator to their future students' learning. However, the data from this research revealed that when considering the use of VWs in the classroom, students encountered barriers to creating a student-centred constructivist learning environment because they were concerned about ‘keeping their students on task’ and delivering discipline specific content knowledge. When the students were asked to conceptualise how they would use VWs in the classroom they tended to favour traditional transmission based models of the teaching-learning process over what might be considered more constructivist approaches.

The students’ perceptions about what they should be doing in their future classroom (teaching) and what their future students should be doing (learning) underpinned the level to which the students were ready to utilise VWs. This was particularly evident from the responses given by the students in Unit 3, Cycle 1, as discussed in Section 6.3. These students were required to participate in a VW activity that was open ended with no set task other than to explore the highly immersive, engaging and new VW environment. The result left some of them feeling that they had not learnt anything
and that they had simply spent the time “messing about” or “having fun”. From this experience they judged that the VW would be unsuitable for use in the classroom as it would be too distracting to their future students.

The implications from the data are that, for a small proportion of students, the possibilities and benefits of learning in unstructured ways needs to be made explicit. Simply showing them the VW or mandating their entry into the VW did not produce the desired response; that of recognising the potential of the learning space. These students made statements such that "the extra technology skills and abilities the students would have to learn to undertake a lesson using VWs could ultimately unravel the idea" (Student 104, Cycle 1) and that using the VW "would take up a lot of teaching time, for the students to be able to work their way around the VW, before they even are ready to think about what they are actually meant to be doing" (Student 37, Cycle 1). These comments indicated that these pre-service teachers felt that the VW needed to be explicitly taught to their future students and immersion in the space would not facilitate learning. As pre-service teachers, many of the students were focused on their ability to manage behaviour and found the unstructured game like environment of the VW would undermine their authority. They made comments such as "students would be tempted to fool around and dance rather than do the tasks. They would want to customise their avatar, thus taking up valuable class time" (Student 34, Cycle 1). There is a perception amongst pre-service teachers that a quiet and controlled class is a reflection of an effective classroom and a good teacher (Stoughton, 2007).

The data revealed that the majority of the students had their concept of what constitutes teaching and learning challenged by the inclusion of VWs. The data also showed that, after using the VW, some of the students realised that a different approach to their teaching-learning process was required in order to fully utilise the affordances of VWs. As one comment revealed: “what we as teachers need to do is think creatively and just be open to integrating new and unfamiliar methods into our pedagogy” (Student 155, Cycle 2). This indicates that the inclusion of the VWs has the capacity to initiate a shift in the thinking of the students about appropriate teaching-learning processes that can, potentially, lead to further exploration of innovative teaching-learning processes either in the VW or in the classroom.
Gaby was one of the students who shifted her concept of teaching and learning and developed strategies that facilitated the integration of VWs. She moved away from believing that she had to teach the students how to use technology before they use it. She believed that the teaching-learning process was “organic” and “it should always be changing in order to adapt to who your students are”. When she first conceptualised how she would integrate VWs in the K-6 classroom she thought she would need to step the children through how to use the software. I suggested that she try to not teach the children but to let them explore. In the first class she followed my advice and discovered that the children were able to learn how to use the VW through trial and error, asking each other and asking her, as they needed help. As a result of that first class she witnessed that the children did not require intense instruction in order to learn how to use VWs. Her approach to the teaching-learning process changed as a direct result of this experience and with each subsequent class she further developed her teaching-learning processes to be more exploratory for the children.

Modelling of the teaching-learning processes by pre-service teacher educators has been described as one of the acts that influence the future practice of the pre-service teacher (Loughran & Berry, 2005; Lunenberg et al., 2007). In this research, the modelling of teaching-learning processes in relation to how they integrated VWs did have an influence on the students’ capacity to develop their own concepts of innovative teaching-learning processes. Those students who were in units led by inexperienced VW educators found it most difficult to reconcile their perceptions of how VWs fitted with their current beliefs about what constituted good teaching-learning processes. Without an opportunity to conceptualise new teaching-learning processes through modelling by pre-service teacher educators they were less able to imagine their own innovations in practice in their own future classroom. The cohort whose unit of study was delivered and supported by more experienced VW educators were consistently able to describe innovative teaching-learning processes.

The students in Unit 5, Cycle 3 were given the opportunity to demonstrate their connection between the use of VWs and the teaching-learning process by developing a VW environment as part of a lesson sequence. One hundred and sixty-one students completed this assessment task using Second Life (n=27), SoaS (n=133) or Minecraft (n=1). Seventy-eight per cent of the environments that were submitted for assessment...
replicated traditional teaching practices with images or text placed in the space to be interacted with by looking at or reading. However, 22 per cent of the students responded by creating and describing ways that their future students would use the VW as a way to learn more about a theme through immersion in a simulated environment or to build their own representations of knowledge about a theme through building in the VW. This level of response was quite significant given that the students were provided with only a small amount of technical support; skills based tuition and modelling of non-traditional teaching-learning processes. They were, however, undertaking their projects at a time when Gaby had already delivered a number of VW projects in the K-6 classroom thus providing concrete examples. Gaby also acted as a mentor to some of the students by meeting with them in Second Life on a number of occasions.

### 8.2.2 Pre-service teacher educators

The pre-service teacher educators were motivated by a desire to implement teaching-learning processes that provided complex, authentic and student-centred experiences for the students. By so doing they wished to engage the students in experiences in which they would learn about VWs and about teaching-learning processes. As a result they hoped that the pre-service teachers would be better equipped to be flexible and adaptive in their future teaching practice. One of the pre-service teacher educators stated that she felt the students needed to be developing the capacity to “adapt pedagogically” because of the rapid changes in technology being utilised in the classroom.

Jon wanted to push the students’ expectations and challenge them to take more risks, especially in terms of assessment tasks. He used the inclusion of VWs as an opportunity to provide the students with an assessment task that was different, on many levels, to what they felt comfortable with. Jon made a choice to not only require the students to build something in the VW but to take ownership over how they were going to gain the skills required. This represented a shift in the teaching-learning process in relation to the introduction of technology with these students. The decision to include a potentially difficult and obviously different activity as part of an assessment task had the desired effect of challenging the students; however, the challenge resulted in a number of students expressing their dissatisfaction.
8.3 Barriers

Barriers play a significant role in deterring individuals from pursuing activities that are different from their usual practice. Literature about the inclusion of technology in education inevitably includes the barriers (for example Kay, 2006) that have deterred teachers and pre-service teachers from pursuing different models of teaching and learning (see Section 3.3). Within this research the participants made claims about barriers that, in most cases, acted as a deterrent, although in some cases these were acknowledged and approached as a problem that could be overcome.

Some of these barriers were common to those associated with the introduction of other new technologies. However VWs present some new barriers that are distinct from those associated with the introduction of previous technology. The barriers that are cited in the literature in relation to technology in education (see Section 3.3) and which were also evident in this research include: access to resources (software and hardware); ease of use; incentives to change; support from the institution (technical and management); personal background in technology use; and time required to develop skills. Barriers that were identified in this research which would appear to be unique to VWs include: the visceral nature of VWs; the capacity to generate a highly emotive response; interaction via an avatar; engaging to the point of distraction and time wasting and cyber-safety concerns due to the capacity to synchronously network with unknown individuals who are in the guise of an avatar. Barriers that are unique to VWs in the K-12 classroom include: blocked access due to restriction on networks in public schools; fears about safety of children in a networked collaborative environment; concerns that parents will perceive their children are playing computer games rather than learning; fears about students behaviour in relation to them changing their appearance; being undressed or acting aggressively towards other avatars; concerns that students will be distracted due to the highly engaging environment and will not maintain focus on the task set by the teacher.

8.3.1 Time

Time was consistently identified as a barrier by both pre-service teacher educators and students. For the students this barrier was mostly based on their perceptions of the amount of time it would take them to be equipped to use the VW at a level they
believed was necessary to be integrating VWs in a classroom. They also felt that the use of the VW would be time consuming in the classroom as students would need to develop the skills and that they would potentially be distracted from the teacher designated tasks.

A lack of both perceived and real time is a genuine issue in universities for both pre-service teacher educators and students. There has been a rise in what Concannon, Flynn, and Campbell (2005) refer to as full-time part-time students. What this means is that students are enrolled in full-time study and also have part-time jobs. The result is that students have less actual time to study and they develop skills in identifying and prioritising what they need to study in order to pass their courses. This tactic is not new and was described in the 1970s by Miller and Parlett (1974) as being cue aware. Data from this research indicates that students were very cue aware as they spoke about how the VW appeared to be very time consuming and that they were already very busy completing other assignments.

A possible solution to the barrier of time could have been to allocate more time within the set class times to introduce the students to the use of VWs and then allocate a portion of time on a weekly basis, within the set tutorial times, to use the VW. If the use of the VW was prescribed an allocated time and fully embedded as part of the regular teaching-learning processes then the student would not have been required to spend extra time that they perceived as being a waste of time. However such allocation of time would be only one step in changing the perceptions of the students, and those units where time was allocated in tutorials did not necessarily overcome these types of barriers.

A further level of concern regarding time was the students’ perceptions that the use of VWs was not time well spent. They believed that talking about and learning to use VWs was taking time away from learning how to teach in the classroom. Students found it difficult to conceptualise that they were not only learning about how to be a teacher in the present but also about teaching and learning in the future.

Pre-service teacher educators described themselves as time poor. Alison mentioned that if work time was allocated for her to explore the VW she would’ve been motivated to do so. Beth stated that she had so many units that she was administering
that she didn’t have time for anything extra or anything more interesting. Time, as a barrier for pre-service teacher educators, was influenced by the level of (a) intrinsic motivation and/or (b) extrinsic motivation (institutional support and/or professional rewards). In such circumstances the level of motivation to pursue a new activity can result in the pre-service teacher educators creating time in their schedule to engage in the activity (in this case, the use of VWs) or chose not to.

The pre-service teacher educators themselves needed a higher level of support from the institution for them to value the time that might be required to investigate the use of VWs more fully than they did. They had support from me as I initiated and supported the actual use of the VW with the students. However, the discourse amongst their peers who were not using VWs focussed on the barriers and the negative comments from students. While there was a small amount of support from middle management the use of VWs was seen as peripheral to the core practices of the School of Education. The pre-service teacher educators who agreed to implement the use of VWs as part of this research were not allocated any extra time for their own professional development in VWs. Pre-service teacher educators are also cue aware as they prioritise the activities that they will gain the most reward from or that are the most pressing (such as the requirements of face-to-face teaching).

8.3.2 Access

Ease of access was another barrier cited by participants and was linked to the barrier of time. Given that the pre-service teacher educators and students had trouble accessing the VW a significant amount of time was spent as they made attempts to (a) connect to the VW (through Internet speed and viewer downloads) and, (b) locate technology that could support the use of the VW either on campus or by upgrading their personal equipment. Many did not have computers with the level of graphics capability required to either run the VW or run the VW at a speed that facilitated a satisfactory experience. The pre-service teacher educators and students who cited these barriers expressed that they became less motivated about the use of VWs as their experience of access to adequate technology became an issue.

For some students lack of access was a barrier that they overcame. For example, Gaby started her journey with VWs without adequate access at home so she travelled to the
University campus and used the computers that she had identified as suitable. A number of other students reported that they had been motivated to get their own computer upgraded so they could use the VWs. A few students on one of the campuses attended a VW tutorial while sitting in a hallway plugged into an Ethernet connection so they could access the VW at an appropriate speed and time.

In order to overcome the barrier of access, a higher level of support from the IT Services would need to occur. Future developments in the IT infrastructure and pre-service teacher educators development should consider not just what is being currently utilised but what might be used in the future, taking advice from pre-service teacher educators who are investigating innovative technology as well as providing leadership. Some of the issues that occurred in this research was the lack of support for computers that have high-end graphics capabilities. There were also restrictions on certain ports in a bid to restrict students’ over-use of websites such as YouTube. These restrictions resulted in limiting the ease of access that students experience particularly when first attempting to enter a VW. What became evident is that the few pre-service teacher educators who were seeking to utilise technology outside of the current suite of applications were lobbying University management and IT Services to support innovation.

8.3.3 The visceral response

One of the barriers that is unique to VWs relates to the immersive nature of the technology. No other technology currently in use in education entails the user taking the form of an avatar as they interact with their teachers and peers. The current capabilities of VWs such as Second Life allow the user to embody a figure that has human features and can speak with their own voice. This experience was disorientating for some of the participants in this research. This is a very visceral experience, as the individual makes a connection with their avatar that they embody as part of the process. This visceral reality can lead to highly emotional responses in either a negative or positive way. Emotional responses are intensely real and as such may lead to a complete rejection or inability to progress especially if the experience may have been very unpleasant. In this research, the most commonly reported emotional response was the result of the participant encountering an unusual or what they perceived as a threatening situation. They may have been approached by an unknown
avatar who asked them to engage in an act they were not comfortable with or they may have felt lost in a part of the VW with no way of getting to where they wanted to be. One of the pre-service teacher educators stated that despite the fact that she wanted to engage with the VW she felt very “uncomfortable being an avatar”.

The visceral capacity of VWs can be a powerful tool in developing learning experiences. When it presents as a barrier it needs addressing in a manner that does not inhibit the participants’ ability to move beyond initial trepidation or negative experiences. As part of this research support was provided for pre-service teacher educators and students who experienced these barriers. A closed VW space was set-up on the SCU Island in Second Life and exact instructions were provided about how to get there. Synchronous contact was available to students through the LMS at the same time as facilitating entry into the VWs so as to be able to communicate with any students who were lost. Possible scenarios that may occur and the capacity for the participant to simple exit the VW viewer thus removing them from the situation were described prior to their first entry into the VW. One-on-one sessions were also provided to help pre-service teacher educators or students to familiarise themselves with the skills required to navigate the space. The negative visceral experiences were the ones that generated a lot of discussion and negative discourse amongst pre-service teacher educators and students to the point that they out-weighed the significantly higher proportion of participants who did not experience these problems.

