Exploring the Affordances of Online Learning
Environments: 3DVLEs and ePortfolios in Second
Language Learning and Teaching

by

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Abstract

Post-secondary education is facing unprecedented and exciting change with the emergence of online learning platforms such as 3-dimensional virtual learning environments (3DVLE) and ePortfolios as extensions of the physical classroom. This dissertation explored the *affordances* of these two online learning environments in the context of second language learning and teaching. The concept of affordance is defined in this dissertation as a characteristic of the space that facilitates learning. Upon a review of 3DVLE and ePortfolio studies, five key affordances were identified which have been linked to reported learning benefits. To position the affordances in practice and for research purposes, this dissertation reviewed the theoretical landscapes from the fields of education, second language acquisition (SLA), and computer assisted language learning (CALL).

This manuscript dissertation includes one unpublished article, one published article and two published chapters. The unpublished article provides context for the trajectory of research included herein (Hartwick, 2017). The published article (Hartwick, 2018) investigates research methods used in traditional classroom-based interaction studies to identify suitable approaches for studies in 3DVLEs. The published chapters are case studies of the two online learning spaces. In the first instance, we explored learning theories in relation to affordances of 3DVLEs to substantiate practice (Hartwick & Savaskan Nowlan, 2018). The second chapter describes an ePortfolio practice *done-well* based on evidence from student surveys and instructor assignments (Hartwick, McCarroll, & Davidson, in press). To further our understanding of learning potential in these spaces, research is best situated at the intersection of theoretical elements (e.g.,

critical thinking, Dede, 2007) and characteristics of affordances (e.g., immersion, Dalgarno & Lee, 2010). Early studies suggest that the affordances of 3DVLEs and ePortfolios will facilitate achievement of 21st century skills such as self-reflection, when practice is *done well* (Hartwick & Savaskan Nowlan, 2018; Hartwick, McCarroll, & Davidson, in press).

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And just like that, it's over!

Throughout my PhD journey I often felt quite alone but looking back at the last five years it was remarkably full of many good, good people. I am grateful to my fellow classmates from the 2013 cohort; this has been quite a ride! I am grateful to the influential professors, friends, and colleagues who I have worked or studied with over the years in the School of Linguistics and Applied Language Studies (SLaLS) and at the Educational Development Centre (EDC). I am of course thankful to Ali Arya for getting me into this mess in the first place when he approached me to use a 3DVLE for language teaching! Also, to John Osborne and Randall Gess, thank you for believing in me and supporting the proposed 3D virtual Carleton initiative.

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Preface

This manuscript dissertation includes one unpublished manuscript (Chapter 5), one published peer-reviewed journal article (Chapter 6), and two published peer-reviewed chapters in edited books—one published (Chapter 7) and one in press (Chapter 8). The unpublished manuscript (Chapter 5) is reproduced in full in this dissertation, with no changes made to the most recent version submitted for publication. Each of the three published texts (Chapters 6–8) are reproduced in full, with no changes made to their content or formatting. Should the reader wish to cite any of these, they should use the bibliographic information of the original publications, as provided below:

- Chapter 5: Hartwick, P. (2017). *Beyond the survey: Observing pedagogical interactions in a 3D virtual learning environment*. Unpublished manuscript.
- Chapter 6: Hartwick, P. (2018). Investigating research approaches: Classroom-based interaction studies in physical and virtual contexts. *ReCALL*, 30(2), 161–176.
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- Chapter 8: Hartwick, P., McCarroll, J., & Davidson, A. (in press). What is ePortfolio “done well”? A case of course-level analysis. In B. Eynon & L. Gambino (Eds.), *Catalyst in action: Case studies of high-impact ePortfolio practice* (pp. 184–196). Sterling, VA: Stylus.

As per article 12.4, sections C and D of Carleton University's Graduate Calendar, the published article and two book chapters have been reprinted with permission. I confirm that I am the primary author of the co-authored texts in Chapters 6 and 7; in both cases, I was fully involved in setting up and conducting the research, including collecting and analyzing data. I was also the primary author in preparing and writing both texts. Permission to publish these texts has been granted by my supervisor and co-authors and provided as separate documents (Appendix A–D).

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List of Abbreviations

3DVLE	3D virtual learning environments (see Glossary)
CALICO	Computer-Assisted Language Instruction Consortium
CALL	Computer assisted language learning
CEFR	Common European Framework of Reference for Languages
CMC	Computer mediated communication (see Glossary)
EAP	English for Academic Purposes
ELP	European Language Portfolio
HCI	Human computer interaction
HIP	High impact practice
LEPO	Learning Environment, Learning Processes and Learning Outcomes
LINC	Language Instruction for Newcomers to Canada
LMS	Learning management systems
PBLA	Portfolio based language assessment
SLA	Second language acquisition (see Glossary)
VI	Virtual input (see Glossary)
VoIP	Voice over Internet protocol
VW	Virtual worlds

Glossary

21st century learner. A 21st century learner is engaged, independent, and technologically savvy. A 21st century learner is a life-long learner who focuses on development of skill and knowledge.

21st century learning outcomes. The achievement of specified learning outcomes related to content knowledge and skills such as critical thinking and communication.

3D virtual learning environment (3DVLE). An internet-hosted space designed to replicate real places and objects and provide online users the opportunity to interact with other users synchronously through voice, movement, or text.

Affordance. In this dissertation, an affordance is defined as a characteristic of an online space that facilitates or promotes learning.

Adaptability. An ePortfolio affordance that explains the ease at which users can edit and link multi-modal artifacts, thereby creating flexible and visual representations of learning that demonstrate creativity and critical thinking.

Artifact. A 3D rendered object that exists in a digital environment designed to complement the space and/ or task. In reference to ePortfolios, an artifact is a text or image, digital or otherwise, that provides evidence of learning.

Asynchronous. Physical or virtual interaction that is not synchronous or not in the same moment of time.

Case study. A qualitative research study that investigates the development of one group, one person, or one space over a period of time.

Catalyst for Learning Framework. An evidence-backed framework used by ePortfolio practitioners to measure or build best practices.

Computer Mediated Communication. Synchronous or asynchronous communication between learners that is mediated or facilitated electronically.

Construct. Key elements from Second Language Acquisition theories such as *input*, or a conceptual idea such as the concept of *affordance*.

Constructed theory. Theory that borrows from multiple theoretical domains but has an element of independence.

Domain. In reference to a field or discipline of knowledge.

Elements. An aspect or part or idea drawn from theories in education, SLA, or CALL such as *interactive*.

ePortfolio. An ePortfolio is an electronically hosted space used in education to showcase students' work and learning progress through digitally enhanced or created artifacts.

Fidelity. An affordance of 3DVLE that refers to the authenticity or realness of the online learning space that gives users a sense of *being there* and leads to real-time social interaction, experiential and situated learning.

Immersion. An affordance of 3DVLE such as synchronous or real-time text, voice and movement which is enhanced by customizable avatars and leads to social interaction and collaborative learning.

Integrated (manuscript) PhD. A series of related studies or research papers that make up the PhD dissertation and demonstrate a program of research during a period.

Learning analytics. System captured units of time spent on task, time spent in a location, or frequency of interaction in a 3DVLE.

Mixed methods. An approach to research that involves the use of quantitative and qualitative methods and data.

Paradigm. A worldview or belief that underlies a theory or approach.

Pragmatism. An epistemological, sensible approach to research that draws on multiple theoretical lenses and recognizes the role of experience, environment, and interaction.

Persistency. An affordance of an ePortfolio that refers to the persistent or “always on” nature of the space that leads to ease of feedback and editing.

Second Language Acquisition (SLA). A scientific discipline that studies the factors and processes involved while learning a second or other language.

Second Life. A free 3D virtual world platform hosted by Linden Lab and used in many 3DVLE studies.

Synchronous. Physical or virtual interaction that happens at the same time.

Virtual Input (VI). Non-linguistic input that exists in the online learning space and is meaningful to the learner according to their experiences with language or in the world.

Visibility. An affordance of the ePortfolio referring to the degree at which information can easily be located; the multi-layered nature of the platform leading to opportunities for feedback, integrative learning, and investment of time and effort.

Chapter 1

Introduction

Our understanding of learning has expanded at a rate that has far outpaced our conceptions of teaching. A growing appreciation for the porous boundaries between the classroom and life experience, along with the power of social learning, authentic audience, and integrative contexts, has created not only promising changes in learning but also disruptive moments in teaching.

—Bass, 2012, p. 23

In Mason's (2002) *Researching your own practice: The discipline of noticing*, he illustrates the importance of active noticing and reflection to bring about positive change in practice; he suggests that change will happen if and when the practitioner notices and records incidents or patterns in practice that they would like to change. I suspect that at some point I noticed a gap, incident, or disruption in my teaching practice which led me to experiment with online learning spaces in my course design and delivery. This in turn led me to record the impact of my changing practice through early research observations and studies toward the completion of my PhD. Importantly, the act of noticing and recording has made me accountable to my practice. Consequently, this journey of research is about situating my practice and experience in theory in order to refine my teaching practice and promote relevant learning experiences for my students.

With a growing interest in online course design and delivery at the provincial, institutional, and practitioner level in post-secondary education in Canada and globally, there has been and will continue to be a proliferation of online learning tools and environments (see, for example, Bass, 2012; Bates, 2015; Garrison & Anderson, 2002;

Lawrence, 2018). As such, it is imperative that the quality of education and learning experiences are not undermined by poorly designed and poorly facilitated courses. Parker (2008) notes that the delivery of quality online learning experiences must see past the funding and hype to ensure that course design and delivery is much more than simply moving a course online; the quality of online courses in post-secondary education needs to be reconceptualised “by – not *to* – the academy” (p. 312, italics added). I argue that online teaching contexts should be selected and evolve according to theoretically guided practice and they should be regularly vetted to ensure key learning principles remain the foundation of space and course design whether in face to face, blended, or online teaching contexts.

Throughout this dissertation, I focus primarily on two online learning spaces, 3D virtual learning environments (3DVLEs) and ePortfolios. A 3DVLE is defined as a 3-dimensional, Internet-hosted space in which users communicate with the space or other users in real-time. An ePortfolio is an online space in which students provide evidence of learning (e.g., writing samples, reflections) through an integrative process of connecting and reflecting on learning. The affordances or benefits of these online spaces are what contribute to increased opportunities for interaction, collaboration, and reflection—all of which positively impact learning. 3DVLE studies often connect learning to the affordances and benefits of these spaces (see, for example, Dalgarno & Lee, 2010; Matsui & Ahern, 2018; Peterson, 2012), while ePortfolio studies stress the positive effects of the practice, where the space affords opportunities for integrated and reflective learning (Bass, 2012; Eynon & Gambino, 2017; Kuh & O’Donnell, 2013).

Rather than ignoring the affordances of new technologies and online spaces in post-secondary education, educators have a responsibility to evolve practices by embracing the affordances of online learning spaces (Savin-Baden, 2008). However, given the ever-changing digital landscapes in education, institutions, researchers, and practitioners often lack clarity in terms of which pedagogical theories should guide them. Given the frequency with which online landscapes for learning change, the debate as to the role of technology in learning (Clark, 1994; Kozma, 1994) is likely not as relevant; hence, the focus of my research is on *how* and *why*, not *if*, affordances of online spaces support learning, specifically language learning in academic contexts.

My position within the program of research

According to Holzemer (2009), “A program of research is defined as an area of high interest and passion to the person defining it. You must be committed to the area so that your interest can be maintained over time” (p. 1). Although Holzemer speaks from the context of healthcare, his definition speaks to me as it easily applies in other domains, such as education, computer assisted language learning (CALL), and second language acquisition (SLA)—all of which are overlapping domains in my research agenda. Throughout my doctoral research trajectory, I have continued to be intrigued by the affordances of online spaces for teaching and learning, and I remain passionate about finding answers to questions that help define and account for learning in these online spaces.

The concept of affordances is discussed at length in Chapter 2. To summarize, in this dissertation, it is defined as a characteristic of an online space that facilitates learning. How can we (teachers) transform the learning experiences for our students by

designing engaging activities in interactive online spaces in today's online teaching and learning contexts? This question guides my research and teaching practice, as I believe the affordances of these spaces, when used properly, promote learner engagement and skill acquisition. These affordances are particularly relevant for learners in my English for Academic Purposes (EAP) course who need opportunities to use language and gain skills in English that will help them succeed in their future academic studies. The program of research described in this dissertation represents my ongoing efforts to seek answers to the above and other questions. The research program described herein is thus situated within the larger context of my own teaching practice and research agenda, past, present, and future.

The journey started in 2011 when I was approached by a professor from the School of Information Technology who wanted to know if I would design and pilot a language learning task for a newly designed 3DVLE. The Internet-hosted online space had been designed by a group of his graduate students. Being a novice to 3DVLEs and with no prior gaming experience, I was unaware of what lay ahead in terms of designing and facilitating a language learning activity for my EAP students. The challenge was both daunting and exciting. What followed was a growing passion and curiosity about the use and viability of online learning spaces for primarily language learning and teaching.

My earliest observations of EAP students interacting in 3DVLEs suggested that students were genuinely engaged when the task was challenging, relevant, and generated opportunities for language production (Arya, Hartwick, Graham, & Nowlan, 2012). Also, in relation to task and space design, I observed that activities which maximize the use of the online space are most successful; however, tasks used in face to face teaching

contexts are not easily transferable to these new spaces. These observations have shaped and guided my research agenda, which can be seen as one long case study in which I remain an active participant, researcher, and practitioner. Throughout this journey I have unpacked the role of the affordances of space in my teaching practice and accepted the challenge of task development to make the best use of these affordances. I have also aimed to address gaps as they have appeared in mine and other scholars' research to better explain how and why affordances of space impact learning. This research agenda informs my practice and supports my students in their own learning trajectories.

Since 2011, I have experimented with both blended and fully online lessons, drawing on an assortment of tools and spaces, including 3DVLEs and ePortfolios. The former provides a rich online learning environment in which students interact in real-time using voice, text, and movement. The latter provides students an online space in which to practice language and academic skills, reflect, and demonstrate learning outcomes for both formative and summative assessment.