A possible solution to the visceral barriers may be to identify the prior experiences and perceptions of pre-service teacher educators and students well before the use of the VW in order to tailor specific entry stage experiences. There is an increasing number of pre-service teacher educators and students who are familiar with being an avatar through digital games. Buddying them up with those who are less experienced may help to ease the process. Until the majority of pre-service teacher educators and students are comfortable with what it feels like to interact in a computer-based environment through a 3D avatar a structured introduction to immersion in VWs is a prudent choice.
8.3.4 Perceptions of the K-12 classroom

A barrier that is unique to pre-service teachers is the perception of the future problems they might encounter in a K-12 classroom. Thirty per cent of the students made comments that they were concerned that their future students would be distracted by the VW, lose face-to-face social skills, won’t have the technical skills or access to the technology. A further 24 per cent had concerns about the VW as being unsafe, addictive and time consuming; all concerns that were heightened by the potential future use with children. These perceptions gave some of the students a reason not to investigate the use of VWs further, while other students recognised that such problems were something they would need to overcome if they arose.

The perception of their future students not being on task was most prominent in Cycle 1. This perception was formulated from their own initial experience in which some of the students reported that they found it difficult to “stay on task” when they were using the VW in the tutorial with a large number of students in the same VW space. In the tutorial they had been presented with an unstructured VW activity - to explore the SCU island, to familiarise themselves with the VW and to begin to discuss how they might use it in the classroom. The participants responded to the activity in a very playful manner; they spent time interacting with each other, changing their avatar shapes and clothes and exploring in-world games and artefacts. They perceived this playful behaviour as not doing “serious work” and not “being on task”. The response of the students reflects their perceptions of what they feel is appropriate behaviour in the classroom and what constitutes ‘real’ teaching and learning.

The students also cited cyber-safety and the addictive nature of VWs as barriers. They transferred their perceptions and experiences of the VW of Second Life (highly social, avatar based and containing adult content) to assume that these issues would also exist in other VWs used in K-12 classrooms. In an attempt to dispel these feelings of fear about VWs there was discussion at numerous points in the introduction of VWs to reiterate that Second Life was not the VW that would be used in K-12 and that it was being used in the university setting so as to learn about VWs in a stable and accessible environment. Despite the discussion and resources provided to the students about the difference between Second Life and other VWs more suitable for K-12 the students continued to raise cyber-safety as an issue. One of the reasons for this may be that
cyber-safety has been a major concern in K-12 educational settings for many years and as such is a key factor influencing the decisions about what type of technology to utilise in the classroom.

One of the ways in which to overcome the barrier of whether the VW is a safe environment for children would be to only use VWs such as SoaS that do not require any access to a network and can not be entered by people outside of the class. When the focus was shifted away from Second Life and towards more activities that utilised SoaS the student responses that indicated safety as an issue decreased.

The reason why some participants moved beyond their perceived barriers about safety, addiction and what was real teaching and learning may have more to do with the mindset of the individuals than the actual barriers. Dweck (2007) describes learners as having one of two mindsets – the fixed mindset and the growth mindset. Those who have a fixed mindset are unable to shift in their thinking as they believe that there are elements outside of their control that restrict their capacity to change. Those who have a growth mindset are able to ‘make an obstacle an opportunity’ and are driven by challenges. Recognising that students come to certain situations with a pre-existing mindset has implications for pre-service teacher educators and for the students as future teachers. Dweck (2007) stressed that teachers enact their own mindset in the classroom and, as such, impact on the mindset of their students. The teacher thus has the capacity to perpetuate a fixed mindset in their students and as such contribute to the extent to which the student is responsive to change.

8.3.5 Negative student feedback

A barrier for the pre-service teacher educators, when they were deciding whether to continue to use VWs in their units, was the negative student feedback. As part of the University’s system of feedback each student is asked to respond to an online survey at the end of their units of study. The responses given by the students is used as part of the process of assessment of the pre-service teacher educators performance and the resulting number, based on the feedback, is used in various contexts, such as promotion within the University.

The negative feedback was not in the majority in any of the units however; it was taken into consideration disproportionally to the positive feedback when pre-service
teacher educators described their VW teaching experience. Jon reported, “some loved it, then really loved it, some hated it, then loved it, some loved it, then hated it, some just hated it, then hated me” (Section 5.6). This reflection shows an even number for and against yet Jon gave this as his number one reason for not continuing to make the VW compulsory in future iterations. The negative feedback from students in two of the units resulted in the use of VWs being changed from mandatory to voluntary, in Unit 5, and to being removed altogether, in Unit 6. The pre-service teacher educators reported that this small amount of negative feedback was enough to make them reconsider whether they would utilise VWs in their units. The reports by pre-service teacher educators to other pre-service teacher educators about the negative feedback had the follow on effect of generating a negative discourse and perpetuating negative perceptions by pre-service teacher educators that had not yet tried VWs. This was recorded through informal conversations with the researcher.

It is not uncommon for only a small percentage of students respond to the student feedback surveys. In units in which a new and challenging approach has been tried students have a tendency to respond negatively and to let this be known through the feedback. This institutional barrier could be mitigated by creating a no blame risk-taking policy in which pre-service teacher educators who trial new technology are given the opportunity to defend the use and are supported to continue without fear of the student feedback impacting on their personal career options.

8.4 Phases of realisation and engagement

During the early stages of this research a model was developed, based on the coding of patterns from the initial data. The model was called the Phases of Realisation as it began to reveal the ways in which the pre-service teachers were describing their realisation of the possibility for using VWs in an educational setting. The development of this model is discussed in more detail in Section 6.3.2 and in Jacka and Ellis (2012). An overview is provided here, with Figure 8.1 illustrating the initial distribution of students within each phase. The phases were defined thus:

1. Pre Realisation – indicates that they wouldn’t use virtual worlds in their teaching and/or could see no place for virtual worlds in education.
2. **Realisation** – comments reveal a conflict between seeing the benefits and being concerned about the barriers.

3. **Replication** – they are able to describe how they would use virtual worlds but weren’t going to make a big effort to initiate their use. They would use virtual worlds if they were already in place in the school setting.

4. **Reimagining** – these students describe ways to use virtual worlds in their teaching that are different from the type of activities already happening in the classroom. They also show an eagerness to adopt the technology regardless of how difficult it might be.

<table>
<thead>
<tr>
<th>Table 8.1</th>
<th>Percentage of students who were identified in each of the Phases of Realisation in cycle one</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cycle One 2011 (N=96)</td>
</tr>
<tr>
<td>Pre Realisation</td>
<td>8%</td>
</tr>
<tr>
<td>Realisation</td>
<td>50%</td>
</tr>
<tr>
<td>Replication</td>
<td>27%</td>
</tr>
<tr>
<td>Reimagining</td>
<td>15%</td>
</tr>
</tbody>
</table>

As more data were collected describing barriers, motivations, perception and experiences, students continued to display patterns that could be grouped into one of the phases. Individual responses appeared to be linked to the degree in which the students considered VWs to be a valuable technology in education and whether VWs could affect their teaching-learning processes. Analysis of the growing body of data revealed that the students were shifting beyond a description of their 'realisation' of the potential for VWs in education towards a representation of the level to which they were engaging with the VW in their studies and in the K-12 learning environment. As such the second iteration of the model became known as the phases of engagement.

The Phases of Engagement model (Figure 8.1) retained the four phases from the initial model (pre-realisation, realisation, replication and reimagining) while incorporating the pre-existing perceptions and experiences of each individual and the barriers and the
actions that need to be enacted to help move individuals between the phases. The latter model includes a final phase, namely implementation, as it represents students such as Gaby and pre-service teacher educators such as myself who were using VWs in a manner that supports innovative teaching-learning processes.

The data indicated that with each change to the micro- and macro-cycles the percentage of students in each phase also changed. This demonstrated that there were factors that could be manipulated in the learning design to facilitate a shift between phases of engagement by the students. In this research the percentage of students increased at the level of replication and reimagining as the integration of VWs increased and changes were made to the activities and resources. The student who was discussed in Chapter 7 (Gaby) clearly progressed in a linear manner between the phases until she was at the implementation phase. The desired outcome to create a positive and increased engagement with VWs would be to facilitate the movement of the student from the phase they are in to one of the levels that exist at the next most engaged level.
Figure 8.1 Flow chart of the process of moving through each of the phases of engagement. The pre-service teacher educator or student enters at one of the phases based on their pre-existing perceptions and experiences. They are met with barriers that have come from the pre-service teacher educator, student or institution. The pre-service teacher educator, student, or institution actions can then reduce the barriers to assist the pre-service teacher educator or student to move to the next phase. In order for the pre-service teacher educator or student to move between the phases some actions are required by the institution, the pre-service teacher educator or the student or any combination of these. Once these actions have been undertaken they may move to the next phase and in turn encounter different barriers.
Figure 8.2 indicates the number of students in each cycle who provided a response that placed them within one of the phases. From this figure a shift can be observed in the number of students at a higher level of engagement (the Reimagining phase). The figure also shows a drop in the percentage of students who were in the pre-realisation and realisation phases that corresponded with an increase in the replication and reimagining phases. While there are complexities inherent in the timing, the cohorts and the activities provided to these students, some conclusions may be drawn. Due to the action research methodology undertaken in this research changes were made before and during the cycles in response to the feedback that the students were providing. These changes facilitated an increase in the level of engagement that the students were exhibiting.

<table>
<thead>
<tr>
<th>Cycle 1</th>
<th>Pre-Realisation</th>
<th>Realisation</th>
<th>Replication</th>
<th>Reimagining</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16</td>
<td>50</td>
<td>24</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Cycle 2</td>
<td>11</td>
<td>26</td>
<td>29</td>
<td>33</td>
<td>1</td>
</tr>
<tr>
<td>Cycle 3</td>
<td>4</td>
<td>15</td>
<td>55</td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 8.2** Percentage of students in each of the phases showing the shift between the percentages in each phase over the course of this research.

Having created this model, based on the data collected in this research, it becomes possible to apply the model prior to implementation of VWs and identify the phase at which an individual is situated. As such, certain learning activities, resources and teaching-learning processes may be implemented to further their readiness. As such, actions may be implemented that shift the individual from one phase to the next.
The development of models to help explain stages that learners progress through, or to assist in the implementation of resources, is not uncommon and such models act as a valuable tool for educators. Conrad and Donaldson (2011) designed a model to assist instructors to guide students through each of four phases (co-operator, collaborator, initiator, partner) when engaging in the use of online learning resources. They define engaged learning as “a collaborative learning process in which the instructor and learner are partners in building the knowledge base” (p. vii). Salmon (2002, 2004) developed a five-stage model for effective online teaching and learning which she then applied to the VW of Second Life. She emphasised the importance of students mastering skills at each level in order to remain engaged and persist to the final stage in which a deeper level of learning has occurred. Salmon, Nie, & Edirisingha (2010) describe a model to develop effective teaching and learning online. O’Brien and Tom (2008) found evidence from an extensive literature review that there are four distinctive stages in the process of engagement with technology. The model that I am proposing has been developed from collection, collation and analysis of data of a large cohort of diverse students in a pre-service teacher course. The purpose of the model is to help identify the readiness of individuals to (a) utilise VWs in education and (b) implement innovative teaching-learning process. The following sections describe each of the phases of the model, how they were developed, the characteristics that describe them and the number of responses from the students that represent alignment with that phase.

8.4.1 Pre-realisation

The pre-realisation phase (Table 8.2) was primarily identified by responses that indicated that the participants could not see any benefit of VWs in education and/or they would never use them. In most cases the participants expressed that were having difficulty conceptualising the use of VWs in the classroom and/or that it was in conflict with (or at odds with) their perception of ‘real’ teaching and learning. The VW experience was often referred to as being fun, which these students linked to being non-educational:

I understand that people learn best when they are having fun. I don’t think that this means everything in a classroom should be a game. Why isn’t it fun for students to talk and interact face to face? I am tech savvy,
I was and am a part of the technological revolution, and I still think VWs should be played with in their own time (Student 23, Cycle 1).

<table>
<thead>
<tr>
<th>Table 8.2 Pre-realisation phase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indicators</strong></td>
</tr>
<tr>
<td>Pre-existing perceptions and experiences</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Characteristics that categorised the individual within this phase</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Barriers keeping them within pre-realisation phase</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Action required to move to realisation phase</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

The pre-realisation phase may have included participants who did engage with the VWs through the resources presented in their units of study and then made a decision not to continue to engage. O’Brien and Toms (2008) emphasise that someone may become disengaged and potentially re-engaged at a later date. As such, those in the pre-realisation phase may, at a later date outside the scope of this research, become engaged in VWs as part of a different teaching-learning process. They may be considered in the adoption of innovation model (Rogers, 2003) as the laggards who may change their attitude once the majority adopt the innovation.
Most of the student responses in the pre-realisation phase were based on their assumptions rather than experience or research. These included that they felt that students would be easily distracted (not on task), be spending too much time on the computer (that would result in a loss of social skills and the development of anti-social behaviour) and that their students wouldn’t have the technical skills or access to the necessary technology.

8.4.2 Realisation

Participants who might be considered as being in the realisation phase (Table 8.3) could see the benefit of VWs but were still unlikely to use them as they identified a number of perceived barriers or concerns. Participants in the realisation phase were able to recognise that they had personal feelings of discomfort or difficulty with VWs but that they felt their students should be given the opportunity to use innovative technology such as VWs.

Students who had engaged with the resources (online readings, videos, lectures) but did not immerse themselves in the VW were most likely to be in the realisation phase. They were making decisions based on their perceptions of VWs rather than an actual experience. They were also having difficulties reconciling their perception that VWs would be useful with their perceptions of the problems that might be encountered:

After undertaking the module on VWs I’m still undecided on my feelings towards the incorporation into the classroom. I can identify the usefulness of the virtual learning. It lends itself towards students directed learning and allows the students to engage in a game-based type learning. I think this would engage students more. It would also allow a greater collaboration for students who cannot be in the actual classroom. However this type of learning and world opens itself up to online bullying and other associated issues. If I were to employ this type of learning in my classroom I would need to ensure the students (online) safety with rules and expectations. (Student 149, Cycle 2)
Hence, the key distinction between those students in the realisation phase and those in the replication phase is that the former were open to the concept of VWs in education but were not ready to move to the step of implementing VW in the classroom. Such students sometimes expressed that they would use VWs if others around them were doing so, or if the barriers were removed:

There really are endless possibilities with the use of VWs, but I still don’t think I am ready to embark upon that journey. Even though I would still be hesitant to use them with my students, mainly through

<table>
<thead>
<tr>
<th>Table 8.3 Realisation phase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indicators</strong></td>
</tr>
<tr>
<td>Pre-existing perceptions</td>
</tr>
<tr>
<td>and experiences</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Characteristics</td>
</tr>
<tr>
<td>that categorised the</td>
</tr>
<tr>
<td>individual within this</td>
</tr>
<tr>
<td>phase</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Barriers keeping them</td>
</tr>
<tr>
<td>within realisation phase</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Action required</td>
</tr>
<tr>
<td>to move to replication</td>
</tr>
<tr>
<td>phase</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
my own lack of capabilities, I can certainly now understand and value their use. (Student 333, Cycle 3)

The students in the realisation phase had fixed ideas about what constituted time well spent. As individuals they had their own context in which they based these decisions. Some of the responses provided more personal insights that included, health reasons, having small children, and working full time as well as studying. Many of the students were concerned that in order to create a VW space for use in the classroom a lot of preparation time would be required.

### 8.4.3 Replication

Participants were considered to have reached the replication phase (Table 8.4) when their reflections demonstrated that they were engaged with the concept of VWs in education to the extent that they were likely to use it in their classroom. This phase was also signified when the participants made links between VWs and their current approach to the teaching-learning process. The demonstrated capacity or desire to utilise VWs, regardless of the barriers that they may have perceived, also placed participants in the replication phase. Such participants were mostly of a growth mindset in which the challenge was at least part of the motivation to engage.

A consistent factor that placed the students in the replication phase was their perceptions about their future teaching environment and their future students. Their belief that the VW would motivate and engage their students was enough to persuade them to engage with the VW to the point of being outside their comfort zone. One student felt “VWs will not be used in many schools at present but I do think it is a thing of the future, a future that I will be teaching” (Student 324, Cycle 3).

Pre-service teacher educators were generally situated in the replication phase as they had accepted that there was merit to including VWs in their units. However, they were still trying to imagine how they would use it and left both the generation of ideas, and the actual implementation to me. Their perception of the value of VWs was a major driver in their engagement with VWs. They believed that their students needed to know about VWs because they perceived that VWs were starting to be integrated in contemporary classrooms and that this use would increase in the future. These views were supported through the examples of work that Gaby and myself
were doing in local primary schools. As a result the feedback to the pre-service teacher educators and students at the University was that VWs were being embraced by the mainstream education sector. The more that each pre-service teacher educators and student heard about and discussed the positive outcomes from the use of VWs the feedback was amplified and permeated the collective consciousness. The perceptions by pre-service teacher educators that VWs was an affective and powerful tool in primary education were supported through feedback from students.

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Students</th>
<th>Pre-service teacher educators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-existing perceptions and experiences</td>
<td>Positive perceptions about VWs</td>
<td>Positive perceptions about VWs</td>
</tr>
<tr>
<td></td>
<td>Positive experiences with VWs</td>
<td>Positive experiences with VWs</td>
</tr>
<tr>
<td></td>
<td>Positive experiences with technology</td>
<td>Positive experiences with technology</td>
</tr>
<tr>
<td></td>
<td>Confident in their interactions with children in a classroom</td>
<td>Confident in their use of technology</td>
</tr>
<tr>
<td>Characteristics that categorised the individual within this phase</td>
<td>Barriers existed but were accompanied by solutions and weren’t high enough to restrict implementation</td>
<td>Barriers existed but were accompanied by solutions and weren’t high enough to restrict implementation</td>
</tr>
<tr>
<td></td>
<td>Motivated by their perceptions about their future students engagement with VWs</td>
<td>Motivated by their perceptions about their students need to know about VWs</td>
</tr>
<tr>
<td></td>
<td>Demonstrated the ability to link the way they would use VWs in education to their current teaching-learning processes</td>
<td>Demonstrated the ability to link the way they would use VWs in education to their current teaching-learning processes</td>
</tr>
<tr>
<td>Barriers keeping them within replication phase</td>
<td>Not enough modelling of different strategies for both the use of VWs and for the teaching-learning process in general</td>
<td>Not enough intrinsic or extrinsic motivation to invest the time in changing the teaching-learning process they currently employ</td>
</tr>
<tr>
<td>Action required to move to reimagining phase</td>
<td>Repeated opportunities to present the use of VW in a replicating manner with discussion about how to change the integration strategies</td>
<td>Repeated use of VW in a replicating manner with discussion about how to change the integration strategies</td>
</tr>
<tr>
<td></td>
<td>Reward for demonstrating innovative ideas</td>
<td>Reward for demonstrating innovative ideas</td>
</tr>
<tr>
<td></td>
<td>Support for innovation by the institution</td>
<td>Support for innovation by the institution</td>
</tr>
</tbody>
</table>

Table 8.4 Replication phase
8.4.4 Reimagining

The reimagining phase (Table 8.5) was signified by responses that indicated that the student or pre-service teacher educators would not only use VWs but also can describe using the VW as part of an innovative approach to the teaching-learning process. Individuals in this phase described the use of VWs as integral to the teaching-learning process with engagement that goes beyond the ‘distracting entertainment features’ (Mayer & Johnson, 2010) or the ‘seductive details’ (Harp & Mayer, 1998).

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Students</th>
<th>Pre-service teacher educators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-existing perceptions and experiences</strong></td>
<td>• Positive perceptions about VWs</td>
<td>• Positive perceptions about VWs</td>
</tr>
<tr>
<td></td>
<td>• Positive experiences with VWs</td>
<td>• Positive experiences with VWs</td>
</tr>
<tr>
<td></td>
<td>• Positive experiences with technology</td>
<td>• Positive experiences with technology</td>
</tr>
<tr>
<td></td>
<td>• Experience implementing innovative teaching-learning process in a non-VW environment</td>
<td>• Experience implementing innovative teaching-learning process in a non-VW environment</td>
</tr>
<tr>
<td></td>
<td>• Confident in their interactions with children in a classroom</td>
<td>• Confident in their use of technology</td>
</tr>
<tr>
<td><strong>Characteristics that categorised the individual within this phase</strong></td>
<td>• Excited about the use of VWs</td>
<td>• Excited about the use of VWs</td>
</tr>
<tr>
<td></td>
<td>• Likely to initiate future uses of VWs</td>
<td>• Likely to initiate future uses of VWs</td>
</tr>
<tr>
<td></td>
<td>• Described how they would use VWs with an innovative approach to the teaching-learning process</td>
<td>• Described how they would use VWs with an innovative approach to the teaching-learning process</td>
</tr>
<tr>
<td></td>
<td>• Barriers were acknowledged but were supported by solutions</td>
<td>• Barriers were acknowledged but were supported by solutions</td>
</tr>
<tr>
<td><strong>Barriers keeping them within the reimagining phase</strong></td>
<td>• Lack of support within their institution to actually implement</td>
<td>• Lack of support within their institution to actually implement</td>
</tr>
<tr>
<td><strong>Action required to move to implementation phase</strong></td>
<td>• Reward for demonstrating innovative ideas</td>
<td>• Reward for demonstrating innovative ideas</td>
</tr>
<tr>
<td></td>
<td>• Support for innovation by the institution</td>
<td>• Support for innovation by the institution</td>
</tr>
<tr>
<td><strong>Table 8.5 Reimagining phase</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The students that were situated in the reimagining phase often expressed excitement in relation to the possibilities of VWs. Words such as fascinating, exciting, astounding, wow, fun and inspired were commonly used to describe their experiences. Indicative comments included: “it was a fascinating experience and I enjoyed the experience more than I thought I would”; or “I was inspired”; or “I feel I need to reiterate how amazed I am by the educational possibilities of VWs”; or “the clip on
virtual learning blew my mind! How fantastic would it be to have a school website that was a VW - gathering information could be fun and students’ hard work could be exhibited on a global scale”.

For the student to be situated within the reimagining phase they needed to have described how they would utilise VWs in a way that they could not use other technology in the classroom and demonstrate a readiness to implement innovative teaching-learning processes. The following comment provides an example of how one such student imagined the possibility for their music class:

    Wow! Again, I can’t believe how much education has changed. I’m really looking forward to using these VWs in my classroom. I can just imagine having a Jimi Hendrix-like avatar shredding it up on the virtual stage. (Student 146, Cycle 3)

The most common ideas expressed by students who were in the reimagining phase included activities that were dangerous such as in science experiments where the student could have “the freedom and confidence to conduct experiments and perform reactions in a virtual laboratory that may otherwise be considered too expensive, toxic or dangerous in the ‘real’ world” (Student 281, Cycle 3). Students also described activities such as visiting the Sistine Chapel for “art students to experience one of the true masterpieces without having to paying thousands of dollars to travel to Italy and see it in real life” (Student 15, Cycle 1). Another student described a number of different ways that authentic experiences could be designed:

    Virtual stores that could teach students about commerce in an environment where they can trade goods and services for real rewards. Virtual governments could teach students about civics and responsibility. Historical characters can be brought to life and scenes re-enacted. Theoretical mathematics could be given real applications in the virtual world. (Student 277, Cycle 3)

The majority of the students in this phase were formulating their knowledge of VWs from limited experience. However, they were able to imagine ways that they could utilise VWs that they had not actually witnessed in either a K-12 classroom or at University. That said the participants who were most able to reimage the types of
activities and the teaching-learning process were those who immersed themselves in actual experiences in the VW embodied by their avatar. This was particularly true if they had a positive experience that included interactions in spaces that revealed new ways of thinking about their discipline. One student reflected “the idea of having interaction and the almost game-like feel would be enticing to many students who may not normally feel as engaged in the typical pen to paper or whiteboard classroom scenario” (Student 77, Cycle 1).

Gaby, the student who used VWs throughout her study, in her practicum and into her professional life moved into the reimagining phase very quickly. Her use of VWs began in the replication phase as she was of the belief that she would use VWs in the classroom but her ideas about teaching-learning processes were still situated in traditional models. As she used the VW more, and did further reading and networking with other educators who were using VWs, Gaby changed the way in which she approached the use of VWs in the classroom. She started to think more creatively and conceptualise new and original ways of integrating this technology. As she developed more confidence to allow students to be more autonomous she provided more and more freedom that translated to non-VW teaching and learning experiences.

### 8.4.5 Implementation

The phase of implementation (Table 8.6) applied to Gaby and I who both acted to implement VWs in the K-6 classroom and in the University context. We both moved through phases and developed our own strategies for implementing that involved shifts in our teaching-learning processes.

<table>
<thead>
<tr>
<th>Table 8.6 Implementation phase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indicators</strong></td>
</tr>
</tbody>
</table>
| Pre-existing perceptions and experiences | - Positive perceptions about VWs  
- Positive experiences with VWs  
- Positive experiences with technology  
- Experience implementing innovative teaching-learning process in a non-VW environment  
- Confident in their interactions with children in a classroom  
- Confident user of technology | - Positive perceptions about VWs  
- Positive experiences with VWs  
- Positive experiences with technology  
- Experience implementing innovative teaching-learning process in a non-VW environment  
- Willing to take risks with teaching and learning experiences in the non-VW  
- Highly confident user of a variety of technology |
### Indicators

<table>
<thead>
<tr>
<th>Characteristics that categorised the individual within this phase</th>
<th>Students</th>
<th>Pre-service teacher educators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Using VWs to promote innovative teaching-learning processes</td>
<td>• Using VWs to promote innovative teaching-learning processes</td>
</tr>
<tr>
<td></td>
<td>• Supporting the use of VWs by other students or teachers</td>
<td>• Supporting the use of VWs by other teachers</td>
</tr>
<tr>
<td></td>
<td>• Willing to take risks</td>
<td>• Willing to take risks</td>
</tr>
<tr>
<td></td>
<td>• Motivated by personal challenges</td>
<td>• Motivated by personal challenges</td>
</tr>
</tbody>
</table>

The implementation phase involves the pre-service teacher educators or student implementing innovative teaching-learning processes. At this point the pre-service teacher educators or student demonstrates a higher level of confidence with the use of VWs and their application to developing innovative teaching-learning processes. Once implementation has proved successful the pre-service teacher educator or student is likely to move into a mentoring role for other’s wishing to implement VWs in their teaching-learning context. The success that the they experience with their implementation also has the potential to act as a catalyst to reduce some of the barriers that others may be experiencing. In particular, the ability to demonstrate that VWs can be applied to a K-12 context, resulting in positive learning outcomes that meet 21st century learning objectives for children, is a powerful motivator for pre-service teacher’s, teacher’s and pre-service teacher educators.

### 8.5 Perception/Experience Matrix

Through the analysis of the data, and the process of situating the participants in the phases of engagement model, it became apparent that each individual came to a phase with pre-existing perceptions and experiences about technology, VWs and education. These pre-existing perceptions and experiences acted either as barriers to initial or further engagement or they acted as the catalyst for personal change. Those participants who had a pre-existing propensity to take risks or try new things were most likely to engage at a higher level than those who were risk-adverse or who had negative perceptions of VWs or technology.