My early exploratory research in 2012 included piloting the Information Technology professor's 3DVLE space with one of my EAP classes as an optional space for group presentations. This experience was reported in a journal article (Arya et al., 2012). At this point I realized the need for a stronger theoretical underpinning, and so I began my PhD studies in 2013. Since my entry into the doctoral program I have explored several related areas: the need for an instrument to analyze recorded interactions in 3DVLEs (Chapter 5); the types of research approaches best suited to online learning spaces (Chapter 6); the impact of activity/task design on interaction in 3DVLEs (Chapter 7); the theoretical underpinnings of online learning from multiple perspectives (Chapter 3

and Chapter 7); and the impact of ePortfolio pedagogy on student achievement (Chapter 8). In sum, this program of research supplies a reinvigorated, richly informed theoretical framework which informs and is informed by on-going empirical research.

Rationale for a manuscript PhD

Due to the relative novelty of online learning environments for language learning and the complexity created by overlapping research domains, I chose to do a manuscript PhD, as it combines multiple studies within one overarching research agenda, thereby capturing the integrative and progressive nature of my work. Briefly, a manuscript PhD integrates multiple articles as opposed to a traditional dissertation which is one extended document or monograph. McGill University's website (Preparation of a thesis, 2016) describes the manuscript PhD as "...a collection of scholarly papers of which the student is the author or co-author..." and for which the "...papers cannot alone constitute the thesis" (para. 15). Similarly, Section 12.4 of the Carleton University Calendar (2018), describes the document as a coherent and unified project that consists of published student manuscripts on a common topic integrated into a theoretically cohesive dissertation.

While more common in engineering and sciences (Carleton University, 2018), the manuscript PhD format is more conducive to my program of research than a traditional dissertation for several reasons. First, the multi-part format mirrors the systematic approach I have taken throughout my PhD to investigate several branches of my central focus on the affordances of online learning. Second, the ever-changing and relatively new topic of online learning environments in language learning and teaching supports multiple areas of research, and so research conducted in multiple stages and presented in

multiple publications is a logical way to respond to and report on multiple facets of the overarching problem and sub-problems being investigated. A manuscript PhD thus suited my dissertation as I investigated a larger problem in smaller units within a shifting and sprawling research context. It should be noted that references cited in this dissertation appear at the end of each chapter, a requirement of the manuscript PhD, which differs from the traditional PhD genre in which all references are cited following the concluding chapter.

The 21st century learner

Throughout this manuscript there are references to the *21st century learner* and *21st century learning*. Tony Bates, keynote speaker at the 2017 World Conference for Online Learning and leader in the field of teaching and learning online, argued that education is changing and while content is clearly important, it is no longer enough; learners need skills. Perhaps of most relevance to my own EAP learners in terms of preparing them linguistically and academically to actively engage in university study are skills such as critical thinking, problem solving, communication, and collaboration. These skills are a recurring theme throughout this dissertation. As an introduction, below is a description of the 21st century learner and the importance of recognizing a paradigm shift in education.

According to Prensky (2006), the 21st century student has evolved to include both digital natives and lifelong and global learners. Many scholars (e.g., Bransford, Brown, & Cocking, 2000; Haythornthwaite & Andrews, 2011; Illeris, 2003; Prensky, 2006) assert that educational content is no longer limited to knowledge acquisition, but includes skill and competency development, and the traditional classroom space is no longer restricted

by time and place. They conclude that effective teaching includes opportunities for learning, not simply the synchronous transmission of information.

The extension of the classroom across time and place may include, but is not limited to, 3DVLEs and ePortfolios. Indeed, the delivery of post-secondary education has shifted to include a myriad of these online learning spaces; as such, an understanding of how the affordances of these spaces contribute to learning—in my case, language learning—may help educators and designers develop meaningful tasks. Further, investigating how learners interact with and because of these online learning spaces has the potential to positively influence teaching practices and contribute to students' success and overall achievement of learning and 21st century outcomes. These outcomes not only include mastery of academic content, but also of 21st century skills such as critical thinking, problem solving, and global awareness (Dede, 2010).

Gaps

The use of 3DVLEs and ePortfolios for language teaching and learning is relatively new, and so there are a host of research opportunities for rigorous empirical study. For example, research in relation to 3DVLEs and language learning has been criticized for being largely under-theorized, anecdotal, exploratory, and descriptive in nature (Connolly, Stansfield, & Hailey, 2011; Peterson, 2006; Twining, 2010). Reinhardt and Sykes (2012) point out that the trans-disciplinary nature of 3DVLEs lacks research that clearly specifies the space, pedagogy, and methodology. They suggest that future studies need to account for the role of task in relation to contemporary theories in CALL and incorporate theories in relation to time and space. Others have called for more empirical study of 3DVLE tasks that suit the affordances of the space (Dalgarno & Lee,

2010) and investigate how learners interact in and with the space (Lan, Kan, Hsiao, Yang, & Chang, 2013; Peterson, 2006; Sykes, Oskoz, & Thorne, 2008). Milton, Jonsen, Hirst, and Lindenburn (2012) argue, “the challenge for language learning in these environments is to engineer tasks which require learners and native speakers to interact and where a condition of success in the task is the meaningful use of language” (p. 101). This statement can equally apply to language learning and ePortfolios.

In relation to ePortfolios, while some research investigates the practice in relation to 21st century and higher order skill development such as written communication (Mazlan, Sui, & Jano, 2017), there appears to be little research pertaining to the affordances of ePortfolios, especially in relation to EAP. Further, within the broader scope of ePortfolio literature in tertiary education, ePortfolios are often undefined or unspecified (Challis, 2005) and there is a lack of a clear understanding of the concept of audience (Buyarski et al., 2015; Gallagher & Poklop, 2014). ePortfolio studies are also largely descriptive in nature (Bryant & Chittum, 2013) and often focus on student and teacher perceptions or attitudes as opposed to achievement of outcomes, skills, and retention rates (Eynon & Gambino, 2017). Similarly, Deneen, Bron, and Carless (2017) claim that ePortfolio research has not yet investigated key areas of assessment, such as assessment validity (Bryant & Chittum, 2013; Buyarski & Landis, 2014). Abrami and Barrett (2005) state that despite the reported benefits for the learner, including a flexible learning process and space, deciding on a valid assessment practice is challenging because knowing what to measure or how to measure non-traditional evidence of learning—such as digital artifacts—is based on judgement and therefore not always reliable. There is also a need for empirical data that links theory to outcomes and supports the

learning benefits of ePortfolios in relation to outcomes (Abrami & Barrett, 2005; Bryant & Chittum, 2013). Abrami and Barrett (2005) claim there is a need for comparative studies that explore advantages and disadvantages of both ePortfolios and paper-based portfolios and lack of clarity in terms of methods.

Particular gaps that have motivated my research direction are the lack of a clearly defined theory that supports teaching and learning in these spaces owing to their affordances, and the lack of clarity about assessment practices which suitably reflect changes resulting from a networked world (Dalgarno & Lee, 2010; Dede, 2003; Loke, 2015; Savin-Baden, 2008; Siemens, 2005). Such theory requires a comprehensive review of literature from multiple domains, including education, CALL, and SLA. Whereas socio-cultural theories are often implied in the literature, in my view these fail to convincingly connect to theories in CALL and SLA. Further, research should consider what is happening in the spaces in terms of how users interact with it and because of the affordances. The 3DVLE and ePortfolio each need to be clearly defined and understood according to how they may facilitate or mediate learning as the affordances differ accordingly. This perspective is expanded in Chapters 2 and 3.

With a clearly specified theory that considers the affordances of the learning spaces, practitioners and designers will be better prepared to establish best practices in terms of identifying measurable learning outcomes that lead to knowledge acquisition, language development, and demonstration of 21st century learning skills in the context of an EAP program. I argue that research efforts to better understand what is happening in these spaces should include observation of student activity and engagement as a

consequence of the affordances of the space and how these spaces might promote skill development and language learning through specific task-types.

Research objectives and questions

My experiences designing online learning spaces, creating tasks, facilitating lessons, and generally researching the affordances of 3DVLEs and ePortfolios for language teaching and learning have left many unanswered questions, questions which I am only now just beginning to understand because of the process of preparing this dissertation. What I have learned through this cumulative process will importantly contribute to our understanding of the validity and function of these spaces based on their affordances; the need for a relevant blended or constructed theory; the importance of task design; and the need for clearly articulated learning outcomes. My research builds upon research in multiple domains and attempts to go beyond existing research in CALL by: (1) establishing sound methods including an observational tool and analytical framework; (2) illustrating the learning benefits according to the affordances of each space; and (3) building a constructed theory¹ to account for how people learn based on the affordances of the space. The work herein is intended to help designers and practitioners create effective learning spaces and may help justify allocation of funding and support by institutions interested in developing programs that make use of these learning spaces.

The questions presented in Table 1.1 have helped me to understand how to

- Record what's going on in the 3DVLE space;
- Research interaction in physical and virtual contexts;
- Situate the affordances across multiple domains and apply to practice;

¹ The term “constructed theory” was borrowed from Hubbard and Levy (2016) and has been interpreted in this dissertation to mean drawing on multiple theories to situate practice and research.

- Explain the impact of ePortfolio pedagogy, when done well, in terms of providing a rich space for reflection and integrated learning.

Consequently, my objective is to understand how and why these online learning spaces may have the ability to enhance current and future language teaching practices, promote learning, and change learner behaviour in a positive way. These learning spaces may prove to be more motivating for certain individuals and could result in increased program availability to those learners previously limited by time and place. For universities and other stakeholders, online language course delivery, whether blended or fully online, could help increase international student enrolment and capture a niche market of International and “digitally savvy” audiences. Table 1.1 outlines key research questions and indicates the chapter in the dissertation that addresses each question. A citation is provided for each manuscript (see Preface for more on citing the manuscripts).

This manuscript PhD allows for the presentation of preliminary findings which have guided my work thus far. The research included herein reflects the open-ended nature of a manuscript PhD. In its entirety, the dissertation includes: background information about and a definition of affordances; a description and definitional framework of the 3DVLE and ePortfolio spaces; a critical review of theory in relation to the affordances across multiple domains, including education, SLA, and CALL; a methods section that supports the published manuscripts; and the manuscripts, published and not, that have provided evidence of research outcomes. In the concluding chapter, Chapter 9, I consider the limitations of my research and explore future directions.

Table 1.1

Overview of Research Questions, Location of Manuscripts in the Dissertation, Status, and Bibliographic Reference

Research Question	Chapter	Status	Bibliographic Reference
How do researchers record and categorize interactional data in 3DVLEs? What observational tools do they use in 3DVLEs studies?	5	Unpublished manuscript	Hartwick, P. (2017). <i>Beyond the survey: Observing pedagogical interactions in a 3D virtual learning environment</i> . Unpublished manuscript.
What research approaches have been used to investigate classroom-based interaction in both physical and virtual settings, particularly in the context of language teaching and learning in and around virtual worlds? What are the benefits and limitations of these approaches?	6	Published, double-blind peer review	Hartwick, P. (2018). Investigating research approaches: Classroom-based interaction studies in physical and virtual contexts. <i>ReCALL</i> , 30(2), 161–176.
What are the pedagogical perspectives that inform instruction in 3DVLEs based on the affordances of space? How might 3DVLEs be used to enhance 21 st century learning skills in English for Academic Purpose (EAP) classrooms?	7	Published, double-blind peer review	Hartwick, P. & Savaskan Nowlan, N. (2018). Integrating virtual spaces: Connecting affordances of 3D virtual learning environments to design for twenty-first century learning. In Y. Qian (Ed.), <i>Integrating multi-user virtual environments in modern classrooms</i> (pp. 111–136). Hershey, PA: IGI Global.

What is the impact of ePortfolio practice done well in an advanced level EAP course? How does an ePortfolio practice contribute to integrated and reflective learning, characteristics of 21 st century learning?	8	In press (expected publication date 9/2018), edited volume	Hartwick, P., McCarroll, J., & Davidson, A. (in press). What is ePortfolio “done well”? A case of course-level analysis. In B. Eynon & L. Gambino (Eds.), <i>Catalyst in action: Case studies of high-impact ePortfolio practice</i> (pp. 184–196). Sterling, VA: Stylus.
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Chapter 2

Affordances, 3DVLEs, and ePortfolios

As noted in Chapter 1, 3DVLEs and ePortfolios need to be clearly defined and described as a space according to their affordances and potential learning benefits. This chapter begins by defining the concept of an affordance followed by a definitional framework for the two learning spaces under investigation.

Affordances

The concept *affordance* is widespread and used across many disciplines, including communication studies and human computer interaction (HCI), yet it is variously defined in the literature (Davis & Chouinard, 2016; Evans, Pearce, Vitak, & Treem, 2017; McGrenere & Ho, 2000). The ambiguity of the term is misleading, thereby weakening the validity of research touting the benefits of affordances. This chapter establishes a clear definition of the concept to examine the affordances of technology in language learning and teaching contexts.

Gibson's (1979) early definition of an affordance describes it as an action possibility provided by the environment, whether acted on or not. In contrast, Norman's (1988) definition of affordance relates to what is perceived or actual regarding the characteristics of an object or thing; if the user does not see or perceive the affordance, then it is not one. In Figure 2.1, McGrenere and Ho (2000) compare features of Gibson and Norman's conceptualization of the term. A significant difference is the influence of the actor's experience.

Gibson's Affordances <ul style="list-style-type: none"> • Offerings or action possibilities in the environment in relation to the action capabilities of an actor • Independent of the actor's experience, knowledge, culture, or ability to perceive • Existence is binary – an affordance exists or it does not exist
Norman's Affordances <ul style="list-style-type: none"> • Perceived properties that may or may not actually exist • Suggestions or clues as to how to use the properties • Can be dependent on the experience, knowledge, or culture of the actor • Can make an action difficult or easy

Figure 2.1. McGrenere and Ho's (2000, p. 3) comparison of Gibson and Norman's concepts of affordances (reproduced with permission as acknowledged).