Overall, the students’ responses indicated that they were influenced by a complex interplay of their perceptions as well as their experiences. Sometimes their initial perceptions were negative and they chose not to engage in an immersive experience. These pre-existing perceptions were developed either through their prior experiences.
(as a small number of students were VW game players) or through second-hand information (such as media reports or stories from friends or colleagues). After being introduced to VWs as part of their units of study their perceptions may have changed. This seemed largely dependent on whether they did have an immersive VW experience and whether they perceived the experience as positive or negative. Those who did not have an immersive experience but engaged with the unit resources and information demonstrated a shift in their perceptions. In order to illustrate the relationship between their perceptions (negative to positive) and their experiences (negative to positive) a perception/experience matrix was developed (Figure 8.3).

When the perception/experience matrix is applied before the student has an experience in the VW it is reasonable to suggest that their pre-existing experiences are based on their experience with technology in general. The student who has negative perceptions and negative experiences is situated in quadrant C and is in need of the most intervention in order to proceed with the use of VWs. The person who has positive perceptions and positive experiences is situated in quadrant B and is most likely to continue to utilise VWs and to shift into a phase of implementation (Section 8.3.5 and 9.2.3.1).

Figure 8.3 Perception/experience matrix.

Figure 8.4 provides an example of how the perception/experience matrix can be applied to the phases of engagement model. The pre-existing perceptions and
experiences of the students in the phases of engagement (Section 8.4) have been used to select the most likely part of the matrix in which students in these phases would be situated. The level of negative to positive perceptions gradually moves through the matrix until it reaches the implementation phase in which students responded with positive perceptions and experiences.

![Perception/experience matrix applied to the phases of engagement data generated from the student responses.](image)

**Figure 8.4** Perception/experience matrix applied to the phases of engagement data generated from the student responses.

On this matrix the realisation phase illustrates that, while students are more positive in their perceptions, they are likely to still have more negative experiences, most commonly with their previous interaction with other technology. A detailed and granular survey of the students, in which they were asked to rate their pre-existing perceptions and experiences on a negative to positive continuum would be required in order to situate them each individually within the matrix. The perception/experience matrix has evolved from the data and as such a survey to gauge the exact position of all 500+ students was not undertaken.

All of the pre-service teacher educators shifted in their conceptualising about VWs in education. The perception/experience matrix provides a model in which their responses to VWs can be plotted, based on their pre- and post- responses as described in the interview.
data. Figure 8.5 illustrates the shift that they each made during this research, from when they were first introduced to VWs to the point at which this research concluded.

Jon and Alison both experienced negative feedback from students and as a result part of their overall experience was negative, thus moving them away from the higher end of positive experiences. Despite their shift in experience they did not shift down in their perceptions. Their overall experience supported their perceptions as still being positive but the negative experience caused them to change the way in which they introduced VWs to their students. I also recorded a small shift into a more negative position as my experience was affected by the responses of the pre-service teacher educators and students. My starting position of being highly positive in both perceptions and experience was altered during the course of this research. The other three pre-service teacher educators all recorded positive shifts edging closer to implementation.

8.6 Conclusion

The data revealed a number of barriers including; time, access, emotional responses, the perceptions of what the requirements for a K-12 classroom were in terms of
technology, teaching-learning processes and student feedback. These barriers combined with the pre-service teacher educators and students pre-existing perceptions and experiences began to reveal characteristics that situated them within one of five phases of engagement. The phases of engagement model proposed in this chapter forms a framework to assist in the development of strategies to introduce, develop and support the use of VWs and the development of innovative teaching-learning processes.
Chapter 9 Conclusions and Recommendations

This chapter answers the research questions based on the data generated through the responses of the pre-service teacher educators and students in the School of Education at SCU when VWs were introduced. A perception/experience matrix is proposed in which the pre-service teacher educators and students can be situated and a framework for the implementation of VWs in pre-service teacher education is provided. Within the framework recommendations are made that, if put in place, will help facilitate the introduction, development and support of VWs in pre-service teacher education. The chapter concludes with suggestions for further research.

9.1 Background

Between 2011 and 2013 over 1500 students and six pre-service teacher educators were involved in the introduction of VWs in the School of Education at SCU. This represents approximately 25 per cent of all students enrolled in the School of Education during this research and 20 per cent of pre-service teacher educators. Five of the six pre-service teacher educators contributed to the data through interviews and discussions. I undertook this research as both pre-service teacher educators participant and researcher. A third of all students introduced to VWs (approximately 500) contributed to the data by responding to surveys, interviews, blog posts and portfolio responses or through using the VW as a space in which to build learning environments.

The pre-service teacher educators data were presented in Chapter 5, the student data in Chapter 6 and a case study of one student in Chapter 7. The findings were discussed in Chapter 8. The following sections of this chapter summarise the findings in relation to the research aim and questions.

9.2 Research Aim and Questions

The aim of this research was to identify factors that influence the level of readiness of pre-service teacher educators and students to introduce, develop and support innovative teaching-learning processes using VWs. Three research questions were designed to address the aim:

1. How do pre-service teacher educators and students respond to the
introduction, development and support of VWs as part of their pre-service teacher education program?

2. To what extent do the pre-service teacher educators and students’ pre-existing experiences and perceptions, intrinsic and extrinsic motivations and barriers influence their engagement with VWs?

3. What level of readiness to implement innovative teaching-learning process using VWs do pre-service teacher educators and students describe and display?

9.2.1 Question one

The initial question about how the pre-service teacher educators and students would respond to the introduction, development and support of VWs as part of their pre-service teacher education program was designed to provide rich data from which patterns would emerge. The complex interplay between the context in which the pre-service teacher educators and students were experiencing VWs and their pre-existing perceptions and experiences of VWs and of technology in general meant that in each cycle a new set of responses were recorded. In the following two sections a summary of their responses is presented and discussed.

9.2.1.1 Pre-service teacher students’ responses

In Cycles one and two there were 33 students who voluntarily reflected on their perceptions and experiences of VWs as part of a written portfolio task in Unit 2 (Section 6.2.2). The responses revealed that the students had a variety of perceptions, motivations and barriers. The main motivation for the students (expressed by 52 per cent of them) was that their future students would be highly engaged by using VWs in the classroom. They also indicated that the affordances of VWs would provide opportunities for their future students to: develop collaboration skills (52%); be active participants in the teaching-learning process (20%); have an increased capacity to express themselves by being an avatar (13%); and develop lifelong learning skills (4%). Fifteen of the 33 students believed that the VW provided the potential to undertake experiences that were too expensive, too dangerous or not possible to do in the non-VW.

The introduction of VWs as part of Unit 3 resulted in 311 students providing responses. Unit 3 was a micro-cycle within each of the macro-cycles. The students’
personal blog posts, written as part of an assessment task (Section 6.3.2), provided the foundation for the development of the phases of engagement model (Section 8.4). The combined responses from the three cycles showed that 12 per cent of the students believed that they would never use VWs in a classroom and that VWs would never be used in a classroom.

The other 88 per cent of students described, to varying degrees, reasons why they felt that VWs would be useful in K-12 education. However, being able to describe the usefulness of VWs for K-12 education did not always translate to the students personally feeling that they would use VWs. A number of factors needed to align for students to believe that they would actually be able to implement the use of VWs (Section 9.2.2.1).

Reasons they gave for considering the use of VWs were the opportunity to:

- develop student centred experiences
- engage students
- develop teamwork
- promote problem solving, initiative and independent thinking
- collaborate with other schools

The students in Unit 3 expressed personal concerns and barriers that were based partly on their perceptions prior to experiencing the VW and also after experiencing the VW. These concerns included that they:

- perceived they weren’t staying on task due to the distracting nature of the environment
- perceived they would experience technical issues
- perceived that using the VW would be time consuming
- experienced feelings of annoyance
- experienced feelings of discomfort
- experienced technical issues

They also perceived that their future students would:

- lose face-to-face social skills
- not be on task
- not have the technical skills
• not have access to adequate technology

These perceived issues had the potential to be barriers for the students when they were considering whether to invest personal time into exploring VWs. The students who expressed these barriers, in some instances, described them as restricting their ability to use VWs in the classroom and some students would describe them as a barrier that would not restrict them, as they would find the means to overcome them.

Students in Unit 4 were introduced to VWs in Cycle 2 (Section 6.4). These students were in their final year of study and, as such, were the cohort with the highest level of experience in the classroom environment. The students were asked to volunteer to use Second Life to present a research paper they had written for a previous assessment. Three students chose to do this and presented work that was a replication of a non-VW presentation in that they created a series of slides and spoke to the slides; the difference being that the group attended the presentation in the VW space as an avatar from non-VW locations that were remote from each other. Two of the three students provided feedback in an interview after their presentations (Section 6.4.3 and 6.4.4). All of the students (n=173) had been presented with resources about VWs and seven of them attended weekly activities held in Second Life. Overall the students’ responded positively to the VWs as evident in the verbal feedback and via Survey 2 (Section 6.4.2).

There were a number of factors that influenced why more students did not use Second Life for their presentation in Unit 4 including that there were easier and quicker technology options with which to complete the assessment presentation task (Section 6.4.2). The students who did use VWs for the presentation expressed that they had perceived that using VWs would be challenging, but that the level of challenge was one of the motivating factors. They also reflected that in hindsight what they had actually done in the VW did not extend what they could have done. The experience of the three students using VWs for a presentation indicates that one of the first steps to lessen the barrier of the VW being too hard may be to require all students undertake a simple presentation task. After completing this task they may consider that using VWs was not as difficult as they first imagined and move on to being able to reimagine the use of VWs.
In Unit 5, Cycle 2 the students in the first iteration were given the option to use a VW and in the second iteration in Cycle 3 it was made compulsory. Three students chose to use VWs in Unit 5, Cycle 2 by creating an immersive space that could be used in the K-6 classroom. Gaby was one of the three students. This was her third use of VWs at SCU and occurred concurrently with her implementation of VWs at a local primary school (Section 7.5). As she became more experienced in her use of VW she developed increasingly sophisticated approaches including the building techniques and the teaching-learning processes. As such her response in Unit 5 was one that showed how the VW could be used to engage the K-6 students in immersive learning through an experience of a simulated space and the development of their own 3D objects. The success that Gaby had with her creation of VW environments was a critical factor in motivating the pre-service teacher educators to include VWs in their units (Section 9.2.2.2) The other two students provided responses during post-interviews (Section 6.5.1 and 6.5.2) with comments that included that they wished they had used the VW more often as they felt that it was not as difficult or time consuming as they had perceived once they actually started using it. They also felt that each time they had used the VW, discussed their ideas and looked for input by visiting other VW environments they had progressed their own concepts of what was possible.

All of the students in Unit 5, Cycle 3 were required to use the VW to build part or all of an imagined immersive learning experience. One hundred and sixty-one students completed this assessment task using Second Life (n=27), SoaS (n=133) or Minecraft (n=1). Seventy-eight per cent of the environments that were submitted for assessment replicated traditional teaching practices with images or text placed in the space to be interacted with by looking at or reading. However 22 per cent of the students responded by creating and describing ways that their future students would use the VW as a way to learn more about a theme through immersion in a simulated environment or to build their own representations of knowledge about a theme through building in the VW. This level of response was despite there being only a small amount of technical support provided and may have been due to the involvement that Gaby had with the unit as a mentor. She provided the students with support in the VW and was able to provide authentic examples of use of VWs in the primary school.
At the conclusion of Unit 5, Cycle 3 the students were asked to respond to a survey (Section 6.5.3). Twenty-six per cent of the students indicated that they had felt under pressure to perform in an assessment task using a technology that was new to them and believed that this put them at a disadvantage. Thirty-seven per cent expressed that they had concerns about VWs in general however, 38 per cent said they were excited by the potential for VWs. The introduction and use of VWs by the students affected the overall perceptions of VWs of 33 per cent of the students. Fifty per cent of the students indicated that the inclusion of the VW had influenced their choice of learning activities while the other 50 per cent indicated that they simply added the VW on at the end. The students who indicated that the VW had influenced their learning activities had used the VW either as a stimulus to engage their students in the theme or to provide them with creative opportunities as a space in which they could respond to the theme by building in the VW.

In Unit 6 all of the students (n=57) were required to undertake a role-play activity in Second Life as a small part of an assessment item (Section 4.7.6). At the completion of the role-play activity the students were asked to complete a survey (Section 6.6.1). Fifteen students (26 per cent) provided responses with four indicating that they were really engaged with the activity and a further three were able to express why VWs were useful. Seven of the fifteen expressed concerns about the difficulties they experienced in using the technology and one student found it difficult but felt that the experience had been valuable to help her understand the content of the task.

Themes that emerged from their responses were that they:

- perceived that their technical skills needed to be at a higher level
- wanted to know more about the use of VWs in education before they could imagine how they would implement VWs
- perceived that it was important to have an understanding of VWs because their future students were already using VWs

The students in Unit 6 engaged in a role-play, which, unlike the other units, required them to carefully consider their avatar as part of the task. Eight of the students expressed that using an avatar in the role-play provided them with a unique opportunity to undertake an authentic simulation of an early childhood scenario that
they couldn’t have done in a non-VW setting. As one student commented that the avatar allowed her “to put on the shoes of her character”. The responses from the students and the feedback provided to the pre-service teacher educators after they undertook the role-play indicated that the use of the VW had been beneficial in providing the students with an experience that they could not have had in the non-VW. However the general perception from the students and the pre-service teacher educators was that they required more experience in being an avatar for them to become completely comfortable utilising the VW for these types of activities.

Overall, the students’ responses from all of the units indicated that they were influenced by a complex interplay of their perceptions as well as their experiences. Sometimes their initial perceptions were so negative that they chose not to engage in an immersive experience. These pre-existing perceptions were developed either through their prior experiences, as a small number of students were VW game players or through second-hand information, such as media reports or stories from friends or colleagues. After being introduced to VWs as part of their units of study their perceptions may have changed. This seemed largely dependent on whether they did have an immersive VW experience and whether they perceived the experience as positive or negative. Those who did not have an immersive experience but engaged with the unit resources and information were also able to shift their perceptions. In order to illustrate the relationship between their perceptions (negative to positive) and their experiences (negative to positive) a perception/experience matrix was developed and discussed in Section 8.5.