Recognizing the difficulty in defining the concept of affordance, Davis and Chouinard (2016) propose another model that explains what, for whom, and in which circumstances an affordance exists. Their model explains an affordance in relation to behaviour within a specific context and assumes that an affordance varies in degree in relation to the user's purpose and the context. In Davis and Chouinard's model, three conditions of an affordance are identified: perception, dexterity, and cultural and institutional legitimacy. Much like Norman's definition, the user's perception of the function is necessary, as is their ability to use a feature; if the user is not aware of the functionality or affordance, then it is not an affordance. So, not only does the user need to realize the affordance, they need to be able to manipulate and use it. For example, in the case of an ePortfolio, the user might know that they can embed multi-media to demonstrate evidence of learning, but if they do not know how to manipulate these features, then the space does not afford opportunities to be creative.

In another attempt to clarify the concept of affordance, from the field of computer mediated communication (CMC), Evans et al. (2017) clarify the concept of a possibility for action that lies “between an object/ technology and the user that enables or constrains potential behavioural outcomes in a particular context” (p. 36). Evans et al. argue that research must critically view an affordance as something that helps mediate behaviour towards an outcome. They identify three steps in the validation of a supposed affordance: (1) confirm the affordance is not a feature of the technology; (2) confirm that the affordance is not an outcome of the behaviour; and (3) confirm the affordance is variable in terms of degree or gradation. In an analysis of concepts used in 188 articles from 11 different journals, Evans et al. apply these three criteria to substantiate reported affordances. Their analysis reveals that anonymity, persistence, and visibility meet the criteria established for an affordance, whereas privacy, collaboration, and features of an object do not. They define *anonymity* as the degree to which the source of a message being communicated is perceived as unknown; *persistence* as the durability and accessibility of the communication; and *visibility* as the degree to which communication or information can easily be located.

I interpret Evans et al.’s explanation to mean that an affordance is a characteristic of the learning space that promotes or facilitates learning outcomes. For example, in the case of an ePortfolio, if multi-media is a feature of the technology (space), and creativity is an expected learning outcome of the behaviour or task, then the affordance of adaptability leads to creative, flexible, and visual representation of learning, or learning

benefits, which includes embedding multi-modal artifacts². This model supports my research as I investigate what the environment affords that facilitates learning.

The term *affordance* is frequently used in research pertaining to CALL and 3DVLE literature. Molka-Danielsen, Mundy, Hadjistassou, and Stefanelli (2012) report on the interactive nature of these environments and define an affordance as “...a quality of an environment which allows an individual to perform an action” (p. 3). From a pedagogical perspective, Dalgarno and Lee (2010) scan twenty years of research to identify commonly cited characteristics of 3DVLEs which distinguish these platforms from other interactive forms of multimedia. The authors categorize affordances of 3DVLEs according to two main features, fidelity of space and learner interaction. They claim that fidelity of space leads to users’ sense of “being there” (presence), which in turn increases the likelihood of user interaction. In terms of language learning and task design in 3DVLEs, Chapter 7 of this manuscript further explores learning theories in relation to affordances of 3DVLEs, namely fidelity of space and immersion.

Reinders and Hubbard (2013) list many pedagogical advantages of CALL resources—i.e., *affordances*—including authenticity, interaction, and monitoring and recording of learning behaviour and progress. While ePortfolios are not as commonly researched in the CALL literature (likely because they are used in many pedagogical contexts and not just language teaching), an article by Golonka, Bowles, Frank, Richardson, and Freynik (2014) lists ePortfolio as an effective technology due to their affordances of learner autonomy and the emphasis on process, not only product. The distinction between process and product is important because the ePortfolio literature rarely uses the term *affordance* explicitly. Instead, ePortfolio scholars make reference to

² An artifact is a text or image, digital or otherwise, that provides evidence of learning.

ePortfolio benefits such as authentic assessment (Abrami & Barrett, 2005; Fox, 2017) and the act of connecting and reflecting (Lorenzo & Ittleson, 2005; Penny Light, Chen, and Ittelson, 2012). In describing ePortfolios, Roberts, Maor, & Herrington (2016) differentiate between the paper-based portfolio and the ePortfolio according to adaptability, depth of evidence, and audience. According to their descriptions, I understand *adaptability* to mean the ease to which ePortfolios can be edited; *depth of evidence* as the ability to link to external sources; and *audience* as the persistent and portable format. Based on these conceptualizations of affordances, especially the three-step validation process proposed by Evans et al. (2017), persistence, visibility, and adaptability are some of the key affordances of ePortfolios.

Though the definition of affordances is at times unclear, in this dissertation I define an affordance as a characteristic of a space that facilitates or promotes learning. For my purposes, I focus on the affordance of *fidelity of space, immersion, persistence, visibility, and adaptability* (see Table 2.1). The affordance of fidelity of space pertains to 3DVLEs and leads to many learning benefits such as, experiential and mediated learning, and real-time social interaction that allows for problem solving and knowledge construction. The affordance of immersion in 3DVLEs leads to the user's sense of presence, which helps with social interaction by lowering anxiety and also leads to experiential, negotiated, and collaborative learning.

Regarding ePortfolios, the affordance of persistency refers to a persistent point of reference that leads to selection, collection, and reflection and makes feedback accessible and connections in learning visible. The ePortfolio affordance of visibility and multi-layeredness makes it easier for the learner to invest time and effort, integrate learning,

and seek frequent and timely feedback. The affordance of adaptability means that the learner has a range of tools and media at their disposal to construct knowledge and create visual representations of learning that demonstrate critical thinking and creativity.

Table 2.1

Affordances and Associated Learning Benefits of 3DVLEs and ePortfolios

Affordances of 3DVLEs	Learning Benefits	Citations
Fidelity of space/ visually rich	<ul style="list-style-type: none"> • Experiential learning mediated by others or object • Real-time social interaction that leads to construction of knowledge and problem solving (as examples) 	<ul style="list-style-type: none"> • Berns, Gonzalez-Pardo, & Camacho (2013) • Dalgarno & Lee (2010) • Lan, Kan, Hsiao, & Yang (2013) • Peterson (2011)
Immersion and sense of presence created through gestures and customizability	<ul style="list-style-type: none"> • Extensions of self • Social interaction/ community • Lower anxiety • Leads to experiential, negotiated, and collaborative learning (as examples) 	<ul style="list-style-type: none"> • Dalgarno & Lee (2010) • Lan et al. (2013) • Liang (2012) • Milton, Jonsen, Hirst, & Lindenburn (2012) • Matsui & Ahern (2018) • Peterson (2012)
Affordances of ePortfolios	Learning Benefits	
Persistency (persistent point of reference)	<ul style="list-style-type: none"> • Selection, collection, reflection • Self-assessment • Accessible feedback • Visible connections 	<ul style="list-style-type: none"> • Clark & Eynon (2009) • Evans et al. (2017) • Penny Light, Ittelson, & Chen (2012) • Roberts et al. (2016)
Visibility (multi-layeredness)	<ul style="list-style-type: none"> • Investment of time and effort • Integrative learning • Frequent feedback and timely feedback 	<ul style="list-style-type: none"> • Bass (2012) • Evans et al. (2017) • Eynon, Gambino, & Török (2014) • Roberts et al. (2016)

Adaptability (flexibility)	<ul style="list-style-type: none">• Range of digital tools/ media• Construct knowledge and create visual representations of learning• Demonstrate critical thinking and creativity	<ul style="list-style-type: none">• Abrami & Barrett (2005)• Clark & Eynon (2009)• Roberts et al. (2016)
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3D Virtual Learning Environments

A description of 3DVLEs necessitates an explanation of the concept *virtual*, which is used liberally in the context of online education and educational technologies, as in *virtual learning*, *virtual teaching*, *virtual education* and *virtual worlds*. While each of these terms denotes something slightly different, readers might reasonably assume a notion of distance in terms of space or separation between teacher and learner or between learner and learner. Similarly, a blog or wiki used for a designated learning activity outside of class time or posting a pre-recorded lecture on a course website is considered, by some, virtual teaching. Virtual worlds (VWs) may be considered a basic virtual display wherein designers have added videos or pictures for the user to select and interact with. In these cases, although the content is virtual, it is only interactive to the extent that the user has the option to switch between different content. These virtual worlds are neither immersive nor 3D in content, but rather 2-dimensional with interactive content and designed for a single-user. On the contrary, 3DVLE refers to worlds, spaces, or environments that are immersive, Internet hosted, multi-player, and include avatar agents and players.

3DVLEs are multi-user environments where avatars communicate in real-time using voice over Internet protocol (VoIP) or synchronous text and movement which lead to an increased number of interactions in the target language (Chung, 2012; Gee & Hayes, 2011; Ibáñez et al., 2011; Peterson, 2006, 2012; Warburton, 2009). Aptly defined by Harris and Rea (2009), “a virtual world is a computer simulated environment that enables users to interact with each other without geographical confines. Each user is represented by an avatar” (p. 138).

In this dissertation work, I am interested in the affordances of the virtual space in which users interact. For instance, Hartwick (2017) notes that in a 3DVLE users have the illusion of interacting with real objects and in simulated spaces, because the environments can be designed to graphically replicate real world places or scenarios wherein users can manipulate an avatar (a personalized representation of themselves) to purposefully communicate with other users' avatars using VoIP to accomplish a task. Additionally, users can interact with physically represented artifacts, such as chairs and tables, and some web-based tools, such as collaborative writing surfaces and text functions. The purpose of the interaction is determined by the assigned task and desired learning outcomes (Hartwick, 2017). Consequently, 3DVLEs are learning spaces that promote social interaction, and interactions that engage the learner in activities that promote the construction of knowledge (Blake, 2008; Chapelle, 2000). Chapters 5 and 7 of this dissertation provide a more thorough definitional context, including images, of the particular 3DVLE used throughout my program of research.

ePortfolios

The second online learning space under investigation is the ePortfolio. Portfolios, whether electronic or paper-based, represent “ongoing selections of learning and development over time” (Fox, 2017, p. 135). Much like a personal webpage or wiki, students collect and provide evidence of learning through text and multi-media artifacts. The ePortfolio literature typically presents these platforms as tools for authentic assessment (Abrami & Barrett, 2005; Buyarski & Landis, 2014; Penny Light et al., 2012); a form of alternative assessment (Fox, 2017); a high impact practice (HIP) (Eynon & Gambino, 2017; Kuh, 2008); or an integrative social pedagogy (Eynon & Gambino,

2017; Lewis, 2017)—but they are rarely discussed according to their affordances.

However, ePortfolios are potentially viable online learning spaces according to their perceived benefits and affordances in the same way that the affordances of 3DVLEs facilitate learning. Below I explain the background of ePortfolios, beginning with the paper-based portfolio, in relation to language teaching and learning.

A paper-based portfolio is described as a collection of student writing that provides a range of evidence of a learner's progress that (it is assumed) stems from learner engagement, reflection on learning, and response to feedback. In other words, portfolios demonstrate students' learning over time (Fox, 2014; Hamp-Lyons & Condon, 2000). Generally, there are two types of portfolios: a working portfolio and showcase portfolio. The former represents a more formative and process-oriented approach, while the latter is a final or summative representation of student work (Fox, 2014). The reported benefits of portfolios included increased active learning, self-reflection, interaction with the teacher, and autonomous learning (Fox, 2014; Fox & Hartwick, 2011; Little, 2009).

Portfolios emerged as alternative forms of assessment or assessment *for* learning (Barrett, 2006) in response to changing assessment practices in Europe and Canada (Fox, 2014; Little, 2009). For instance, college-level writing programs and language programs moved from summative to formative assessment practices because of the reported learning benefits of portfolios related to self-directed, learner-centred, communicative, and autonomous learning (Hamp-Lyons & Condon, 2000; Little, 2009). Writing assessment portfolios were designed to measure a more complex variety of assigned writing tasks in a changing educational landscape. These assessment practices are linked

to notions of authentic assessment in which practice is deemed to be collaborative and knowledge constructed (Williams, 2014).

Despite the intended benefits of formative assessment and portfolios for learning, portfolios have come under fire because of how and what is being assessed. As portfolio assessment is tightly integrated with instruction, it was a challenge to account for the context of teaching in the practice of assessment and determine exactly what is to be assessed (Hamp-Lyons & Condon, 2000). Hamp-Lyons and Condon (2000) praise portfolio assessment “because portfolios help teachers help learners assume more responsibility for their own learning...” (p. xv). While this is an admirable stance, it is not always the case. In describing the expected benefits of the European Language Portfolio (ELP), Little (2009) explains how the language portfolio was designed to promote learning by doing and learner autonomy based on the Common European Framework of Reference for Languages (CEFR) “I can” statements; however, he claims that the reported benefits from reflective language learning are not always attainable as students are unable to self-assess.

While the ELP has by all accounts been successfully implemented (Little 2009), Fox’s (2014) case study of portfolio-based language assessment (PBLA) in LINC (Language Instruction for Newcomers to Canada) classes suggests that portfolios have not achieved the same success in Canada. Fox (2014) found that despite the expected benefits of PBLA, lack of student buy-in and misalignment in teachers’ delivery caused the assessment practice to shift from formative practice (the intention) to summative assessment, thereby mitigating the value of the practice. According to Fox (2014), the challenge of buy-in might be linked to students’ expectations and beliefs about

assessment practices, especially for those students from different educational cultures (Deneen et al., 2017). The intention was that PBLA would move assessment from summative to formative because of the frequency of feedback, students' active noticing, and student's ability to self-assess; however, students are not always convinced that this type of assessment practice is legitimate as compared to traditional tests or writing assignments (Fox, 2014). Fox reported that some teachers felt more accountable to their practice because of PBLA, but most felt that PBLA made assessment practices more frequent and summative in nature. Further, the lack of student buy-in resulted in a shift with the PBLA to assessment *of* instead of *for* learning. The intended benefits were grounded in the belief that learning would be autonomous and student-centred, but (incorrectly) assumed students were motivated and able to self-assess.