Question one did not seek to reveal whether the pre-service teachers would be positive or negative toward VWs. What it did seek to do was to create a context in which to gain more understanding about the factors that influence the pre-service teachers in their decisions to engage with both the concept of VWs and the actual utilisation of VWs in their studies and in their future professional work as a teacher.

9.2.1.2 Pre-service teacher educators' responses

There were six pre-service teacher educators included in the data collection for this research. Responses and reactions varied between each of the pre-service teacher educators. All of the pre-service teacher educators had volunteered to introduce VWs into their units and were open to assess the experiences that they and their students
had during the process. Table 9.1 illustrates the cycles in which the pre-service teacher educators were involved and indicates the number of cycles that each continued to participate in the research. Three of the pre-service teacher educators were only involved for one cycle; Jane had an unforeseen redesign of her unit that was unable to accommodate VWs, Anne relocated to another university and Alison chose not to use VWs again due to negative student feedback. Jon included VWs in two cycles however he changed the requirements for the students’ use from voluntary to mandatory between Cycle 2 and 3 and back to voluntary after Cycle 3. Lisa and Beth both included VWs in their units for all three cycles. Beth and Lisa’s units focus on technology use in education, making the inclusion of VWs an easy and obvious option.

Table 9.1 Pre-service teacher educators use of virtual worlds across the cycles of research

<table>
<thead>
<tr>
<th></th>
<th>Cycle 1</th>
<th>Cycle 2</th>
<th>Cycle 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jane</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anne</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alison</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lisa</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Jane was very interested in the potential for VWs both in her unit and in the K-6 classroom. She was open to developing a different approach to the teaching-learning process and offering the students a more authentic activity than she was able to do in the non-VW. Jane’s personal experience in VWs was limited but she was a confident user of technology and had previously explored new technologies as part of her teaching. I undertook the role of expert tutor as I designed and delivered the section of the unit that involved the use of Second Life. Jane’s main role was to encourage the students to imagine ways in which VWs could be used in the primary school classroom. Jane’s response to the work that the students created in Second Life was very positive as she felt that they were able to extend their understanding of the topic through the use of immersive and simulated materials that was previously not possible in the non-VW activity. One of the ways that she felt that VWs would enhance her unit was to introduce a greater level of creativity into the science curriculum.
Beth was involved for all three cycles as her unit focussed on the use of technology in education. However, VWs were not her interest area and the inclusion of VWs figured alongside a number of other technologies. Her response to VWs was that it was an important new technology for students to be aware of. However she felt that she and her students were time poor and as such VWs were competing for their attention against a range of technologies that are currently predominantly used in K-12 schools. Beth spent approximately 15 hours in the VW over the three years. She attended three of the workshops conducted in the computer lab in which she observed the students’ reaction to using Second Life and SoaS. This experience had a profound impact on her as she responded that she “could see the students learning in the space without me teaching them anything”. The pre-service teacher Gaby also expressed this sentiment when she first taught SoaS in a public primary school. Beth had expressed that Gaby’s experiences had also influenced her own response to the use of VWs with the pre-service teachers. They both came to their individual realisations that they could shift the teaching-learning process and “let go of being the teacher”.

Anne had a vision for how the VW could be used to extend the way that students responded to an assessment task. Her first experience of Second Life was attending a talk presented by Anna Peachey from the Open University (UK) in the lecture theatre on SERI. Anne’s opinion of the potential of VWs was opened up by this experience. She found that the requirements were quite low, in terms of her skill and technology, and the opportunity to link students with experts from all over the world had the potential to change the teaching-learning process. Over the one cycle she spent approximately five hours in the VW and three of her students chose to use Second Life. She was disappointed that more students hadn’t used Second Life. Anne felt that the students who did could have better utilised the affordances of Second Life. She did not continue to use VWs as she moved to a different university. Anne commented that VWs “had great potential in the future” but she felt that had not “been realised yet, especially in higher education”. This comment is consistent with comments made as part of a global survey undertaken of over 223 pre-service teacher educators at 134 institutions by S. Gregory et al. (2015). This study found that “those who are teaching in a VW perceive these spaces are important for teaching and learning” however there are issues that need to be mitigated in order for “the great educational potential of VWs to be realised” (p. 12).
Jon was interested in including VWs in his unit and started slowly by offering the use as an option in Cycle 2 and then as compulsory in Cycle 3. Over the two cycles he spent approximately 15 hours in the VW. At the start of this research he was looking for a technology that he thought would be useful to introduce to the students and be personally of interest to him. He had always integrated technology in his units and confessed to being keen on gadgets but he felt that in recent years he had been unable to find something that really engaged him. I took on the role as the VW expert who designed the resources and provided the technical support for the students who used VWs. As such Jon had very little interaction with the actual VW spaces in Cycle 2. Three students used Second Life in Cycle 2 and, as a result, he decided to make the entire student cohort in Cycle 3 use a VW. He was very impressed with the work that the three students had done and the potential for VWs to be taken into the K-6 classroom. In Cycle 3, because of the now compulsory requirement that the students use a VW in an assessment task, he fielded questions and complaints that resulted in Jon feeling that VWs were too difficult for too many. He was also disappointed that the majority of the students did not utilise the affordances of VWs or reconceptualise how they would integrate them into the teaching-learning process.

Alison also made the use of VWs compulsory in one of the assessment tasks. She used Second Life to role-play a scenario relevant to the students’ learning to be early childhood teachers. Alison believed, before and after, that the VW was an effective way to undertake this task, however the responses from the students were mixed. Some of these responses may have been due to Alison’s own sense of discomfort. She described how Second Life was very much outside of her comfort zone and “being an avatar” was not something she enjoyed. Her discomfort translated into the short period of time she chose to spend immersed in the VW being approximately six hours in Second Life, including attendance at an on-campus workshop. Alison decided not to continue to use VWs after Cycle 2. She cited the reasons as being her personal discomfort coupled with the negative student feedback she received albeit from only 25 per cent of the students. Alison believed that the negative student feedback came mostly from those students who had less support as they were based on campuses remote from her and I.
I was one of the six pre-service teacher educators involved in this research as a participant and was the most active in my promotion of VWs and in conceptualising different ways to include VWs to extend the teaching-learning processes. This was understandable as I was the most experienced in the use of VWs. I taught the VW component of each of the units and put in place as many resources and structures as I could to facilitate a supportive introduction to VWs. I offered every individual student the opportunity to work with me if they required assistance at any stage of their use of VWs. While this may have appeared to be unworkable, if every student had made that choice, the uptake of individualised tuition was extremely low. I also offered all of the pre-service teacher educators the opportunity to be guided individually, at times that suited them. From that offer only Anne asked me to help them outside of a group meeting time. The other four pre-service teacher educators attended at least one in-world group meeting.

My overall response to the use of VWs in pre-service teacher education is that it is an important new technology that has the capacity to change the way in which the teaching-learning process is both taught to students and used by pre-service teacher educators. However my perceptions about how that can be undertaken has changed over the course of this research.

Overall, the pre-service teacher educators felt both before and after the introduction of VWs in their units that it was important for their students to be introduced to VWs as an innovative technology. They believed that VWs were being used in K-12 classrooms and would be used more widely in the future. This perception was reinforced through the experiences that Gaby and I had while working with K-6 students in local primary schools as described in Jacka and Booth (2013). Four of the pre-service teacher educators agreed that they could have spent more time trying to understand better ways to utilise VWs in order to fully realise the potential of VWs in ways that extended the teaching-learning process. These four identified that a lack of time in their workload had prevented them from doing this.

In hindsight, all of the pre-service teacher educators expressed that they could see that they needed to develop a different approach to the manner in which they introduced VWs in order to foster the best outcomes for the students. I believed at the outset that the use of the VW needed to be fully integrated across the weekly lectures and
tutorials and not just as a small part. However I was not in a position to request pre-service teacher educators do this. I was initially optimistic that introducing VWs as a small part could influence a wider integration but I found, through the research, that a number of factors influenced whether this would happen.

9.2.2 Question two

All pre-service teacher educators and students have pre-existing perceptions and experiences that influence their engagement with any new experience. In relation to a new or unfamiliar technology these experiences and perceptions have the capacity to influence whether they will introduce, develop or support the integration of that technology in their teaching-learning processes. The second question in this research was designed to identify the factors that influence the pre-service teacher educators and students in their engagement with VWs and the extent to which those factors influence the introduction, development or support of VWs. These factors begin with their pre-existing perceptions and experiences and, as they interact with either the concept of VWs or the actual immersion in VWs, their perceptions and experiences develop with the support of intrinsic and extrinsic motivations and the process of encountering barriers. This intertwining of processes, the back and forth of learning something new, all influence the extent to which the pre-service teacher educators or student engages with VWs.

9.2.2.1 Factors that influenced the pre-service teachers

Over 1500 pre-service teachers were introduced to VWs at SCU during this research. A third responded to VWs by creating work or written reflections mostly due to that being part of an assessment requirement. Approximately four per cent (n=64) voluntarily chose to write about (n=41) or create a learning experience (n=23) in the VW. The small number of voluntary users indicates that in order to introduce, support and develop the use of VWs the factors that influence students’ choice not to use VWs are critical. Table 9.2 provides a summary of the factors that students indicated in the data were influencing their decision to engage with VWs.

Data revealed that the pre-existing perceptions and experiences of the students had the capacity to be highly influential in the students’ attitude towards, and their choices to engage with, VWs together with their capacity to overcome any barriers. All students
come to university with pre-existing perceptions and experiences in relation to a wide range of ideas and concepts including technology, study, learning, teaching and schools. As described in Section 9.2.1.1 it was possible to plot the students on a matrix that reflects the interplay between the degree to which they have positive or negative perceptions and experiences. By so doing the actions undertaken by the pre-service teacher educators can be targeted to specific groups of students rather than a homogenous approach to introducing, developing and supporting VW implementation.

<table>
<thead>
<tr>
<th>Category</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-existing</td>
<td>• pre-existing mindset</td>
</tr>
<tr>
<td></td>
<td>• prior experience with VWs</td>
</tr>
<tr>
<td></td>
<td>• perceptions about VWs</td>
</tr>
<tr>
<td></td>
<td>• prior experience with technology</td>
</tr>
<tr>
<td></td>
<td>• attitude towards change and innovation</td>
</tr>
<tr>
<td></td>
<td>• attitude towards technology in the classroom</td>
</tr>
<tr>
<td>Motivating</td>
<td>• being required to satisfy an assessment task</td>
</tr>
<tr>
<td></td>
<td>• experiences that were positive in the VW</td>
</tr>
<tr>
<td></td>
<td>• perceptions that VWs would increase K-12 student engagement</td>
</tr>
<tr>
<td></td>
<td>• perceptions that VWs would help them to meet standards set by the teacher registration board to be a 21st century teaching</td>
</tr>
<tr>
<td>Barriers</td>
<td>• negative discourse about VWs by their peers</td>
</tr>
<tr>
<td></td>
<td>• negative discourse about VWs by pre-service teacher educators</td>
</tr>
<tr>
<td></td>
<td>• negative discourse about VWs in society</td>
</tr>
<tr>
<td></td>
<td>• negative experience in the VW</td>
</tr>
<tr>
<td></td>
<td>• perceptions that VWs would not be used in K-12 schools</td>
</tr>
<tr>
<td></td>
<td>• perceptions that K-12 students would experience barriers</td>
</tr>
<tr>
<td></td>
<td>• their inexperience as a teacher</td>
</tr>
<tr>
<td></td>
<td>• their concerns about the safety of VWs for children</td>
</tr>
<tr>
<td></td>
<td>• perceptions about time requirements</td>
</tr>
<tr>
<td></td>
<td>• the amount of time they actually spent using VWs</td>
</tr>
<tr>
<td></td>
<td>• their level of access to the appropriate technology</td>
</tr>
<tr>
<td></td>
<td>• their level of skill in relation to the use of any technology</td>
</tr>
<tr>
<td></td>
<td>• the type of modelling they had received about how to use VWs</td>
</tr>
</tbody>
</table>
Gaby provides one example of the way in which pre-existing factors influence the positive engagement with VWs. Gaby was a highly motivated mature-age student who believed she needed to gain more technology skills in order to be competitive in obtaining a position as a classroom teacher. Gaby described herself as someone who liked to solve problems and undertake challenging tasks. She came to university with pre-existing experience of being a teacher due to her work in a Steiner preschool. She also exhibited what Dweck (2007) refers to as a growth mindset in that Gaby assumed that she would be no good at using VWs but she was determined to try to use VWs and do her best to become good at them; she perceived she could affect change in herself.

On the other hand, the students who believed they would be no good at VWs, that it would be too hard or time consuming, were not sufficiently motivated or were too fixed in their mindset about their capacity to change that they chose not to pursue the use of VWs. They exhibited what Dweck (2007) calls a fixed mindset. People with fixed mindsets are less likely to change, as they do not believe that they have the capacity to change. These mindsets formed part of the pre-existing perceptions and experiences that the students entered their introduction to VWs with.

Extrinsic motivation played an important role in influencing the choices that the students made in relation to their engagement with VWs. Students are cue aware, based on their ability to identify what is most important for them to engage with as part of their studies (Miller & Parlett, 1974). They make these choices primarily from listening to the discourse of the lecturer and pay particular attention to what they believe the lecturer demands in terms of assessment. As such, assessment becomes a key driver in motivating the students. In Cycle 2 students were asked to indicate what would encourage them to use VWs in the future, to which three of 12 respondents stated that if it would need to be an assessment item. In the units in which the use of VWs formed an assessment item six of the 25 responses indicated that they felt disadvantaged at being required to use VW as they usually get good grades using traditional tools such as essay writing. The mandatory aspect of the VW caused them anxiety, as they perceived the effort required was unnecessary and burdensome in order for them to achieve well.
Students were also extrinsically motivated by the skills they believed they needed to be a teacher in a classroom and who they perceived their future students to be. This factor is extrinsic as it is driven by a sense that they have to have certain skills especially when it comes to what has been specified by the requirements of curriculum and syllabus documents. In relation to their future students they believed that K-12 students would be highly engaged by VWs. This factor was consistent even with the students who did not want to use VWs. Forty-six per cent mentioned that VWs would be engaging for K-12 children. As such the perceived future engagement of children in the K-12 classroom is a factor that could be utilised by pre-service teacher educators to convince students to invest time in exploring ways that they could use VWs in a learning environment.

Barriers were expressed by students in a variety of ways and may have been physical or mental barriers that can be overcome through actions in relation to technical problems or issues or may require modelling by pre-service teacher educators or the design of particular resources. Four of the main barriers were discussed in Chapter 8 and included; time, access, emotional responses and the perceptions about K-12 classrooms/students. Barriers dominated responses given by students who were the most reticent about taking the first steps into trying to use the VW. The students had developed some of these conceptual barriers through actual experience and some were based on second-hand information such as stories they had been told or read. Those who were acting on second-hand information may have simply engaged with the content for the unit that included machinimas, articles, lectures and web resources and then made a comment about VWs without having immersed themselves in the VW. These perceptions (not based in experience) resulted in some students deciding not to proceed past barriers such as their feelings that their skill level would not be high enough or that the process would be time consuming. One of the ways in which to encourage students to overcome the barriers created through second-hand information was to make actual immersion into the VW a mandatory requirement. However, as I found in Unit 5 and Unit 6, and as discussed in Jacka and Ellis (2010) and Wilks and Jacka (2013), making the use of VW mandatory can generate negative student feedback that impacts on the future iterations of the use of VWs.
Identifying factors that include barriers, motivations, experiences and perceptions provided the underpinning elements upon which to design recommendations for future integration and implementation. Some of these factors have been previously identified as influential when introducing new technologies in education. However a number of them are unique to VWs and to VWs in pre-service teacher education. The 3D immersive environment that students encounter creates a visceral, new and often disorientating experience that challenges them. The expectations of a student in pre-service teacher education are often that they will be trained in the skills to be able to work in a school setting. When they are in an environment that is different to their traditional concepts of a classroom they can be significantly challenged.

While many of the factors that I have identified may be addressed by providing access to technology, support and modelling, the factor of the students overall expectations of their experience at university would require a systematic approach towards a new discourse about what school (and education) looks like. This may be considered a necessary part of a reconceptualisation of school, education and teaching-learning processes so that new technologies are effectively utilised.

9.2.2.2 Factors that influenced the pre-service teacher educators

The pre-service teacher educators displayed some similar pre-existing factors, such as being interested in new technology, willing to take a risk and being situated within a constructivist philosophy of teaching and learning. However each of them had different degrees of positive and negative perceptions and experiences in relation to VWs. This led me to work with them individually, to help them conceptualise the introduction, development and support of VWs in their units. Finding a balance between providing an introduction to VWs as part of an already dense workload of content, and achieving the potential benefits that come from a prolonged and integrated use proved to be extremely difficult due to the factors that influenced the pre-service teacher educators. Table 9.3 lists the various factors that were acknowledged by the pre-service teacher educators as influencing their experience and perceptions of VWs.
### Table 9.3 Factors that influenced the pre-service teacher educators

<table>
<thead>
<tr>
<th>Category</th>
<th>Factor</th>
</tr>
</thead>
</table>
| **Pre-existing** | • growth mindset  
                | • interest in new technology  
                | • constructivist teaching philosophy  
                | • willingness to take risks |
| **Motivating** | • include more technology in their unit  
                | • provide the students with the opportunity to do something that they could  
                |   not do in the non-VW  
                | • increase the students’ level of digital literacy  
                | • be able to collaborate across geographic locations  
                | • utilise the physics engine for science content  
                | • increase student centred learning activities  
                | • showcase the work that was already being undertaken in K-12 schools  
                |   (particularly that of Gaby)  
                | • offer the students a different way to respond to the unit content using the  
                |   3D space & building tools  
                | • challenge the students to take more risks  
                | • enhance a role-play activity  
                | • have a personal challenge |
| **Barriers** | • limited in the amount of time they could spend on VWs  
                | • personally uncomfortable with being an avatar  
                | • affected by the negative student feedback they received  
                | • restricted by their access to appropriate hardware  
                | • restricted by their skill level |

The pre-existing factors were notably similar across the six pre-service teacher educators. This is most likely due to the manner in which the pre-service teacher educators were recruited to undertake the research. The pre-service teacher educators already had an interest in working with new technology and believed in the important role that they could play in introducing their students to technology that would be valuable in the future classroom. I had spent the most significant amount of time, prior to the research, both in experiencing the VW and designing VW learning activities. The other five pre-service teacher educators had at least one prior
experience in VWs, which had influenced their perceptions and provided a basis from which they built their new perceptions about VWs for education.

Some of the motivating factors were specific to individual pre-service teacher educators and some were identified by more than one pre-service teacher educator. Jon was the most intrinsically motivated, as he wanted to challenge himself with using a new technology in a way that was unfamiliar to both himself and his students; he wanted a new challenge. Jon was the most persistent, other than myself. In Cycle 2 he offered the use of VWs as a voluntary activity to his students and, despite only a small uptake, he decided to make the use of VWs mandatory in Cycle 3. The factors that motivated him to make the change included: the quality of the work produced by the three students in Cycle 2 in terms of educational outcomes and VW experience; and the work that Gaby had been doing in the K-6 classroom. However, he encountered a barrier to continue to implement VW use with all students; namely, the negative student feedback he received. This demonstrated the extrinsic motivators that can impact negatively as discussed in Section 8.3.5.

The potential affordances of the VW were a factor that influenced all of the pre-service teacher educators. Each of them were introduced by me in our initial conversations, to what the VW might offer their students that they currently were not able to experience in the non-VW learning experience. As a result, Jane believed that VWs could provide the students with the opportunity to create a sustainable design project that was more authentic than the traditional way of completing this task. Alison redesigned her role-play scenario assignment to be undertaken within the VW early childhood centre to provide students with the simulated experience of being in an early childhood centre, dressed as an early childhood educator or parent and discussing the relevant issues.

The most extrinsically motivating factor was that the pre-service teacher educators all believed that VWs was a technology that would be used in the future classroom and therefore their students should be aware of it. Each of the pre-service teacher educators had slightly different views about whether the engagement with VWs, by the students, should be voluntary. Two of the six believed that the students should be required to explore the concepts of VWs for teaching and learning. Three of the pre-service teacher educators decided, that at this stage in time, a limited introduction was
adequate as it provided the students with the knowledge of VWs existence that would help them in their future teaching. These three pre-service teacher educators expressed the view that VWs were competing with a range of other technologies currently being used in the K-12 classroom, and that this, made it difficult for students to allocate time to develop knowledge, skills and resources.

Barriers have been consistently identified in the literature concerning VWs, and a number of publications that I have co-authored have focussed on pre-service teacher educators barriers (Gregory et al., 2015; Jacka et al., 2011; O'Reilly et al., 2015). The barriers that the pre-service teacher educators encountered in this research (Section 8.3) influenced the scale of implementation but did not stop the pre-service teacher educators from including VWs in their units. The range of barriers acted in tandem to restrict the manner in which pre-service teacher educators decided to further develop the integration of VWs. When asked about which barriers were most influential, two of the six indicated that the negative feedback they received from the students was the main barrier. However, one of these two pre-service teacher educators had also encountered other barriers; she felt uncomfortable about being an avatar as well as feeling that there weren’t enough other educators that she knew using VWs. Some of these barriers required intrinsic motivation to overcome, such as a prolonged use of an avatar and joining educator groups, while others required extrinsic support from the University, such as the need for negative student feedback to have less impact in the assessment of individual pre-service teacher educators performance. This indicates that barriers can, in some contexts be generalised but in many cases require an individualised approach with attention to the pre-existing factors and motivations.

9.2.3 Question three

The third question asked; what is the level of readiness to implement innovative teaching-learning processes using VWs do the pre-service teacher educators and students describe and display. In order to explore this question a number of models were developed over the period of this research. In the early stages, during Cycle 1, a checklist was developed to help educators to evaluate the capacity for VW environments to support learning in pre-service and K-12 education. The checklist provided a substantial list of factors that if identified in the VW would indicate whether the VW had potential value in an educational setting. The intention being that
if the choice of VW was based on the underlying value to the educational experience then the students would be more willing to engage with the VW. A phases of realisation model was developed from a small sample of students in Unit 3, Cycle 1. The phases of realisation emerged from the data as the students responded to the introduction of VWs in a manner that indicated the level to which they realised the potential significance of VWs in education. As more data was collected the model was extended and more detail was added that resulted in the Phases of Engagement model (see Section 8.4). This iteration of the model included five phases: pre-realisation, realisation, replication, reimagining, and implementation. The characteristics identified in the phases of engagement model can assist in identifying the pre-service teacher educators and pre-service teacher educators level of readiness to introduce, develop and support VWs and innovative teaching-learning processes. The final model that is the Level of Readiness is illustrated in Table 9.4 (student level of readiness) and 9.5 (pre-service teacher educator level of readiness) with a summary of the levels discussed in the following section.

9.2.3.1 Pre-service teachers' level of readiness

Table 9.4 provides details of the factors by which the students’ level of readiness can be rated. Each level is signified by a combination of the pre-existing perceptions and experiences, the motivating factors and the barriers that may have been highly restrictive or simply acknowledged with solutions offered. The level of readiness is described on a scale from very low to advanced.

The students who rated very low displayed resistance and gave responses that indicated that they could not see any benefit of VWs in education and that they could not envisage any way they would use them. They were resistant to the idea that VWs could be implemented in a K-12 classroom and, in turn, believed that it was a waste of their time to be learning about a technology that they would not be using in the future.

The next level indicates that the students were at a low level of readiness. At this level they had started to indicate a level of readiness to think about using VWs in education but were significantly hindered by barriers. At this level they were mixed in their pre-existing perceptions and experiences and wavered between being sceptical but appreciating that perhaps VWs should be investigated. Extrinsic motivators, such as
being required to undertake assessment tasks in VWs, had the effect of shifting some students from low to intermediate.

Most of the students were not required to be immersed in VWs and, as such, responses that discussed how they would use VWs were not necessarily based on actual VW experience. The intermediate level of readiness showed that the students discussed ways that they would use VWs based on a replication of traditional teaching-learning processes. The students who were required to use VWs in Unit 5, Cycle 3 mostly created work that was at an intermediate level of readiness (Section 6.5.3).

The high level of readiness was the point at which students showed they were ready to implement innovative teaching-learning processes facilitated by VWs. At this level they were describing how and why they would use VWs to implement teaching-learning processes that were different from the traditional transmission based models of teaching. They described complex, authentic and student centred activities. However they were unlikely to be actually implementing VWs due to the barriers that impacted on their capacity to do so such as having access to a class or having the technical confidence with the VW.

The final level of readiness is when the student has actually moved to using VWs with K-12 children. During this research only two students reported that they had been able to actually implement the use of VWs in a K-6 school. There were a number of barriers to them being able to apply the technology in schools. As pre-service teachers they needed the support from the schools they were working in, as well the confidence to implement a technology when they were unsure about how it would be received by the pre-service teacher educators and students at the schools. Gaby was able to implement VWs in the K-6 classroom because she had the support of an expert as well as the confidence to take a risk with an untested technology. It is most likely that students were unable to integrate VWs due to their lack of access to a classroom setting. When students are undertaking practicum placements they have restrictions on what they are able to undertake and they are in a high-pressure situation to perform well. It is unlikely that a student would take the risk to implement a technology that they were unfamiliar with. Doing so would require the student to have a pre-existing disposition to take risks and challenge themselves and their students.
<table>
<thead>
<tr>
<th>Pre-existing perceptions and experiences</th>
<th>Motivating factors</th>
<th>Barriers (may have a barrier from one of the preceding levels)</th>
<th>Teaching-Learning Processes</th>
<th>Pre-implementation</th>
<th>Intermediate</th>
<th>High</th>
<th>Implementation</th>
<th>Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Negative perceptions of VWs</td>
<td>• Could not see the benefit of using VWs in education</td>
<td>• Perceived amount of time required</td>
<td>• Not able to describe how VWs would be used</td>
<td>Very Low</td>
<td>Low</td>
<td>Intermediate</td>
<td>High</td>
<td>Same as Intermediate plus</td>
</tr>
<tr>
<td>• Negative experiences in VWs</td>
<td>• Would not use VWs in education</td>
<td>• Concerns about cyber-safety and addiction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Experience designing innovative teaching-learning process in a non-VW</td>
</tr>
<tr>
<td>• Negative experiences with technology</td>
<td></td>
<td>• Lack of access to technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Willing to take risks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Lack of skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-implementation</td>
<td>Implementation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Barriers focussed towards extending the use of VWs and assisting other students and teachers to use VWs</td>
</tr>
<tr>
<td>+ Positive perceptions of VWs</td>
<td>+ being required to satisfy an assessment task</td>
<td>+ experiences that were positive in the VW</td>
<td>+ Not enough modelling of different strategies for both the use of VWs and for the teaching-learning process in general</td>
<td>+ Same as Very Low but more willing to work to overcome the barriers</td>
<td>+ Lack of support within the institution (K-12 school) to actually implement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ Positive experiences with VWs</td>
<td></td>
<td>+ perceptions that VWs would increase K-12 student engagement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ Positive experiences with technology</td>
<td></td>
<td>+ perceptions that VWs would help them to meet standards set by teaching registration board to be a 21st Century teacher</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ Confident in their interactions with children in a classroom</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ Confident in their use of technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivating factors</td>
<td>Teaching-Learning Processes</td>
<td></td>
<td>Teaching-Learning Processes</td>
<td>Very Low</td>
<td>Low</td>
<td>Intermediate</td>
<td>High</td>
<td>Same as Intermediate plus</td>
</tr>
<tr>
<td>• + Positive perceptions of VWs</td>
<td>• Same as Very Low</td>
<td>• Described the way they would use VWs with traditional teaching-learning processes</td>
<td>+ Described how they would use VWs with an innovative approach to the teaching-learning process</td>
<td>+ Implementing VWs using an innovative approach to the teaching-learning processes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• + Positive experiences with VWs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Combining all of the student responses into the level of readiness model revealed the following percentages of students (Figure 9.4). Clearly the highest percentage of students were in an intermediate level of readiness that indicated that overall the students were able to conceptualise that VWs had a role to play in education but they were restricted by a variety of factors in relation their capacity to move into one of the levels that would mean they could conceptualise the use in an innovative teaching-learning process (high level) or that they would be able to actually implement the use (advanced level).