With the advent of technology, digital media, and online teaching, there has been a shift in practice from paper-based portfolios to ePortfolios. An ePortfolio is web-based and allows students to collect, store, and showcase evidence of learning, either in real-time or asynchronously. A report published by the Higher Education Quality Council of Ontario (Hinton et al., 2017) defines an ePortfolio as a “digital collection of files often used as part of a job application, professional development, planning or assessment of learning outcomes (p. 9). Lorenzo and Itteson (2005) define an ePortfolio as “a digitalized collection of artifacts, including demonstrations, resources, and accomplishments that represent an individual, group, organization, or institution” (p. 2). Meanwhile, Abrami and Barrett (2005) describe ePortfolios as “digital containers capable of storing visual and auditory content; software for which may also be designed to support a variety of pedagogical processes and assessment purposes” (para. 1). An

ePortfolio is like a digital archiving system wherein users collect and store pieces of work that have been purposefully selected for an intended audience. ePortfolios are “defined by the mantra: collect, select and reflect” (Clark & Eynon, 2009, p. 18). Accordingly, an ePortfolio is an electronically hosted learning space used in education to showcase students’ work and learning progress. In this space learners provide evidence of meeting learning outcomes through critically placed artifacts, whether text-based, multi-modal, or digital representations of learning, such as embedded media.

Unpacking the affordances of ePortfolios is a challenging task because of the different assessment practices and platforms associated with them. Like in paper-based portfolios, there are two main assessment practices depending on the type of electronic portfolio: a showcase portfolio and a process or working portfolio. Essentially, the former characteristically provides evidence of accomplishing certain competencies, while the latter demonstrates evidence of the learning process (Abrami & Barrett, 2005; Fox, 2014). Showcase ePortfolios focus on the illustration of learner competencies, which are often presented in the form of a digital artifact. Evidence of learning is often constructed as a final collection or documentation, usually aligned with a summative assessment practice. Process-based ePortfolios, on the other hand, focus on frequent feedback and the developing of a student’s ability to reflect and self-assess (Abrami & Barrett, 2005; Fox, 2014). Process-based ePortfolios assume learning is an integrative, reflective, and social process that occurs over time, where outcomes are achieved through an iterative and creative process (Eynon & Gambino, 2017; Lewis, 2017).

Further ePortfolio assessment practices are deemed authentic, as they focus on the assessment of higher order skills (Abrami & Barrett, 2005). A report prepared for the

Higher Education Quality Council in Ontario (Hinton et al., 2017) identifies higher order skills as essential learning outcomes, including skills like critical thinking, written and oral communication, and integrated learning through connection making and reflection (Lorenzo & Ittleson, 2005; Penny Light et al., 2012). Many of these skills align with 21st century learning theories reviewed in Chapter 3. I understand this to mean that ePortfolios have the potential to move beyond simply selecting and collecting evidence, but also provide learners a space to practice and demonstrate these higher order skills through reflection and integration of experience and knowledge.

To further complicate the unpacking of affordances, like 3DVLEs there are also different platforms used in ePortfolio studies, including Web 2.0 tools like Wordpress.com or Wikispaces, to commercial platforms like PebblePad or open source platforms like Mahara (Barrett, 2006; Clark & Eynon, 2009; Lorenzon & Ittleson, 2005). These different ePortfolio platforms may have different affordances. Moreover, the context may vary, as ePortfolios are used in many programs (e.g., visual arts, nursing, pre-service teacher education) and at different levels (e.g., K-12 to tertiary education, at the course, program, or institutional level) (Clark & Eynon, 2009; Lorenzo & Ittleson, 2005). The study reported in Chapter 8 refers to a course-level investigation of ePortfolio practice in an EAP course (Hartwick, McCarroll, & Davidson, in press).

Compared to paper-based portfolios, the ability to easily integrate a variety of multi-media artifacts such as audio, video, and graphics make ePortfolios flexible and adaptable, thereby affording iterative and reflective learning processes (Abrami & Barrett, 2005; Barrett, 2006; Bryant & Chittum, 2013; Clark & Eynon, 2009). Additionally, the easy integration of multi-media and user-generated content helps

learners demonstrate higher-level competencies such as critical thinking and connection making (Clark & Eynon, 2009; Penny Light et al., 2012). Moreover, the persistent nature of ePortfolios allows for frequent and easy accessibility lending itself to peer and/or teacher feedback and opportunities to self-assess and reflect, reported to help develop 21st century and higher order skills (Roberts et al., 2016). Personalized learning experiences, more flexible outcomes, and opportunities to reflect are other reported benefits that help the learner make sense of their learning process (Penny Light et al., 2012). Further, as a social pedagogy, ePortfolios have recently been identified as a high impact practice (HIP), like first year seminars, and are positively correlated to student retention and achievement in post-secondary education (Eynon & Gambino, 2017). Based on these reported benefits, the ePortfolio promises to move the student from novice to expert as they work towards achieving learning outcomes related to content or skill in a space where progress can be easily demonstrated (Deneen et al., 2017).

Despite the reported benefits of ePortfolios, the literature does not clearly identify affordances in relation to associated learning benefits and outcomes. Moving forward, I argue that ePortfolios, like 3DVLEs, are unique because the affordances facilitate learning. This is the basis of inquiry throughout the dissertation. In Chapter 3, I provide an in-depth review of theories from several domains including education, SLA, and CALL, which have helped to situate and guide my research.

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Chapter 3

Making Sense *with* Theory

To move forward, to know where to invest our energies, we have need of theory.

—Kaptelinin & Nardi, 2006, p. 23

Theories bring order out of chaos.

—Long, 2007, p. 22

Much of the literature pertaining to learning in 3DVLEs is situated in sociocultural theory (Vygotsky, 1986), including constructed (Dede, 2007), mediated (Kaptelinin & Nardi, 2006), or experiential (Gee, 2007) accounts. Similarly, studies relating to ePortfolios are commonly situated in constructivist theories (e.g., Abrami & Barrett, 2005; Eynon & Gambino, 2017), self-regulated learning theory (e.g., Wade, Abrami, & Sclater, 2005), situated learning theory (e.g., Batson, 2011), and integrative social pedagogy (e.g., Eynon & Gambino, 2017). This *theory buffet* (Levy & Stockwell, 2006, as cited in Hubbard & Levy, 2016) has blurred the lens through which I have attempted to investigate the affordances of online learning spaces in my own research. In which of these theories did my research best belong? To further complicate things, in which domain was my research best situated—education, second language acquisition (SLA), or computer assisted language learning (CALL)? The concept of affordances of space—defined in Chapter 2 as a characteristic of the space that can facilitate learning—became increasingly important.

Consequently, this chapter systematically unravels terms from various learning theories (e.g. Vygotsky, 1986), SLA theories (e.g. Krashen, 1982), and CALL theories (e.g. Chapelle, 2000) in order to situate my own research and the concept of affordances.

In this process, I use the term *element*, which I define as an integral component, characteristic, or part of a theory, like the terms social, mediated, and integrated. This chapter helps illustrate the depth of theoretical possibilities, which in turn contextualizes my program of research. What transpires is the “drilling down” (Fox & Hartwick, 2011) of elements from multiple theories, beginning with general learning theories.

Learning Theories and Learning into the 21st Century

This section is motivated by my own pedagogical experiences using various digital spaces for teaching EAP, including learning management systems (LMS), ePortfolios, and 3DVLEs. As noted earlier and throughout my program of research, I have tried to understand which theoretical approach or combination of approaches best accounts for how people learn according to the affordances, and what are recurring elements across theories. A common thread throughout this dissertation is the importance of drawing on multiple theoretical approaches to better understand or capture the affordances of each online learning space, 3DVLEs and ePortfolios.

My practical understanding of learning theories suggests that no one theory adequately accounts for how people learn in online spaces. This thought is confirmed in the literature by experts like Anderson (2008), Dede (2003), and Haythornthwaite and Andrews (2011), who call for a new or modified learning theory in these contexts. Indeed, the background section of the publication submitted in Chapter 7 of this dissertation acknowledges the complexity of accounting for how people learn with respect to more well-known learning theories such as behaviourism and constructivism, as they fail to consider the affordances of the online space. Chapter 7 begins by exploring elements from general learning theories in relation to 3DVLEs to help inform a series of

activities designed for an EAP class. The challenge in preparing to write this publication was identifying the many elements from existing learning theories that might best inform practice in these ever-changing online learning contexts. Although Chapter 7 includes a thorough analysis of multiple learning theories, I will briefly summarize the results of the analysis below to better situate the reader.

In language teaching, classroom practice has moved beyond dictation, imitation, and rote learning towards more individualized learning paths that focus on promoting critical thinking and problem-solving skills. Therefore, a move towards more contemporary, social approaches to learning, including social and persistent online spaces that nurture critical thinking and promote skill development, is warranted. This includes elements from learning theories that guided 20th century practice, like practice and rote, and elements from learning theories and approaches in the 21st century—mostly socially motivated—that highlight the affordances as a mediator of interaction and skill development. The following summary focuses on elements from multiple learning theories and frameworks that have most guided my research, such as Bransford et al.’s (2000) four lenses of learning and Dede’s (2010) framework for learning in the 21st century. These in turn influenced my choice to look to an analytic framework by Phillips, McNaught, and Kennedy (2012) that closely captures the process of learning I have observed in 3DVLE and ePortfolio spaces. The analytic framework is explained in the methods chapter, Chapter 4, and in the publication in Chapter 7.

In the manuscript in Chapter 7, I and my co-author (Nuket Savaskan Nowlan) draw on multiple learning theories to unpack important elements³ (see Table 3.1)

³ Note: In Chapter 7 we use the term *characteristic* instead of *element*. In the dissertation I have chosen to use *element* to differentiate from the use of *characteristic* in reference to affordances in Chapter 2.

including *practice* and *repetition* derived from behaviourist theories, and elements like *active learning* and *collaboration* derived from socio-cultural theories. As we note in the chapter, elements of constructivist and socio-cultural theory are also evident in 21st century pedagogies. For instance, Vygotsky's (1986) social view of learning is especially prevalent in contemporary theories of learning wherein learning is believed to be *active*, *social*, and *collaborative*, among other things. Following a review of behaviourist, cognitivist, and constructivist learning theories, Chapter 7 captures elements from a range of more contemporary learning theories and approaches that help to make sense of learning into the 21st century. These include digital competencies (Siemens, 2005), higher order skills like critical and connective thinking (Dede, 2007; Siemens, 2005), physical experiences in online spaces (Loke, 2014; Savin-Baden, 2008), the role of Internet and technology (Prensky, 2006; Scardamalia & Berreiter, 2006), and the role of learning space (Gee, 2007; Savin-Baden, 2008).

Table 3.1

Learning Theories and Relevant Elements

Theory	Theoretician(s)	Element (s)
Behaviourism	Skinner (1957)	Drill, practice, repetition
Cognitivist	Gagne (1985)	Skills and strategies
Constructivist/ Socio-cultural	Dewey (1896), Piaget (1959), Vygotsky (1986)	Interactive, constructed, supported, prior knowledge and experiences
Connectivist	Siemen (2005)	Networked, digital, socially connected, digitally savvy
Space	Gee (2007), Prensky (2006), Savin-Baden (2008)	Digital and physical experiences, ubiquitous
21 st Century	Dede (2007, 2010)	Skills & content, digital literacy, collaboration, problem-solving

It is evident that theories and approaches to learning are numerous and diverse. I have shown how terms like *connected*, *experiential*, *negotiated*, *intentional*, *collaborative* and *interactive* are key elements in these theoretical approaches, but a consideration of the affordances of space in learning, whether physical or virtual, is especially pertinent for understanding how people learn in online spaces. For my purposes, I suggest that the focus of research include observation of student activity and engagement as a consequence of the task and the specified affordances. As such, understanding what is happening in and because of the space is critical to any theoretical approach to learning in 3DVLEs and ePortfolios. Further, as the focus of my research pertains to learning a second or other language in an academic context, a review of key constructs from SLA theories is also necessary. As such, this next section critically examines key constructs from SLA theory to understand how they may or may not contribute to my own program of research in terms of how learners interact with and in 3DVLEs and ePortfolios and because of the affordances of these learning spaces.

Second Language Acquisition Theory

Chapter 7 and the above summary illustrate which elements from learning theories and 21st century learning theories best resonate with my program of research, but how does my research connect to SLA theories and how do SLA theories help explain language learning and acquisition in 3DVLEs and ePortfolios? These are important questions, as my participants are second (or additional) language learners, and so a review of key SLA theories is a necessary part of my dissertation. The following review of SLA theories is arguably longer than the section on learning theories, as the review does not appear in any of the publications included in this dissertation. The review is

interpreted in relation to my program of research and my growing understanding of the affordances of space, namely fidelity of space, immersion, persistency, adaptability, and visibility (see Table 2.1). As such, the focus is on affordances of space, learning, and linguistic and virtual interaction. I assume that learning is active and includes interaction with others, objects in the environment, and with the environment itself. I also assume that opportunities for interaction, collaboration, experiences, and knowledge construction are presented in the learning environment and because of the affordances of the space.

As in general learning theories, the theoretical scope of SLA includes a multitude of perspectives, including cognitive, psychological, educational, linguistic, and social – theories that seek to understand the learner and the learning process (Ellis, 2008). While interdisciplinary due to its relative novelty as a field, Long (2007) believes that the proliferation of SLA theories is problematic because of the comparative differences and disconnect to language teaching theories and research. As such, I begin with a brief historical account of SLA theories followed by a critical presentation of key constructs, such as input, output, noticing, and interaction as understood by key theorists namely: Krashen, Swain, Long, and Schmidt. Their theories consider how second languages are acquired by investigating the role of input and/ or output and the role of conscious or unconscious awareness and attention to form; further, they consider the differences between production and comprehension in relation to learner acquisition.

Historical Account

Historically, SLA theories have drawn on theories from first language and child language development. In the 1970s SLA studies focused on acquisition order, first language influences, learner errors, and non-classroom learners (Ellis, 2008). This era

was followed by Krashen's Input Hypothesis in which the language acquisition was explained through interaction and comprehensible linguistic input. As reported by VanPatten and Benati (2010), by the 1990s there were a multitude of competing theories, including innate and skill-based accounts of SLA. Moving into the 21st century, socio-cultural accounts of SLA began to emerge. I have organized this review around four theoretical constructs and a socio-cultural account of SLA that best explain SLA in relation to the affordances of online spaces. A more comprehensive review of SLA theory is outside the scope of this dissertation.