![Bar chart showing levels of readiness](chart.png)

**Levels at which students are ready to design innovative teaching-learning processes using VWs**

**Figure 9.1** Student level of readiness framework applied to all of the data.

When the level of readiness is applied across the three cycles (Figure 9.1) there is some shift in the level of readiness. There was an obvious drop in the percentage of students who were very low and low and a corresponding rise in those that were intermediate and high. While there are complexities inherent in the timing, the cohorts and the activities provided to these students some conclusions may be drawn. Due to the action research methodology undertaken in this research changes were made before and during the cycles in response to the feedback that the students were providing. These changes facilitated an increase in the level of readiness that the students were exhibiting.

Cycle 1 was the preliminary phase in which the concept of using VWs was very new to all of the students and the pre-service teacher educators. The students’ responses to
VWs in relation to the barriers they experienced were addressed in subsequent cycles. The effectiveness of the changes that were made is apparent in the shift in the students’ level of readiness. By Cycle 3 two of the students and I had utilised VWs in a K-6 school setting, thus providing a number of authentic examples. We had also shifted the emphasis from Second Life to other VWs that while more technically challenging for the new user, presented a more acceptable model of what could be used in a K-12 school.

9.2.3.2 Pre-service teacher educators' level of readiness

The pre-service teacher educators' level of readiness model (Table 9.5) distinguishes between pre-implementation and implementation phases with all of the pre-service teacher educators involved in this research being part of the implementation phase. The pre-implementation phases have been designed based on the indicators from the student data, factors drawn from my personal knowledge of pre-service teacher educators and the literature about the adoption of innovation in education. The six pre-service teacher educators that were involved in this research have been categorised at the varying degrees of implementation (Intermediate, High or Advanced).

I was the one pre-service teacher educators who was at the advanced level as I was implementing the use of VWs in both K-6 and higher education. I acted to initiate innovative teaching-learning processes whenever possible. However, I also experienced barriers to fully achieve complex, authentic and student-centred learning experiences. These barriers were associated with many of the factors listed in Section 9.3.2. Principally I was restricted in the unit that I taught by the pre-determined structure of the unit and the limited time allocated to VWs. The pre-service teacher educators in charge of the units decided what percentage of time was spent on any given topic within the unit. I was also restricted when I worked in other units by the time allocated by the pre-service teacher educators in those units. Barriers created by restrictions occurring at an institutional level, and often outside of the pre-service teacher educators control, are cited as a major factor influencing the continued use of VWs by university staff (Gregory et al., in print; Newman et al., 2013; O'Reilly et al., 2015).
One of the pre-service teacher educators was situated at a high level as he chose to require all students use the VW to design and create a resource as part of a lesson sequence. Jon was motivated intrinsically to extend his own teaching-learning processes. He was also motivated by his desire to extend the students ability to conceptualise student-centred learning. Four of the pre-service teacher educators were at an intermediate level with three of the four only including VWs in their unit for one cycle. Due to the short time frame and the small amount of time that they personally allocated to experiencing VWs their barriers to implementation remained at a similar level to when they started. The investment of time required to develop innovative teaching-learning processes to fully utilise the affordances of VWs appears from the pre-service teacher educators data to have hindered their capacity to move into a higher level of readiness. The intermediate level of implementation is the significant first step in which the design of the VW activities are replicating the traditional non-VW activity.
Table 9.5 Pre-service teacher educators' level of readiness

<table>
<thead>
<tr>
<th>Pre-existing perceptions and experiences</th>
<th>Pre-implementation</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very Low</td>
<td>Low</td>
</tr>
<tr>
<td>Negative perceptions of VWs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative experiences in VWs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative experiences with technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivating factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can not see the benefit of using VWs in education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Would not use VWs in education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Believes that there is no place for VWs in education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barriers (may have a barrier from one of the preceding levels)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived amount of time required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative discourse from other pre-service teacher educators, students and the university</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of technical support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of time to acquire skills and knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teaching-Learning Process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not implementing VWs as part of the teaching-learning process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not implementing VWs as part of the teaching-learning process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uses VWs in a manner that replicates their current teaching-learning processes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uses VWs with an innovative approach to the teaching-learning process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uses VWs with an innovative approach to the teaching-learning process</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 9.5 continues on the next page.
9.3 Recommendations

Based on the responses, factors and level of readiness the following recommendations can be made to assist the introduction, development and support of VWs in pre-service teacher education. A framework is proposed that if put into place will optimise the introduction, support and development of VWs to assist in the development and use of innovative teaching-learning processes. In the following section some of the initiatives that can be implemented at the university level (management, IT services and professional development services) and the School of Education level (Head of School, staff and students) are provided. Within each of the Tables (28 and 29) three levels at which the framework could be applied to facilitate a small, medium or wide scale adoption are described.

9.3.1 University

Laurillard (2002, p. 6) claimed that while it is assumed “when teachers think differently, they can act differently. Thinking differently is not a sufficient condition for acting differently, however. We must also be enabled to act differently. The institutional context must afford and encourage the actions we need”. Universities’ level of infrastructure and management is a key contributor in the process of promoting innovative teaching-learning processes. In O’Reilly et al. (in print) we argue that the introduction of VWs in university programs need to be aligned with pre-service teacher educators training, IT services, and a reconceptualization of the teaching-learning processes and learning design.

In the introduction and utilisation of VWs technical support from the IT services staff is vital. This includes those at a management level who are guiding the types of equipment and networking availability as well as the staff who assist the pre-service teacher educators and students with technical issues on a personal basis. While VWs can be used in a university without the complete support of IT departments, if a minimum level of support is provided then the innovators amongst the staff are more able to grow the use of VWs. As part of a separate study I was involved in during this research (Gregory et al., in print; Newman et al., 2013) we found that institutional support was a major factor in why pre-service teacher educators had stopped using
VWs. The data in this research confirmed that the pre-service teacher educators and students struggled due to the lack of support from IT, university management and the technology provided on-campus.

VWs have particular IT requirements in order that the user experience is as close to seamless as possible and that the user is able to experience a “suspension of disbelief” (Dede, 2009). With low-end graphics and slow processing speeds the experience can lead the user to feel that the experience is less than satisfactory when they are in a situation that is designed for learning. In all universities the staff and students are restricted by the IT services that are provided to them. In many cases the IT services are also restricted by what the university management determine is appropriate in terms of support and level of technology based on a variety of factors including budgetary constraints and overall philosophical goals of the university. If the university is motivated to provide and develop innovative technology then the commitment to fund innovation may be less of an issue. Table 9.6 outlines the recommended requirements for the university management, information technology services and professional development services in order to introduce, support and develop VWs at a small, medium and full scale.
### Table 9.6 Recommendations for introduction, development and support of VWs in a university

<table>
<thead>
<tr>
<th>Management</th>
<th>Small scale</th>
<th>Medium scale</th>
<th>Full scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single unit, program or school</td>
<td>Multi-unit, program or schools</td>
<td>Campus wide</td>
<td></td>
</tr>
<tr>
<td>Support voluntary use of VWs across the university</td>
<td>Mandate use of VWs in sections of the university</td>
<td>Mandate use of VWs across the university</td>
<td></td>
</tr>
<tr>
<td>Acknowledge work undertaken in the use of VWs</td>
<td>Acknowledge work undertaken in the use of VWs</td>
<td>Acknowledge innovative work undertaken in the use of VWs through the inclusion of case studies in reports, newsletters, media releases and awards</td>
<td></td>
</tr>
<tr>
<td>Provide funding to pilot the development of a VW environment</td>
<td>Generate positive discourse</td>
<td>Generate positive discourse through personal conversations, directives and acknowledgements</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Information Technology Services</th>
<th>Small scale</th>
<th>Medium scale</th>
<th>Full scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support networking between pre-service teacher educators who are using VWs</td>
<td>Support networking between pre-service teacher educators who are using VWs</td>
<td>Supporting networking between pre-service teacher educators who are using VWs and students</td>
<td></td>
</tr>
<tr>
<td>Develop models of best practice</td>
<td>Develop models of best practice</td>
<td>Developing models of best practice</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Professional Development Services</th>
<th>Small scale</th>
<th>Medium scale</th>
<th>Full scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training provided for pre-service teacher educators that includes technical skills and teaching-learning processes</td>
<td>Same as small scale but with a wider reach</td>
<td>Same as medium scale but with a wider reach</td>
<td></td>
</tr>
<tr>
<td>Support networking between pre-service teacher educators who are using VWs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop models of best practice</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9.3.2 School of Education

The discipline of education, within a university, is the only sector in which the act of teaching is that which is being taught. The teacher educator is engaged in the act of teaching adults about teaching children and as such they are required to both teach appropriately for adult learners and model practices that are appropriate for children. Lunenberg and Korthagen (2003) describe this, “teacher educators not only teach a subject (teaching), but are also role models for teaching. In this respect their profession is different from, for example, doctors teaching medicine” (p. 32).

Developing models of the teaching-learning process that do not necessarily mirror the models that pre-service teachers observe when in a K-12 classroom can be challenging and confronting for pre-service teachers. In order for the accepted integration of innovative technology to be successful pre-service teacher educators need to create an environment in which pre-service teachers are willing to explore new teaching-learning processes. This will only happen with a systematic and concerted endeavour by all levels of staff within a university.

Pre-service teacher educators’ need to be supported by their university as well as being intrinsically motivated about the use of VWs. Once they are using VWs with their students they can utilise teaching-learning processes that facilitate the best learning outcomes and model best practice. The students need a high level of extrinsic motivation and the removal of barriers in order to fully understand and utilise VWs, both in their studies and as a practicing teacher. The main extrinsic motivators need to be rewards that recognise the effort required by them in using and designing VWs environments. These would most commonly be in the form of assessment tasks and the affiliated grades and grade weightings.

Table 9.7 outlines the recommended requirements for the Head of School, pre-service teacher educators and students in a pre-service teacher program in order to introduce, support and develop VWs at a small, medium and full scale.
Table 9.7 Recommendations for introduction, development and support of VWs in a pre-service teacher program

<table>
<thead>
<tr>
<th>Head of School</th>
<th>Small Scale</th>
<th>Medium Scale</th>
<th>Full Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single unit</td>
<td>Multi-unit</td>
<td>Whole school</td>
</tr>
<tr>
<td><strong>Pre-service teachers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provide professional development to pre-service teacher educators who are interested in VWs that includes allocating time for them to develop skills and resources</td>
<td>Same as small scale plus</td>
<td>Design more complex VW learning experiences as part of a team of designers</td>
<td>Same as medium scale plus</td>
</tr>
<tr>
<td>Promote the work of pre-service teacher educators who are using VWs</td>
<td>• Generate a positive discourse about the use of VWs</td>
<td>• Join collaborative networks to discuss, critique and design VW learning experiences</td>
<td>• Research into the use of VWs within the School of Education and more widely across the university needs to be supported, encouraged and recognised as an important part of the mission of the school</td>
</tr>
<tr>
<td>Encourage a positive discourse about the use of VWs</td>
<td>• Provide funding to develop a VW environment that can be utilised by all pre-service teacher educators and students</td>
<td>• Mentor other pre-service teacher educators and students</td>
<td>• Take a leadership role in the use of VWs and in the process of change</td>
</tr>
<tr>
<td>Fund the development of a VW environment in one unit</td>
<td>• Design small VW learning experiences</td>
<td>• Conduct research and present work at conferences and in books and journals</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre-service teachers</th>
<th>Medium Scale</th>
<th>Full Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generate a positive discourse</td>
<td>Design small VW learning experiences</td>
<td>Design more complex VW learning experiences as part of a team of designers</td>
</tr>
<tr>
<td>Network with other VW educators</td>
<td>Join collaborative networks to discuss VW learning experiences</td>
<td>Join collaborative networks to discuss, critique and design VW learning experiences</td>
</tr>
<tr>
<td>Encourage the students to become involved in VW use in their units</td>
<td>Generate a positive discourse by promoting the work of other VW educators</td>
<td>Mentor other pre-service teacher educators and students</td>
</tr>
<tr>
<td></td>
<td>Provide students with opportunities to use VWs regardless of the set task</td>
<td>Conduct research and present work at conferences and in books and journals</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Students</th>
<th>Small Scale</th>
<th>Medium Scale</th>
<th>Full Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attend sessions run by pre-service teacher educators to introduce them to VWs</td>
<td>Same as small scale plus</td>
<td>Develop skills in VWs beyond any basic expectations driven by assessment</td>
<td></td>
</tr>
<tr>
<td>Practice VW skills in workshops and at other times</td>
<td>Design VW learning environments on a small scale in VWs such as Second Life and SoaS</td>
<td>Join networks of innovative K-12 teachers using VWs</td>
<td></td>
</tr>
<tr>
<td>Be open to trying to utilise VWs</td>
<td></td>
<td>Design VW learning environments on a larger scale in VWs such as Second Life and SoaS</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Implement VWs in K-12 schools</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mentor other pre-service teacher educators and students in the use of VWs</td>
<td></td>
</tr>
</tbody>
</table>
9.4 Suggestions for Further Research

There is a growing body of research into the use of VWs in education that includes pre-service teacher, K-12 education and the university sector more broadly. As I was undertaking this research a number of studies were published and at various stages I have referenced these new findings and built upon them. This research and my practice began to move into the use of VWs in K-6 education as I created opportunities to work in the school environment in order to create classroom examples of use for the pre-service teachers and pre-service teacher educators.