Key Constructs

The constructs reviewed below, while not necessarily a chronological account, exist within prominent SLA theories including Krashen's Input Hypothesis; Long's Interaction Hypothesis; Swain's Pushed or Comprehensible Output; and Schmidt's Noticing Hypothesis. They help make sense of how to observe and possibly measure SLA in 3DVLE and ePortfolio practice. Importantly, I am interested in how elements from these theoretical constructs may account for what happens outside of the learner's head and make sense of how the affordances may contribute to or facilitate language learning as I investigate the role of the learner's physical and virtual presence in these novel social learning environments. My objective is to critically examine constructs from SLA theories and question how certain elements, like spontaneous feedback, may or may not contribute to my own program of research.

Input

A review of SLA theories inevitably includes *input*, an essential construct in SLA. Input provides the learner with data or information from which to learn, quite literally

“...information about what is possible within a language” (Gass & Mackey, 2007, p. 177). VanPatten and Benati (2010) describe input as the language a learner is exposed to, a “major data source for the language learner (p. 36)”. Ellis (2008) distinguishes between two types of input, interactive and non-interactive, where the former is participatory (e.g., conversation) and the latter is direct (e.g., language input provided by a written text). One of the most notable SLA theories is Krashen’s Input Hypothesis (Krashen, 1982).

Krashen distinguishes between acquisition and learning, stating that acquisition is a subconscious process compared to learning, which he describes as an intentional, conscious process (Ellis, 2008). Krashen’s Input Hypothesis highlights the role of input in the acquisition of a second language and claims that input must be comprehensible for acquisition to occur. Further, acquisition assumes progress is sequential and is facilitated by input that is just slightly beyond the learner’s competence: “...input becomes comprehensible as a result of simplification and with the help of contextual and extralinguistic clues...” (Ellis, 2008, p. 246). Based on the premise that there is a natural order to learning a language, this hypothesis claims that to move from one level of competence, level i , the learner needs $i + 1$ to move to the next level. Gass and Selinker (2008) concur that learners progress naturally from one stage of acquisition to the next because of comprehensible input.

According to Krashen’s model, the point at which input is comprehensible is the point at which the learner processes or acquires language. Input can be simplified and made more comprehensible if the speaker slows their speech rate and uses simpler syntax and vocabulary, sometimes called *foreigner talk* (Gass & Selinker, 2008; Krashen, 1982; VanPatten & Williams, 2007). Long (1996) posits that input is mediated and depends on

the learner's level of proficiency and attention. Further, comprehensible input leads to comprehension, and interactional factors, such as recasts.

Yet, however necessary, comprehensible input is not sufficient for acquisition. While a learner may understand, understanding is not sufficient evidence that they have learned and can therefore produce the language properly. According to VanPatten and Williams (2007), comprehensible input is almost certainly assured assuming the learner has a basic level of language or *i*. Also, good input is input that is comprehensible to the learner regardless of level of competence and will be aided by frequency, delivery rate, length of utterance, and comprehension checks by another speaker, especially in earlier stages of acquisition (Gass & Selinker, 2008; Krashen, 1982). Good input needs to be interesting and relevant and "rich and comprehensible" (VanPatten & Williams, 2007, p. 29) and speech emerges because of acquisition. Gass and Selinker (2008) differentiate input from intake, in that input is what is available, whereas intake is what is internalized.

According to Krashen's Input Hypothesis and my understanding of what constitutes comprehensible input, the affordances of 3DVLEs and ePortfolios must facilitate comprehensible input, otherwise acquisition will not be possible because spontaneous feedback and recasts are not possible unless there is a speaker of the target language present in the environment. Spontaneous feedback is not always possible, as users are often alone in 3DVLEs and ePortfolios. However, in terms of affordances like immersion and visibility, I argue that virtual input (VI), or non-linguistic input, is input that is rich and comprehensible because of learners' past experiences with language or connections to and experiences in the world. Thus, VI and Krashen's input may facilitate acquisition because of the affordances of the learning space.

Other notable factors contributing to successful acquisition is learning in low-anxiety environments (Krashen, 1982). Krashen's *affective filter* accounts for why learners with lower anxiety levels are more likely to acquire the language, as they tend to have a positive attitude towards learning the language (VanPatten & Williams, 2007). Accordingly, the lower the filter, the better the chances of acquisition. Early observations in 3DVLE contexts show that students who are more familiar with the technology demonstrate good use of language and content; acquisition has yet to be measured in my own studies. Perhaps increased schema and lower cognitive load (in cases where students are comfortable using gaming-like technologies) are variables in these cases.

Consequently, future 3DVLE studies could attempt to demonstrate that 3DVLEs are low-anxiety contexts by asking learners to indicate their comfort levels while learning in a 3DVLE. For instance, a post-survey questionnaire could evaluate learners' anxiety level by asking the participant to indicate on a scale of 1–10 how anxious they felt. For even richer data and validation, a small focus group could assess users' comfort levels. It would need to be demonstrated that 3DVLEs are less conducive to overt correction thereby reducing the learner's anxiety. In addition to anxiety levels, Krashen's (1982) Affective Filter hypothesis shows how traits like motivation and self-confidence are correlated to successful SLA. The 3DVLE literature claims that the affordances of these spaces also promote these traits, which could potentially be captured by a post-study questionnaire (see for example, Peterson, 2010). Similarly, literature reviewed in Chapter 2 on ePortfolios reports on benefits like self-regulated and autonomous learning (as example, Wade, Abrami, & Sclater, 2005).

Krashen (1981) makes another distinction between acquisition and learning, stating that acquisition is aided by informal environments so long as the learner is actively involved, while learning is supported by formal instruction. He further distinguishes between formal and informal learning environments, claiming that informal environments are conducive to acquisition if language is used for communication, while formal environments help learners become more proficient. Informal or natural environments are characterized by contexts in which a learner is immersed in the target language, but in which no explicit linguistic feedback is provided; however, there is frequent and comprehensible input. Comparatively, formal environments like an English language class provide explicit, rule-based instruction. In his book *Second Language Acquisition and Second Language Learning*, Krashen (1981) reviews outcomes from a handful of studies, demonstrating the following: informal instruction may positively impact adult language learners; motivation and skill may positively impact learners regardless of the environment; real and sustained language use in informal contexts positively impacts the learner; and informal, immersive environments are possible predictors for success. However, Krashen claims that for an informal environment to promote language acquisition, the student must be actively involved and engaged.

Most relevant to my own research is the idea that language might be acquired more naturally in these contexts, because the 3DVLEs and ePortfolios are immersive, persistent and visible; these affordances lead to learner engagement. Consequently, it could be expected that learners will engage or interact with the task and the space facilitating a subtle or informal learning process. Based on Krashen's research, if these online spaces can be described as informal, immersive, and engaging learning

environments that provide rich and comprehensible input, then we might be able to show that 3DVLEs and ePortfolios facilitate SLA. In my own research, I consider input as virtual (VI), visual, non-linguistic, and linguistic, and I hold that input is a consequence of the learner's experiences in the space. Further, I assess written language to determine whether language, content, and self-awareness are acquired due to the affordances of the learning space that lead to learning benefits like interaction and input. Krashen's model is perhaps overly simplistic for my purposes in that it considers linguistic input only.

Krashen's Input Hypothesis has been criticized because of its lack of emphasis on the role of output. As suggested by Long (1996), while comprehensible input is necessary, it is not sufficient for SLA to occur. This is supported by Swain's (1985, 2000) seminal research with French immersion students, whom they found could comprehend the target language, but had difficulty producing it. As above, Long views input in relation to the linguistic environment whose role is to provide the non-native speaker both positive and negative input. He claims that input includes the speaker's attention, awareness, and focus on form, not simply frequency. The role of linguistic devices, such as repetition and reformulation, are part of the linguistic environment. In addition, Long (1996) argues there is a causal relationship between conversation and acquisition based on evidence that suggests negotiation of meaning improves comprehension; however, empirical research cannot easily control for external variables across time to conclusively show cause.

Based on the above, in assessing language and content in my tasks, I should differentiate between comprehension and acquisition; however, much like Swain's French immersion studies, I am more interested in whether the affordances facilitate

comprehension as demonstrated by language production or use. Furthermore, the distinction between input and interaction is not always clear. Some type of input, not necessarily linguistic, is relevant to my 3DVLE research, as I use an observational matrix to measure quality, frequency, and type of interaction with VI (see for example, Chapter 5); but, based on these theories, it is linguistic output that is measured to determine learning and acquisition.

At this point, while I appreciate the importance of Krashen's (1981, 1982) Input Hypothesis because the affordances of online spaces help to increase the amount and possibly the frequency of language input, it does not account for the social context and mediating factors, such as artifacts. Further, as stated previously, the notion of input is limiting in the SLA literature, as it views input as purely linguistic, i.e., either heard or read. Even constructs like noticing (further discussed below), awareness, and focus on form refer to linguistic forms. Krashen's hypothesis thus does not adequately account for non-interactive input such as visual artifacts and learner experiences, or other observed interactions such as interaction with the space, the tool, or a peer. These are important in relation to the affordances and seem to be underrepresented by this theory. For example, the affordance of fidelity or authenticity of space in 3DVLEs leads to social interaction. In observing 3DVLE interactions and according to an observational matrix I developed (see Chapter 5), I look at types of input, including verbal, visual, and spatial. This next section describes the construct of output as understood by many SLA theorists and explores possible relevance to my own research.

Output

While Krashen's Input Hypothesis highlights the importance of input in SLA, he does not account for the role of output. Swain (2000) highlights the importance of output in SLA and learning. Her significant contribution to SLA theory is the Comprehensible Output Hypothesis in which she argues output is a necessary condition for learning, as it pushes the learner to produce syntactically and morphologically more accurate language. She argues that, "negotiating meaning needs to incorporate the notion of being pushed toward the delivery of a message that is not only conveyed, but that is conveyed precisely, coherently, and appropriately" (Swain, 1985, p. 249).

Swain's Comprehensible Output hypothesis emerged from her earlier research wherein she hypothesized why French immersion programs in 1970s Quebec, while they provided learners with plenty of rich linguistic input, did not produce learners with strong syntactical and grammatical output. Swain suggests that "pushed" output needs to be more syntactically accurate in terms of form and not just meaning (Ellis, 2008). In a review of Swain's Comprehensible Output Hypothesis, Gass and Selinker (2008) point out how it distinguishes between language used for communication and language produced accurately, a move that focuses on syntactic as opposed to simply semantic meaning. Gass and Selinker reiterate how Swain's hypothesis focuses on the learners' ability to use language productively as opposed for just comprehension. It is this distinction that led Swain (1985) to introduce the notion of comprehensible or pushed output, which relates to the learners' ability to produce language in speech and writing.

Swain's theory is based on the learner progressing through three stages: (1) noticing a linguistic gap in production; (2) testing production for accuracy through

feedback; and (3) reflecting on correct linguistic production. Swain (2000) identifies these three steps as a necessary process for acquiring specific linguistic forms. At the noticing stage, she stresses the importance of practice and interlocutor feedback, arguing that comprehensible output will lead to language acquisition because of learner adjustments to language production that occur from noticing. At this stage, communication is a critical component because, “collaborative dialogue is dialogue in which speakers are engaged in problem solving and knowledge building” (Swain, 2000, p. 102). This collaboration assumes a certain level of social interaction with an interlocutor and a level of meta-linguistic knowledge on the part of the learner.

At the testing stage, learners may hypothesize or test language accuracy when speaking or writing, thereby modifying language output. At this point, Swain argues output leads to acquisition, which evolves from the learner’s opportunity to modify speech through feedback, negotiation, and/ or recast. This claim is supported by a study by McDonough (2005) and reported by Gass and Selinker (2008). Accordingly, output is the language that is ultimately produced by the learner. In my studies, production or output is a measurable way to determine how well a learner has acquired the language and importantly demonstrates the learner’s ability to think critically or make connections. Based on Swain’s theory, communication with an interlocutor is a necessary condition, but affordances like persistency may create opportunities for active noticing and reflection, which may facilitate achievement of higher order thinking and connection making rather than linguistic characteristics of output described by Swain.

Swain considers output as more important than input in language learning as it pushes the learner to communicate. Swain and Lapkin (1995) show how learners who are

given tasks that push output through negotiation demonstrate evidence of acquisition or consolidation of knowledge. The inclusion of an interlocutor in the process of negotiation is the first indication of SLA involving more than just the learner. Key to Swain's theory is that learners develop and test their own language hypotheses through interaction with a speaker of the target language. She also notes the importance of the learning environment and cites van Lier (2000) who argues, "...all social activity forms a part of the learning environment" (p. 99). Her perspective of SLA has shifted to include more than just the learner and aligns better with my own view.

In her later work, Swain (2000) states that input and output hypotheses do not adequately account for language learning from a socio-cultural perspective. From this perspective, language is believed to be learned through collaborative dialogue which mediates language and knowledge. Moving beyond the Output Hypothesis, she favours the terms *writing* and *utterance* instead of output. Further, she stresses the role of mediated activities in which language is one of the most obvious mediators in terms of learning, "physical and semiotic tools mediate our interaction with the physical and social environment" (p. 103-104). This view reflects how I perceive the affordances of 3DVLEs and ePortfolios as they mediate interaction and facilitate opportunities for linguistic and virtual input. According to a socio-cultural interpretation of output, whether the learner attends to meaning or form because of collaboration depends to a large extent on the task (Swain, 2000). Therefore, if students are asked to focus on form, their dialogue is still meaning based as they collaborate on what to notice in terms of form; language is reflective. Swain (2000) cites a study by Holunga (1994) wherein she reflects how

“dialogue mediated their co-construction of strategic processes and of linguistic knowledge” (p. 109).

Swain’s shift towards a more socio-cultural perspective includes the interlocutor as a necessary part of acquisition in which interaction is mediated and collaborative and outside of the learner’s head (VanPatten & Benati, 2010). This evolving view on SLA is more relevant to online learning spaces as the affordances, such as fidelity of space, may help to mediate the task and facilitate learning. Consequently, future research should consider carefully what is mediating language development in these environments. And, if output or production is used to measure learner competence or acquisition, future studies should necessarily include a pre- and post-test to measure acquisition.

Alternatively, while complicated, studies may look for examples of noticing by having students identify instances through a think aloud process while watching recorded interactions. However, this is moving away somewhat from my own program of research, which investigates how the affordances of space lead to improved language production from a semantic perspective. My research is less focused on discrete linguistic accuracy as described by Swain’s Output Hypothesis, and instead asks, can the learning space function as an interlocutor?

Whereas Swain (1985, 2000) looks for evidence of learning by transcribing learner conversations, my research looks for evidence of learning in students’ written responses to prompts wherein they reflect on their experiences interacting in and with the space. Their success is measured more holistically as opposed to linguistically and according to three areas, content, language, and self-awareness. As noted by M. Rodgers (personal communication, July 7, 2017), I am demonstrating certain traits or skills that

are associated with acquisition, such as interaction, awareness and noticing, rather than demonstrating acquisition. If the learner can respond to the prompt using comprehensible language and if comprehension is enhanced by the affordances, such as immersion, then is this productive? As I am more interested in the learners' ability to demonstrate learning and meaning due to affordances that lead to interaction and experience, perhaps my studies measure comprehensible production rather than linguistic accuracy or output?

The role of output in SLA is not apparently all that conclusive: "output, then, as merely repetition may be less useful than output where learners are given opportunities to incorporate new forms in their production" (Gass & Sleinker 2008, p. 329). As explained, "we can have a language learner recite a speech that is perfect English, but it is too far beyond their abilities to understand it or use any of the new linguistic information" (M. Rodgers, personal communication, July 7, 2017). Previously, my beliefs as a teacher assumed comprehensible output meant the learners' ability to communicate content and meaning while demonstrating critical thinking. Consequently, as the learner acquired language, their semantic and syntactic proficiency increased. Comprehensible output assumes a level of linguistic accuracy in the SLA literature.

I continue to struggle with how to generalize these theories to my own research as there is not always an interlocutor, nor am I attending to linguistic form, but rather to the learners' ability to demonstrate understanding of content that has emerged because of the affordances. As suggested by M. Rodgers (personal communication, July 7, 2017), these are perhaps not mutually exclusive, and while the 3DVLE (as an example) may provide the learner an understanding of content and form, theoretically this could lead to

opportunities for linguistic learning. This leads to the construct of noticing in the SLA literature.

Noticing

In contrast to Krashen's Input Hypothesis, Schmidt (1990) believes that language acquisition is the direct result of consciously noticing a linguistic feature. This feature may or may not lead to learner uptake, which is an observable behaviour in response to native speaker recasts or feedback. Uptake differs from intake, which may exist in the learner's mind but is unobservable (VanPatten & Benati, 2010). Schmidt's (1990, 1993a) Noticing Hypothesis states that what learners notice consciously about language is intake, whether lexical, phonological, or otherwise. This model is concerned with attention allocation or alertness, orientation in terms of what is focused on and which may be task dependent, and detection (Gass & Selinker, 2008). Accordingly, learning is a result of attention to form upon noticing a gap. While arguably vague, he compares dichotomies of unconscious to conscious learning and maintains that in terms of SLA, noticing is important and can occur incidentally.

Schmidt's Noticing Hypothesis (1990, 1993a) identifies three issues related to conscious and unconscious learning: (1) incidental versus intentional learning; (2) attention to or awareness of linguistic form and noticing a gap; and (3) implicit versus explicit learning or short term versus long term memory. The first issue considers the difference between incidental and intentional learning, where the difference is primarily between semantic and grammatical acquisition, and in some instances due to purpose of language use. For example, grammar may be explicitly taught and therefore intentionally learned, whereas language may be used simply to convey a message. The second issue

considers the process of input to intake and noticing. At this point, the learner must intentionally attend to or notice input for input to become intake, as “...intake is that part of input that the learner notices” (Schmidt, 1990, p. 141). Gass and Mackey (2007) describe attention as a mechanism that explains how learners sift through the masses of input made available to them. A third issue related to unconscious versus conscious learning is the difference between implicit and explicit learning and how these relate to understanding. Schmidt (1993a) explains that explicit learning is more rule-based and a result of direct teaching, whereas implicit learning may be a result of exposure or immersion.

Schmidt (1990, 1993a) attempts to differentiate between conscious and unconscious learning but appreciates the need for both. Regarding noticing, it can be implicit, meaning that the learner does not have to explicitly attend to anything. According to Schmidt, consciousness or awareness is typically related to noticing content and not grammar. This is conscious process, which he argues is more than perception, “...having noticed some aspect of the environment, we can analyze it and compare it to what we have noticed on other occasions” (Schmidt, 1990, p. 133). Perhaps this occurs while interacting online whereby the learner notices content, which may or may not be used in production. VanPatten and Benati (2010) further describe the notion of awareness in relation to learner experiences and as the learner’s ability to show, report, and describe their experiences.

In their book, VanPatten and Benati (2010) summarize key terms in SLA literature, such as *aspect*, *attention*, and *feedback*. The notion of *attention* means the learners’ cognitive ability to select one stimulus over another; this is not specific to

linguistic form and so may be more relevant to my program of research if one considers the user's attention to VI or stimuli, linguistic or otherwise. Further, VanPatten and Benati define individual differences that may impact learning and acquisition, such as aptitude, motivation, learning styles and strategies. Individual differences certainly influence learning in 3DVLEs and ePortfolios. For instance, I can anecdotally report buy-in, technical aptitudes (gaming familiarity), motivation, and learning styles help learners successfully achieve outcomes; however, this has not been the focus of my research.

Interaction

According to Long (1996), interaction is useful and a necessary component of SLA. While Krashen ignores the role of output through conversation in SLA, Long believes that conversation and output are attributed to interaction. Consequently, interaction arises from the learner's need to communicate. The claim is that input and interactional modifications will facilitate acquisition, leading to the Interaction Hypothesis:

I would like to suggest that negotiation for meaning, and especially negotiation work that triggers interactional adjustments by the NS or more competent interlocutor, facilitates acquisition because it connects input, internal learner capacities, particularly selective attention, and output in productive ways. (Long, 1996, p. 451-452)

Long's Interaction Hypothesis states that interaction helps to make input comprehensible through actions like negotiation and feedback (Ellis, 2008). Empirical research has shown that interactionally modified input may facilitate or promote SLA. Updated interpretations of the Interaction Hypothesis suggest acquisition depends on

negotiated meaning that leads to noticing and learner's readiness (Ellis, 2008). In explaining the role of interaction, Gass (1997) states that interaction is between two or more speakers and that conversation is the means of input. Further, interaction is useful and necessary for SLA and includes negotiation: "within this framework, the input to the learner coupled with the learner's manipulation of the input through interaction forms a basis of language development" (Gass, 1997, pp. 86–87).

The importance of interaction in SLA is highlighted by Gass and Selinker (2008), who make the connection between input and output or outcomes and production more salient. They introduce *negotiated meaning* as a component of interaction and state that interaction research "takes as its starting point the assumption that language learning is stimulated by communicative pressure and examines the relationship between communication and acquisition and the mechanisms (e.g. noticing, attention) that mediate between them" (p. 317). Therefore, if interaction aids language acquisition, and acquisition is facilitated by input and feedback, then it makes sense that acquisition is facilitated because of the affordances of 3DVLEs and ePortfolios. For example, in Chapter 2, Table 2.1 links the affordances of fidelity of space, immersion, persistency, and adaptability to interaction. This is useful with regards to my own research and observations in 3DVLEs wherein I use an observational matrix to record the frequency and different types of non-linguistic interactions, such as VI. Similarly, the manuscript published in Chapter 8 shows that the persistent and visible nature of ePortfolios lends well to opportunities for interactions with faculty and peers, which students agree is valuable and helps them make connections and develop a deeper understanding of content (Hartwick et al., in press).

The definition of *interaction* according to these theories refers to linguistic interaction in the form of feedback, recasts, negotiated meaning, etc. (Ellis, 2008). What remains unclear is that these definitions of interaction are not defined according to my semantic understanding of the word, but rather in terms of interactive strategies that may assist the learner, including feedback, error correction, foreigner talk, and the like. Intuitively, I understand interaction as an active, participatory action in which one or more individuals engage in a meaning making activity. While the Interaction Hypothesis assumes oral interaction via multiple forms, such as feedback, can I assume that, in my two online learning spaces, interaction can also occur with an object or from an experience? This is an important consideration as my research is interested in interactional behaviour of learner in terms of interlocutor, but also in terms of affordances of space.

Input and output models of SLA have been criticized by socio-culturalists for not adequately accounting for the social element because they put too much emphasis on the individual (Block, 2003; Ellis, 2008). Ellis (2008) states that socio-cultural theorists actually object to the terms input and output and cites van Lier who argues that interaction cannot be investigated by breaking it down into its component elements (as the input-output model seeks to do); rather it is necessary “to look at the active learner in her environment’ and study interaction in its totality in order to show the emergence of learning” (Van Lier, 2000, as cited in Ellis, 2008, p. 272). Whether from the position that language is acquired due to an innate capacity or from linguistic input, output, and/ or interaction, SLA theories do not adequately account for the social context in which the learner is behaving in or engaged with.

From a socio-cultural perspective, the constructs described above are therefore limiting, especially in terms of input and interaction which do not account for social and physical elements in which the learner is acting or learning. van Lier's (2000) social-ecological approach or worldview on language learning seems to bridge this gap. He states that not all learning is inside the head, but that perception, social interaction, and verbal and nonverbal interaction facilitates learning, too: "From an ecological perspective, the learner is immersed in an environment full of potential meanings" (p. 246). Not surprisingly, van Lier draws on the work of Vygotsky, Dewey, and Bakhtin—the pioneers studied in my first year of the PhD program who have influenced my perspective.

Based on this review, affordances are seemingly overlooked in SLA theories, as the focus is more on explicit, linguistic input and output. Consequently, I also look to socio-cultural perspectives of SLA theories, as I understand SLA to be a social process that involves input (linguistic and otherwise), learners, spaces (including perceived artifacts interlocutors, space itself), and mediating factors like time and affect. To this end, SLA is a process that necessitates interaction in a social system in which interlocutors are either other speakers or artifacts in an environment that provides cues (visual or linguistic). This interaction helps the learner produce comprehensible output due to factors including language, shared experiences, shared knowledge.

In the previous two sections, I "drilled down" into elements from general learning theories and SLA constructs that relate to affordances of 3DVLEs and ePortfolios. Based on this review, I argue that if the affordances of online learning spaces provide increased opportunities for interaction, collaboration, and reflection, then language learning may

ensue according to constructs from SLA theories. Further, I coined the term VI to describe non-linguistic input that is facilitated by the affordances and that may stimulate the user's linguistic experiences and knowledge. Similarly, as a practice, ePortfolios afford opportunities for reflection and connection in non-linguistic ways. Before considering the implications of this “drilling down” process, I provide an overview of learning and SLA theories cited in the field of CALL beginning with a historical account.

Computer Assisted Language Learning

Early computer language training began in the 1960s with drill and memory exercises consistent with a behaviourist theory that equated language learning to pattern practice and repetition⁴ (Skinner, 1957); computer language exercises were designed to mimic the design and purpose of language exercise books from that era (Blake, 2008). The development and commercialization of CD-ROMS for language learning in the 1980s triggered a need for research and an approach to computer facilitated language learning situated in a more non-behaviourist framework (Blake, 2008). Chapelle (2000) calls this the “pre-network CALL era” in which the learner simply interacted with the PC or a piece of software. She compares this to the networked-based language teaching era, including computer-mediated communication (CMC) between more than one user at the same time. Finally, with the ever-growing prevalence of technology and Internet in language education, CALL was gradually recognized as a professional and academic field and strengthened by the formation of the Computer-Assisted Language Instruction Consortium (CALICO). As a result of changes in technology and the widespread availability of Internet and digital tools, CALL researchers moved away from a linear and behaviouristic view of learning to a belief that language learning in these contexts

⁴ For a more detailed description, see Chapter 7.

depended on social interaction, and interactions that engage the learner in activities that promote knowledge construction (Blake, 2008; Chapelle, 2000). This shift likely coincided with socially motivated theories in education and SLA and a general curiosity around the process of learning in these contexts (Salaberry, 1996).

To demonstrate the complexity and depth of CALL, Salaberry's (1996) historical review of CALL applications, pedagogical claims, and SLA theory points to the distinctions between synchronous and asynchronous interaction and on-screen and off-screen environments. A further distinction is made by Kern and Warschauer (2000), who describe the field of CALL according to three discrete stages which they say parallel the evolution of technology: mainframes, PCs, and multi-media/Internet. The third stage includes Internet-based tools that allow for CMC, such as email and discussion boards. Second and third generation Internet tools include wikis, blogs, chat rooms and more recently 3DVLEs and ePortfolios, all of which allow for synchronous and asynchronous communication among multiple users.

Thorne and Payne (2005) report that with the growth in institutional use of Internet-based communication tools in the 1990s, like email and chat, followed by the evolution of digital technologies and availability of online tools, including wikis and blogs, educational norms were being challenged. They suggest that this advent impacted education in such a way that a gap between student needs and educational and institutional goals emerged. They urged educators and CALL researchers to consider the potential of technology mediated communication in terms of communication, content, and thinking. Thorne and Payne's article investigates trends in technology use in language education and research and cites two influential CMC studies, including Kern

(1995) and Chun's (1994), which investigate the impact of CMC on user participation and linguistic sophistication at stage of language production. These studies question the relationship between CMC and oral proficiency and draw on SLA theories proposed by Krashen (1982), Swain (1985), and Long (1996). Other CALL literature from this era is situated according to an interactionist approach to language learning and Krashen's input hypothesis (Thorne & Payne, 2005), socio-cultural and socio-cognitive theories (Darhower, 2002; Salaberry, 1996), and theories in situated cognition (Salabery, 1996).