While this research has sown the seeds for the use of VWs in education across a number of subject areas and with a significant number of students only a small number of these students extended their use of VWs in their studies and into the K-12 classroom. A question that remains unanswered is to what extent has the introduction of VWs in the pre-service teacher education program at SCU impacted on the future teaching practices of the pre-service teachers in this research. A longitudinal research project that maps the use of VWs over an extended period of time and into the classroom would offer insight into the learning potential of VWs in both pre-service teacher education and K-12. This would require a longitudinal study that follows pre-service teachers who have been introduced to VWs into their professional practice to observe in what way their approach to the teaching-learning process develops and changes.

Six pre-service teacher educators were included in this research, however a number of other pre-service teacher educators were also exposed to the use of VWs as tutors within the units. These tutors were not directly included in this research and another unanswered question is to what extent did their perceptions and experiences influence the pre-service teachers. This would provide data about the impact that pre-service teacher educators outside of the main unit designer or lecturer have on the willingness of pre-service teachers to participate in the use of innovative technology and to conceptualise innovative teaching-learning processes. Anecdotal evidence from this research implies that the discourse generated by the pre-service educators who were tutors in the units did have an impact, particularly when the conversations reinforced the pre-service teachers’ perceptions. The main pre-service teacher educators in the
units also referred to their inability to control what the tutors said in tutorials and their awareness that tutor comments may provide mixed messages to the pre-service teachers. Further research could include observations of tutors in relation to the manner in which they present new ideas. The tutors could be given the opportunity to openly communicate to the researcher, who would need to be not directly connected to their continued employment, about their perceptions of the innovative technology and how they felt the pre-service teachers were responding. A comparison between tutors in similar contexts could be undertaken to determine whether certain attitudes were influencing the pre-service teachers in a manner that was counter productive to the motivations of the unit designer. Interventions could be provided in order to evaluate what processes need to be put in place in order to generate a discourse that critiqued the use of VWs without necessarily being critical.

Research that builds on the work I have done to date could start with a supported and fully integrated use of VWs in pre-service teacher education. Pre-service teacher educators and students would be tracked across a number of cycles. The pre-service teachers would be supported and encouraged to implement VWs in a K-12 context and to collaboratively develop resources that further extend the use of VWs. A community of practice would be created in which innovative ideas were supported, developed and rewarded. By creating this context in which to gather data the element that appeared to be most lacking from this research would be evident; the continuity of use of VWs in a manner that allowed the participant to build on their initial perceptions, experiences and skills.

This research has concentrated on the VWs of Second Life and Sim-on-a-Stick and their use in a university context. During this research differences were observed in the way in which children and K-12 teachers responded to VWs to the way in which the university pre-service teacher educators and pre-service teachers responded. This may be explained due to the pre-existing perceptions and experiences that K-12 children bring to VWs. It is likely that K-12 children’s views are related to, and derived from, game playing and, as such, a high level of engagement. They are less concerned with the educational value of the VW than pre-service teachers or pre-service teacher educators may be. Further research would be valuable to systematically investigate
the introduction of VWs in the K-12 context, evaluating responses and the factors that influence the K-12 teachers and children. Such findings’ results would usefully inform pre-service teacher programs and provide empirical evidence about the capacity for VWs to have a positive impact on K-12 education. The aim of this research would be to provide recommendations and examples that could be used to guide future practice and to influence the pre-service teachers to adopt VWs while studying in order to fully utilise VWs in their future teaching practice.
References


259


Halverson, R., & Shapiro, R. B. (2012). *Technologies for education and technologies for learners: How information technologies are (and should be) changing


Appendix A  Interview Questions

Before using VWs

Pre-service teacher educators and students

- What is their teaching philosophy?
- What is their learning philosophy?
- What are their beliefs and/or perceptions about using ICTs?

Pre-service teacher educators

- Do they feel they are able to implement their philosophy of teaching in their current teaching practice?
- Do they feel that the pre-service teachers are learning in the way that they wish them to?
- What are the barriers or not to realizing both the teaching and learning they desire?
- Can they imagine a different type of teaching and learning environment?
- What might that look like to them?

Students

- Do they feel that they have the opportunity to learn in the way that they want to?
- Can they imagine a different learning environment?
- What might that be/look like?

After using VWs

Pre-service teacher educators and students

- What is your teaching philosophy?
- What is your learning philosophy?
- What are your beliefs and/or perceptions about using VWs?
- Have any of these changed?
Pre-service teacher educators

• How has the use of the VW changed what they imagine teaching practice is for both themselves and their students?
• If so – what elements of the VW most contributed to this?

Students

• How has the use of the VW changed what they imagine teaching practice is?
• How has the use of the VW changed what they imagine learning is for both themselves and for their future students?
• If so – what elements of the VW most contributed to this?
Appendix B  Survey Questions

Survey 1 (Unit 3, Cycle 1,2,3)

• What is your gender?
• What is your current age?
• Do you use social networking applications?
• Do you play computer games?
• Are you familiar with the term ‘virtual world’ and understand what a virtual world is?
• Have you visited or experienced any virtual worlds?
• Can you see the possibilities for virtual worlds in the classroom?
• Please list any apprehensions you have about teaching and learning in a virtual world.

Survey 2 (Unit 2, 4, 5, Cycle 2)

• What is your gender?
• What is your current age?
• Which course are you enrolled in?
• Which of the following units are you enrolled in?
• During the semester you were given the option to use a virtual world as part of your assessment. Please indicate what was the single most important factor for you choosing not to use virtual worlds.
• I am interested in knowing more about ways to support students to use virtual worlds. Please indicate what would be the single most important factor that would encourage you to use virtual worlds in the future.
• A number of resources were made available as part of the units you were enrolled in. You may have chosen not to access any of them. Please indicate how useful you found each of these resources or whether you didn't access them.
• Other comments
Survey 3 (Unit 6, Cycle 2)

• What is your gender?
• What is your current age?
• In previous years the early childhood scenario activity required students to present a written response. This year you have undertaken a role-play using the virtual world Second Life. How did using the virtual world influence your response to the activity and your understanding of the scenario?
• How many times did you come into Second Life for this activity?
• Would you like the opportunity to undertake other University assignments and activities using a virtual world such as Second Life?
• Please feel free to make any other comments in relation to virtual worlds in education.

Survey 4 (Unit 5, Cycle 3)

• What is your gender?
• What is your current age?
• Have you used a virtual world before?
• Which virtual world did you use for the unit five assignment?
• Approximately how many times did you enter the virtual world to complete this assignment?
• Give the main reason why you chose Sim-on-a-Stick or Second Life.
• Chose one of the statements that best describes how you felt before you started this assignment.
• How did using the virtual world influence the type of lesson sequence you designed for the assignment?
• Indicate to what extent your perceptions of virtual worlds for education changed while undertaking this assignment. Likert scale.
• Describe one of the ways your perception has or hasn't changed.
• Would you like the opportunity to undertake other University assignments and activities using a virtual world such as Second Life
or Sim-on-a-Stick?

• What are some of the ways that you believe the use of virtual worlds could be facilitated in your studies at University?

• How likely is it that you will use virtual worlds in your teaching in the future? Likert scale

• What will be the single most important factor that will effect your decision to use virtual worlds in your teaching?
Appendix C  Background to Southern Cross University
School of Education Program

Southern Cross University - http://scu.edu.au/

Table C.1 shows the courses that were available in the School of Education at SCU during the data-gathering period of this research (2011-2013) and the locations at which the student could chose to study.

| Table C.1 Overview of the courses offered at SCU during the time of the research |
|---------------------------------|----------------|----------------|----------------|
|                                 | Distance | Lismore | Coffs Harbour | Gold Coast |
| Bachelor of Education (Early Childhood) |         | ✔      | ✔            | ✔           |
| Bachelor of Education (Primary)    |         | ✔      | ✔            | ✔           |
| Bachelor of Education (Secondary)  |         | ✔      | ✔            | ✔           |
| Bachelor of Technology Education  | ✔        |        |              |             |

A student enrolled in the Bachelor of Education (Primary) undertakes 32 units of study (of which 29 are compulsory). The program is made up of 3 units in English, 3 units in maths, 2 units in Science and Technology, 2 units in Creative Arts, 2 units in Human, Society and its Environments, 2 units in Personal Development, Health and Physical Education, 1 unit in Learning Technologies, 4 practicum units and a variety of units covering aspects of teaching such as positive behaviour support and supporting learners with disabilities. A student enrolled in the Bachelor of Education (Secondary) will already have an undergraduate degree in a suitable discipline for teaching in a secondary school in NSW. They will undertake 12 months of study in education including 4 general education units and 2 discipline specific units.

SCU uses the terminology unit to mean a unit of study similar to what might be termed a subject or a course in some universities. SCU also uses the term session to describe the block of time in which the unit is undertaken. The term session is used, as there are currently 3 sessions over the year when previously there were 2 semesters for every calendar year. The sessions run from February to June (session one), June to October (session 2) and October to the following February (Session 3).
A unit of study typically consists of up to 150 hours of study per session. In the School of Education most units have 10 designated teaching weeks to allow for practicum weeks when students are in schools. The rest of the University has up to 13 teaching weeks. Typically each unit will have a 1-hour lecture and 2-hour tutorial or workshop each week. Students are generally expected to spend up to 10 hours on a unit each week (including the lecture and tutorial/workshop).

Note that the program requirements and structure changes on a regular basis due to the requirements for pre-service teacher program in NSW adhering to guidelines put in place by the NSW Institute of Teachers (NSWIT). NSWIT is a regulatory board that oversees the registration of all teachers and teacher training programs in NSW. Recently there has been a transition taking place towards a central regulatory board that will oversee all of Australia called the Australian Institute for Teaching and School Leadership (AITSL) and the NSWIT has amalgamated with the Board of Studies to now be called the Board of Studies, Teaching and Educational Standards NSW (BOSTES).
Appendix D  Biographic Information

How I came to be interested in innovative ICTs and education is important in declaring my personal investment in the research I have undertaken. In many ways my career has been a series of opportunistic paths resulting in a portfolio career typical for a woman of my generation. I have not undertaken this research at the end of my undergraduate studies as used to be the traditional model. I have arrived at this point having studied and worked in the areas of the Visual Arts, Media and Education.

My undergraduate degree is in Visual Arts from the South Australian College of Advanced Education (SACAE). I completed my degree at the end of the 80s and the closest I came to utilising digital technology was the Umatic tape video editing suite similar to those used in television broadcasting. I had specialised in photography and when my first professional work was at the Adelaide Advertiser as a photojournalist. It was 1991 and Rupert Murdoch had decided to introduce colour to his Australian newspapers. The ability to add colour photographs and graphics to a newspaper was facilitated by the graphic interfaces of the Apple Macintosh and applications such as Adobe Photoshop. I was chosen to be the one who would be trained to use this new technology even though my qualifications seemed to be that I was young and smart. At the time I didn’t realise how significant that choice was but I clearly had an aptitude for the technology.

For a long time after I finished working at the Adelaide Advertiser I avoided computers because of the cost and the conflict I had about what my art practice was and whether technology had a role to play. It wasn’t until 1995 that I started to realise that there could be a connection between the use of technology and my own art practice. I had moved from Adelaide to Sydney and began working for Australian Associated Press (AAP) in the picturegram room and the photo-library. Both these areas were using early digital imaging technology. I was also enrolled in a Graduate Diploma of Art at Sydney College of the Arts (SCA). At SCA, in 1994, they had five computers and I was encouraged to link the skills I was developing at AAP with my
art practice. I continued to produce photographs using wet processes however the technology had not yet matched what I could achieve with the traditional process.

A year later I was living in Lismore, NSW and had been invited to join a group of female students at SCU who were interested in using computers for creative pursuits. We formed a group and designed websites using the computers in the laboratories at SCU. I enrolled in the Honours program and spent 1996 researching, writing and building a website. The turning point for me in terms of my engagement with technology was that I could create and share and I could afford to have my own system to do it when and how I wanted. I was developing websites in which I could add my creative content.

I had never intended staying in Lismore and in 1997 there was very little work for someone with my skills and very limited capacity to connect with the opportunities that city life brings. My partner and I moved to Melbourne and in 1998 I started working in a high school as an art technician. There I discovered I had an aptitude for teaching. A strong team of art teachers supported me to undertake my Graduate Diploma of Education (Secondary), which I did externally with the only technology support being an audiotape sent of one recorded lecture. I had hoped for more from Monash University at the time as I had been using the Internet at home albeit very slowly. During my time working as an Art technician and as a Visual Art, Media, Visual Communication and Design teacher I introduced technology to pre-service teacher educators and students. Significantly I initiated girl’s only computer classes and encouraged everyone to include the use of technology across discipline areas.

After four years in Melbourne we moved again, this time to Townsville. I discovered that I had a perfect combination of skills for teaching in a School of Education at a university. I had worked in industry, in a classroom, I could use and trouble shoot technology, I had creative problem solving skills and I was increasingly concerned about making sure teachers of the future were engaging children. I was employed at James Cook University as a casual lecturer.

The move into university teaching facilitated the push for me to do research and undertake a PhD. I came across an article about SCU using Second Life by chance. I
had seen Second Life in a TV documentary in 2004 and at the time felt that it was going to be really exciting but I was unable to adequately access it due to the limitations of the technology I had access to. When I came across the article about SCU implementing VWs I knew that this would be an opportunity to research an emerging technology and the way that a university was going to do that.
Appendix E  Copies of Publications

DVD attached inside back cover includes all literature published by the author during the course of this research.

Opening the DVD will reveal a folder called “Publications”. Inside this folder is a Microsoft Word document called “Index_of_Publications”. Each of the publication files are hyperlinked to this file.

Note: Content not included in the electronic copy