Lantolf and Thorne (2007) place strong roots in activity theory. They claim that language and objects mediate behaviour and believe that interaction occurs within a mediated social context; mediation is an activity that is regulated by an object or self. The authors describe language as a cultural artifact used by humans "...to mediate their connection to the world, to each other, and to themselves" (p. 205). Based on this perspective, might we assume that learner interactions in 3DVLEs and ePortfolios are mediated by artifacts, other users, and the space itself and that these interactions create learning opportunities as the learner engages in process of meaning making? If language in SLA includes pragmatic, communicative, and linguistic competence, then SLA may be viewed as the result of an active and meaningful process which includes multiple constructs; it is therefore representational and ecological.

While the field of CALL grows as quickly as new technologies and online environments emerge, so too does the need for theories that help to account for what is going on as these newer examples of CMC are potentially great learning environments (Peterson, 2006). Kern and Warschauer's (2000) "third stage" closely matches my own research trajectory as it includes more current trends in digitally mediated

communication, such as Web 2.0 tools, but (likely due to the publication date) it does not adequately capture what Sykes et al. (2008) refer to as *social bookmarking* (collaborative websites) and social spaces (e.g., Second Life and 3DVLEs). Sykes et al. (2008) suggest that the complexity of these spaces evokes characteristics of collaborative, communicative, and pragmatic practices, as “immersive modalities offer significant opportunities for engaged interaction and language socialization within specific genres and communicative norms” (p. 535). These authors refer to research in immersive worlds (e.g., Sadler, 2007) and Gee (2003, 2005), who consider aspects of identity and appearance and social roles in their research.

ePortfolios are often situated within a constructed or situated learning theory due to the affordances or benefits of the platform (Batson, 2011; Duncan-Pitt & Sutherland, 2006). Thus far, the reported benefits align with many of the elements emerging from social learning and socio-cultural language learning theories reported in Chapter 2, such as knowledge construction, peer feedback, interaction, engagement, and authentic assessment. Clearly, there are many theories and domains from which to draw when investigating the affordances of newer and more sophisticated online learning spaces like 3DVLEs and ePortfolios for language learning purposes.

In Chapter 2, I argued that the affordances of space will facilitate learning and define an affordance as a characteristic of the space that facilitates learning and not a feature of the technology or an outcome of the behaviour (Evans et al., 2017). In this chapter, I provided a review of theories from education, SLA, and CALL in order to tease out elements that may be relevant in accounting for what is going according to the affordances. As I have also positioned myself as a practitioner in this program of

research, this review importantly leads to a discussion of implications for classroom practice based on the definition of affordance and combined theoretical elements from education, SLA, and CALL.

Theoretical implications for classroom practice

The theoretical implications for classroom practice are far-reaching, but how do we make sense of the implications in relation to the many theories and affordances of the two online learning spaces? In the expanded edition of *How people learn: Brain, mind, experience, and school*, Bransford et al. (2000) provide an update to a framework originally published in 1999. Bransford et al.'s (2000) *How People Learn* framework characterizes four perspectives of learning environment design: (1) learner-centered, (2) knowledge-centered, (3) assessment-centered, and (4) community-centered. I present the implications for practice according to this framework and the affordances identified in Chapter 2, namely fidelity of space, immersion (presence), persistence, adaptability, and visibility. I then propose a fifth lens, space-centered, to capture the affordances of space.

Learner-centered

According to Bransford et al. (2000), learner-centered design builds on what the learner brings to the educational environment in terms of knowledge, experience, skill level, and cultural beliefs. Additionally, a learner-centered environment promotes collaboration and socialization to foster a range of competencies across multiple levels of discourse, like mathematics. From this perspective, activities are designed to consider a learner's prior knowledge, typically gathered by means of diagnostic instruction, introductory activities, and cultural exchanges (Holden & Westfall, 2010). Importantly, diagnostic-style activities can find out about the learner's comfort and experience with

technologies accessible within and outside the 3DVLE and/ or ePortfolio. This learner-centered lens is important, because often practitioners wrongly assume the student is digitally savvy and competent while they are not (Savin-Baden et al., 2010).

Holden and Westfall (2010) relate affordances of synchronous and asynchronous multi-user interaction and participation to a learner-centered environment, which is described by Bransford et al. (2000) and by Anderson (2008) as an environment that recognizes the needs of the institution, teacher and student. As 3DVLEs afford immersion which leads to real-time, multi-user, synchronous interaction through first-person voice, text and movement, they help to establish a sense of presence and co-presence⁵. This sense of presence facilitates opportunities for sharing and exchanging information, and co-constructing meaning, and practicing newly acquired skills, all characteristics of many of the learning theories addressed at the beginning of this chapter and in Chapter 7.

This learner-centered lens captures elements from 21st century and constructivist learning theories. According to this lens, students are expected to be more self-sufficient and in control of their own learning with respects to acquisition of skills and knowledge; 21st century learners need to be responsible for their own learning by actively participating in and achieving specified learning outcomes; this includes adapting to new forms of communication (Ally, 2008; Haythornthwaite & Andrews, 2011; Ireson, 2008). As noted by Haythornthwaite and Andrews (2011), today's students need to adapt to multiple modes of information and learning delivery thereby acquiring multiple literacies. Owing to the affordances of 3DVLEs and ePortfolios, learners can acquire and practice

⁵ Holden and Westfall (2010) use the term co-existence rather than co-presence to refer to synchronous interaction between participants in the virtual space.

new media skills with the support of peers or on their own time in an asynchronous context.

Knowledge-centered

According to Bransford et al. (2000), knowledge-centeredness refers to how the environment is organized so that it contributes to knowledge growth and skill development as opposed to simply the acquisition of generic skill sets and strategies. With respects to more cognitive learning theories, Ally (2008) suggests that learners need strategies to organize information and make connections. Yet, Anderson (2008) claims that knowing how and which resources to access is a skill; this notion is reminiscent of Siemen's connectivism theory described in the publication in Chapter 7. The implication here is that learners are free to explore, gather, select and evaluate information anytime and from anywhere (Ally, 2008). The authenticity and visual representation of learning space defines the knowledge-centeredness (Holden & Westfall, 2010) and is related to elements connected and experiential. In a knowledge-centered environment, learners understand the landscape of the environment so that they can access the resources that will best support their own learning trajectory (Bransford et al, 2000).

Through this lens, Bransford et al. (2000) suggest students are better off learning how to navigate the environment to become self-sufficient learners. That is, they learn to become effective problem solvers through exploration, elaboration and self-evaluation or monitoring. From this perspective, learning theories that include notions of doing, experience, exploration, knowledge construction, and teacher as facilitator emerge. The visually rich, graphical interface of 3DVLEs and the visible, multi-modal nature of ePortfolios allows users to interact directly with objects and tools in the space to

accomplish a task; these spaces go beyond the capacity of a traditional classroom as they allow users to be connected through other tools inside or outside the environments. The affordances promote problem solving, critical thinking, and knowledge construction depending on the task, which requires carefully planned curricula and task development with a focus of experiencing rather than memorizing information, and making sense of information through interaction, reflection and learning about learning (Ally, 2008).

Assessment-centered

According to this lens, effective learning environments must provide ample opportunity for continuous assessment, whether summative or formative to provide learners with the opportunity to revise (Bransford et al., 2000). This can be achieved in 3DVLEs and ePortfolios because of the immersive, authentic, and persistent nature of the learning spaces. For example, students working on building a research portfolio can share their electronic portfolios through a screen-share function on any number of surfaces throughout the environment. This sharing can be done informally throughout the term whereby feedback is provided by peers and teachers and helps to motivate the learner into meeting the learning objectives. Similarly, students can readily share ePortfolios during class-time to provide and receive feedback from other students or teachers. Additionally, feedback in the form of summative assessment can be given as the result of a formal presentation of the learner's electronic portfolio or grade submission. From this perspective, assessment moves away from recall and memory to a more process-oriented and participatory approach in which the learner has some control of their experience; assessment in these contexts is for learning (Haythornthwaite & Andrews, 2011).

3DVLEs and ePortfolios provide asynchronous and synchronous learning opportunities which allow for regular feedback and multiple forms of assessment through collaboration and interaction with others or the space itself. The persistent nature of the spaces and additional affordances allow for regular self, peer, and formal assessment opportunities (Holden & Westfall, 2010). Obviously, these environments require a change in teaching practice, which remains a challenge as we unpack elements from existing theoretical framework and best practices (Savin-Baden et al., 2010). For example, Anderson (2008) cautions teachers and designers not to over-assess simply because of the vast choice of online tools and assessment vehicles that can be integrated into online learning spaces. As reported by Fox (2017), alternative assessment practices, such as ePortfolios, redefine or necessitate newly articulated language constructs. Fox states that discrete measures tests get at the minutia of linguistic structures as opposed to, for example, practical aspects of developing language, i.e., language that may be more representative of the language learner's ability to participate in a social practice through communication.

Community-centered

Holden and Westfall (2010) stress the importance of converging perspectives and gratifying collaboration as learners work towards shared goals. As noted by Anderson (2008), “the community-centered lens allows us to include the critical social component of learning in our online learning designs” (p. 51). Similarly, Bransford et al. (2000) focus on the importance of cultural norms, beliefs, and expectations at the level of the classroom. The affordances of 3DVLEs provide unique opportunities in which learners from multiple and diverse backgrounds can participate anonymously and safely in a

community designed to welcome different beliefs about teaching and learning. Consequently, this facilitates sharing and collaborating in a safe context. For instance, learners can choose to contribute in class either verbally through VoIP or non-verbally via text, depending on their own classroom beliefs/ norms. Interaction via text chat may be preferable for a learner who is not comfortable or familiar with speaking up in class. Further, 3DVLEs may provide contexts for students to contribute knowledge and skills learned incidentally and outside the classroom, such as technical knowledge. Overall, the notion of community-centeredness is significantly altered in a 3DVLE space compared to a 2-dimensional platform because of the affordance of immersion which contributes to a better sense of presence or ‘being there’ while simultaneously respecting the user’s anonymity.

Space-centered

To conclude, I propose a hypothetical 5th lens called space-centered (see Figure 3.1), which is informed by experiences teaching in these spaces during the last five years and captures elements from theories in education, SLA, and CALL; importantly this lens includes the affordances of 3DVLEs and ePortfolios reported in Chapter 2. The significance of the affordances in relation to learning benefits and expansiveness of the space are not sufficiently captured by the four preceding lenses, as they were created with a physical space in mind.

Figure 3.1. Five lenses in consideration of learning environment design.

I argue that these learning spaces are situated in social learning theories and the affordances contribute to experiential, collaborative, and connected learning; however, there is insufficient emphasis placed on how users interact with, in, and because of the affordances. And, while socially situated theories are useful in accounting for learner behaviour and outcomes, we need to consider both “digital learning spaces: where explorations occur about new types of visibility, literacy, pedagogy, representation of knowledge, communication and embodiment” (Savin-Baden, 2008, p. 13) and “reflective learning spaces: which reach beyond contemplation and reconsidering past thoughts, they are spaces of meaning-making, and consciousness-raising” (p. 12). However, technology is only a medium for instructional practice; it is ultimately what educators do with the technology that matters; the designer is ultimately responsible for creating learning spaces that are motivating and engaging (Ally, 2008; Clark, 1994).

How can we design research that makes sense of the affordances of space and from what Hubbard and Levy (2016) refer to as a *theory buffet*? Hubbard and Levy claim that CALL theory is largely constructed, as it borrows from other domains but maintains a certain “independence”. This concept of affordance in relation to existing theories is what I perceive to be the independent variable. This leads the discussion to Chapter 4, methods.

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Chapter 4

Methods

Informed by the concept of *affordance* as defined in Chapter 2, the theories presented in Chapter 3, and building on the methods from past research, this section outlines the research methods proposed for the 3DVLE (see Chapter 7) and ePortfolio (see Chapter 8) studies. The overreaching approach to this program of research is pragmatic and generally informed by multiple theories. Pragmatism, as an epistemological approach to inquiry, supports research appropriate to a given context (Creswell & Plano Clark, 2011; Teddlie & Tashakkori, 2009) and "... acknowledges that the values of the researcher play a large role in the interpretation of results" (Teddlie & Tashakkori, 2009, p.8). According to Teddlie and Tashakkori (2009) one characteristic of pragmatism is that "theories are viewed instrumentally (they are "true" to different degrees based on how well they currently work; workability is judged especially on the criteria of predictability and applicability" (p. 74). In other words, proponents of pragmatism view the role of experience, agent or organism, environment, and interaction as highly important; further, this view recognizes the benefit of drawing on multiple theoretical lenses to best account for what is going on (Johnson & Onwuegbuzie, 2004). Pragmatic research is just that. I believe it is a pragmatic, sensible, workable approach to inquiry that is well suited to a manuscript PhD, which was described in Chapter 1. The methods section below was designed to guide my understanding of the complexity of 3DVLEs and ePortfolios as unique learning and teaching environments. Thus, as a teacher-practitioner and researcher with an array of practical concerns, I adopt a pragmatic approach to my PhD program of research.

I begin with a description of the mixed-methods used to collect data published in Chapters 7 and data stored for future 3DVLE analysis and research (explained in Chapter 9). Next, I provide a summary of the qualitative research method reported in Chapter 8, regarding the ePortfolio study. It should be noted that the 3DVLE study design was the larger study in the organization of the dissertation, whereas the ePortfolio study design emerged because of the exploration of 3DVLEs and resulted in a simpler, single case study design. The data collected under the 3DVLE will be used in future studies. Details for the overall study that were omitted in the published article for 3DVLE study (Chapter 7) are provided here below, whereas, specific details regarding the ePortfolio methods are provided in more detail in Chapter 8.

3DVLE Study Design⁶

This study was originally designed as a mixed-methods study with the intention to collect both quantitative and qualitative data. I chose mixed-methods as it allows for a focus beyond quantitative outcomes to include qualitative data on how the observable processes of interacting in a 3DVLE might contribute to student learning in an advanced level EAP course. Briefly, mixed-methods research uses qualitative and quantitative modes of inquiry that interrelate and inform each other at one or more stages of the research process (Dörnyei, 2007; Teddlé & Tashakkori, 2009). Further, this approach triangulates multiple data sources to better interpret a research phenomenon, specifically by combining the strengths (and offsetting the weaknesses) of both qualitative and quantitative methods, providing more and more diverse forms of evidence, and helping to address more complex research questions that could not have been addressed as

⁶ The design described in this section pertains to the published manuscript appearing in Chapter 7 and is referenced in future directions in Chapter 9.

effectively by one method alone (Creswell, 2015; Creswell & Plano-Clark, 2011; Dörnyei, 2007). Additionally, mixed-method approaches may enhance the researcher's understanding of a relatively new phenomenon and strengthen their theoretical stance or understanding of a problem.

Creswell and Plano Clark (2011) recommend a mixed-method approach in the case of research that spans time and includes multiple stages, as my work did. They also identify the main drawbacks, including, a lack of expertise in quantitative analysis and differences in samples size between qualitative and quantitative components. While I designed and intended to follow a mixed-method approach, the results reported in Chapter 7 follow a single case, qualitative method. Although the original design included a control and experimental group (as will be described below), the low participant numbers in the overall study did not support a robust quantitative study, thereby influencing my decision to move to a single case study (experimental group) for Chapter 7. Case study research “involves developing an in-depth analysis of a single case or of multiple cases” (Teddlie & Tashakori, 2009, p. 25); it “...entails the detailed and intensive analysis of a single case” (Bryman & Teevan, 2005, p. 42). In second language education research, Brown and Rodgers (2002) state that case study research is a means at understanding language learning processes and development. While often criticized by quantitative research community as results are not generalizable (Bryman & Teevan, 2005; Yin, 2003), case study research is used frequently in the social sciences as it can “...contribute to our knowledge of individual, group, organization, social, political, and related phenomena” (Yin, 2003, p. 1).

The overall 3DVLE study design, described below, sought to understand how the affordances of a 3DVLE may facilitate the achievement of certain learning outcomes (dependent variable) for learners in the environment compared to learners doing a similar lesson in a regular classroom. Prior to beginning the study, this research was approved by Carleton University's Research Ethics Board, Ethics ID: Project 104925 (see certification of ethics, Appendix E). Students from my own intact class (experimental group) and from two other intact classes (control groups) were invited to participate in the study. As these were convenience samples and randomly assigned groups, this study is categorized as quasi-experimental according to Creswell (2003). In quasi-experimental research, random assignment of participants is not possible; however, the results are intriguing due to the authenticity of the intervention or treatment – teaching lessons in this case (Bryman & Teevan, 2005; Teddlie & Tashakkori, 2009). I acknowledge that differences in control and experimental group size, and differences in teachers and tasks are inevitable, but the study design is intended to mitigate unreliability in several ways: students are from shared demographic mix and language proficiency and level; involved teachers team-teach and share similar teaching approaches to material design and assessment; and the lesson designs for the 3DVLE and the physical classroom are comparable except where adapted for context (Vogt, 2007).

The research design is presented in Figure 4.1 wherein I define the 3DVLE as the case, each group as an independent variable, and the achievement outcomes as the dependent variable or factor. I propose to integrate qualitative data from recorded observations in the experimental space, and researcher field notes, with quantitative data in the form of participant achievement outcomes in the way of test scores from both

control and experimental groups. These details will be further explained in the sections that follow.

Figure 4.1. Original 3DVLE mixed methods design.

A more detailed timeline of the original study is presented in Table 4.1. In sum, data was collected concurrently during the fall 2016 academic term and preliminary results were interpreted and reported on at CALICO conferences in spring of 2017 and spring of 2018. The expectation is that this breadth of data from multiple collection techniques will provide a more comprehensive view of participant's perspectives and experiences, affordances of the learning space, and tasks and learning outcomes thus contributing to a greater understanding of these spaces in learning, specifically language learning. Test scores will be used to determine if the observations in terms of interaction due to affordances of the space contribute to achievement of learning outcomes in experimental group compared to control group.

Table 4.1

Detailed Timeline of Methods for Original 3DVLE Study

Time When?	Task/ Tool What?	Space/ Context Where? Who?	Product/ outcomes Why?	Analysis How?
September 15, 2016	Lesson 4.0 Holland Code Appendix F In class activity including a follow- up assessment Researcher field notes	Classroom Control and experimental groups	Results of lesson and assessment 4.0 <i>Language</i> = vocabulary <i>Content</i> = traits, skills and career preferences <i>Metacognition</i> = connections b/w Holland code outcomes and choice of major and experiences to date in course	Data: Test-scores Q 4 = QUAN Field notes = QUAL Action: Grade outcomes using standardized rubric (.5, .6, .75, 1) Code field notes for comments based on interaction
September 20, 2016	Online Survey Appendix G	Control and Experimental group Online; unique course hosted in learning management system	Gather demographic info Likert scores and ranked statements (comfort, level, beliefs, experience) Multiple choice (metacognitive)	QUAN analysis/ SPSS or Excel to establish participant information from control and experimental groups QUAN information used to link b/w experience, beliefs and comfort in relation to achievement outcomes
September 22, 2016	Lesson 4.1 Spatial and	3DVLE	Metacognition = Observe spatial and technical	Data: Test-scores Q 5–10 = QUAN

	Technical Orientation Appendix H	Experimental group only	skills in 3DVLE Comment on metacognitive skills (does participant do what they say they do/ feel in space)	Field notes = QUAL Recorded observations experimental group = QUAL Action Use SPSS or Excel to establish participant information from ranked, yes/ no, and cloze answers Q 5–10 Code field notes for comments based on interaction Use matrix (Appendix I) to account for observational data from screen capture recordings of experimental group in relation to outcomes: Do participants' individual observable actions correlate to answers 5–10
	In class activity including a follow-up assessment			
	Researcher field notes			
September 27, 2016	<u>Lesson 4.2</u> Explore your career Appendix J	Classroom & 3DVLE	Results of lesson and assessment 4.2 <i>Language</i> = listening for and incorporation of vocabulary in written response <i>Content</i> = traits, characteristics, and skills <i>Metacognition</i> = connections b/w experiences interacting, choice of careers and speculations made in Q 1 and 2	Data: Test-scores Q 1 & 2 = QUAN Field notes = QUAL Recorded observations Experimental group = QUAL Action: Grade outcomes from Q1 using standardized rubric (.5, .6, .75, 1) Code field notes for comments based on interaction Use matrix (Appendix I) to account for observational data from screen capture recordings of experimental group in relation to outcomes: Do participants' individual observable actions correlate to answers 1 & 2
	In class activity including a follow-up assessment	Control and experimental groups		
	Researcher field notes			

October 11, 2016	<u>Lesson 4.3</u> Defining Sustainable Development Appendix K In class activity including a follow- up assessment Researcher field notes	Classroom & 3DVLE Control and experimental groups	Results of lesson and assessment 4.3 <i>Language</i> = formal versus informal/ content specific and topic relevant <i>Content</i> = writing a formal definition <i>Metacognition</i> = connections b/w experiences and knowledge in critical thinking and problem solving (21 st century skills)	Data: Test-scores Q A, B, D – F Experimental = QUAN Test scores Q A – D Control group = QUAN Field notes = QUAL Recorded observations Experimental group = QUAL Action: Grade outcomes from Q1 using standardized rubric (.5, .6, .75, 1) Code field notes for comments based on interaction Use matrix (Appendix I) to account for observational data from screen capture recordings of experimental group in relation to outcomes: Do participants’ individual observable actions correlate to answers A, B, D – F in experimental group
November 2, 2016	<u>Lesson 4.4</u> Applying Sustainable Development Indicators Appendix L In class activity including a follow- up assessment Researcher field notes	Classroom & 3DVLE Control and experimental groups	Results of lesson and assessment 4.4/ group collaborative writing documents and individual responses where applicable <i>Language</i> = use of topic specific vocabulary particularly relating to sustainable goals, practices, <i>Content</i> = demonstrates understanding of sustainable indicators and trade offs	Data: Test-scores Q 3 Experimental = QUAN Test-scores Q 4 Control = QUAN Field notes = QUAL Recorded observations Experimental group = QUAL Action: Grade outcomes from Q 3 and Q 4 using standardized rubric (.5, .6, .75, 1) Code field notes for comments based on interaction

Metacognition = connections
b/w experiences and
knowledge in critical
thinking and problem
solving (21st century skills)

Use matrix (Appendix I) to account for
observational data from screen capture
recordings of experimental group in
relation to outcomes: Do participants'
individual observable actions correlate to
answers to Q 3

Participants

The participants drawn for this study were a convenience sample of students registered in three sections of an advanced level EAP class. I was the instructor of section C, while sections A and B were taught by a second instructor, thus I played a dual role as instructor and researcher of the experimental group. Research involving the teacher-researcher's own students has potential ethical concerns because a power differential may exist between the researcher and the participant. To mitigate potential risks to participants, a third-party representative outside of the EAP unit was recruited to invite students to participate in the study. This representative went to all three classes in September 2016 to invite students to participate and was responsible for collecting and storing the data until final grades were released. Student participation was voluntary and had no impact on student grades as neither of the instructors, researcher in one case, had access to participant names until winter 2017, after marks for the course had been submitted and window for contestation of marks was closed.

Volunteer participants from all three sections engaged in the same lessons and assessments as their non-volunteer counterparts. My class, the experimental group, had lessons in the 3DVLE, whereas the control group had all lessons in their regular classroom or computer lab. The 3DVLE lessons and corresponding assessments were worth a total of 5 grade points. Participation for the control group was $n = 10$ and for the experimental group $n = 10$. The ages of participants ranged between 18 and 22. All participants were studying concurrently in their degree program at the same university, and came from a range of first language groups, but were primarily Chinese and Arabic speakers.

I acknowledge that convenience sampling limits discussion to a particular group making the results hard to generalize; however, the purpose of the study is to understand how the affordances of the learning space help learners achieve certain outcomes, and so results should help designers determine which tasks are best suited to the space.

Additionally, while the sample size of each the experimental and control group is low, the richness of the observational data and test score results is a significant first step in understanding the relationship between affordances of space, tasks, and achievement outcomes (Dörnyei, 2007; Vogt, 2007).

Instruments

The instruments used in the study included a survey, lessons and related assessment practices, observations, and field notes.

Survey

Students from sections A, B, and C were invited in September 2016 to participate in the study. Interested students were directed to a unique course on the learning management system (LMS) and asked to consent to participation in the study by completing an online survey (Appendix G). The survey was designed to collect information on student demographics, meta-cognitive awareness, and experience with technology. The survey included Likert-type questions to elicit quantitative results. The survey was done outside of class time and is estimated to have taken up to 20 minutes to complete.

Lessons and assessments

All students from sections A, B, and C, regardless of participation in the study, completed Lesson and Assessment 4.0 (Appendix F), 4.1 (Appendix H), 4.2 (Appendix

J), 4.3 (Appendix K), and 4.4 (Appendix L) during class time. The purpose of these activities varied, but they were in line with the instructional goals and overarching theme of the course, which was Sustainable Development. Goals of the course included: identifying individual personality traits, skills, and career preferences in relation to their majors at university (4.0); learning how to move in the 3DVLE (4.1 – experimental group only); understanding characteristics of different careers in relation to their personalities (4.2); defining sustainable development based on academic knowledge and course content (4.3); and applying sustainable development indicators from course content (4.4).

The Lesson and Assessments were designed to target: students' content knowledge regarding an understanding of their majors and disciplines and thematic topic; language in terms of topic specific vocabulary; and meta-cognition regarding their ability to make connections between experience and knowledge. Generally, the Lesson and Assessments 4.0 – 4.4 were designed to determine whether the student has achieved the desired learning outcomes according to the task design and affordances of the 3DVLE space.

Recorded observations

All students from the experimental group, section C, including study participants and non-participants, were instructed to record the Lesson and Assessment 4.1 – 4.4 in the 3DVLE. Students used a screen capture technology called TechSmith Relay, version 5.0.7, to record their experiences. Access to the recordings was made available on an external USB once the final grades were submitted. The recorded data was so that the researcher could examine student interactions in and with the 3DVLE as a consequence

of the task. An observational matrix (Appendix I) was used to analyze the recorded observations for coding of interaction types and frequencies.

Field notes

As the instructor of experimental group and researcher, I elected to keep field notes after each lesson as a source of rich observational data. Hamilton and Corbett-Whittier (2013) describe the importance of field notes for helping the researcher continuously assess the research purpose, direction of goals, and to ascertain whether the data collection choices will ultimately benefit the researcher. Field notes may focus on a range of observations including participant behaviour, mood of room, and physical interactions among participants and can be both descriptive and reflective (USC Libraries, 2016). These notes will help me to recall and illuminate new themes during the analysis and data interpretation stage – “... journal keeping becomes part of the analysis and interpretation process as researchers start to mull over new data and themes” (Duff, 2008, p. 142). In addition to descriptive information, field notes should be reflective and include the researcher’s thinking, questioning and any new ideas that may evolve during the observation process (USC Libraries, 2016). According to Riazi (2016) field notes are systematic, descriptive, observational, and reflective and will become more focused and selective over time. In future studies, I plan to use the field notes as a qualitative data source along with other steps of analysis process. Field notes may be coded according to comments based on interaction and related to categories from the matrix.

Analytical Framework and Procedures

As my research explored learner interactions in non-traditional classrooms spaces, it was important to include more dynamic research approaches for what Phillips et al.

(2012) describe as an “interactive learning system”. Consequently, I chose to use their Learning Environment, Learning Processes and Learning Outcomes (LEPO) framework because it views learning as facilitated by an environment in which the task(s) is acted out and learning outcomes are subsequently demonstrated or achieved – this is appropriate given my research problems and theoretical approach. Under this broad framework, emphasis is on the process of learning, learning environment, and learning outcomes. Especially important for my own research trajectory is the inclusion of physical and digital environments, which include curriculum and task design. Chapter 7 clearly describes the framework and applies the learning process, environment, and outcome to each of five separate activities.

Regarding the learning processes, the LEPO framework recognizes two learning processes, contextual and cognitive, which are important to task and context and the types of learning interactions. Importantly, Phillips et al. describe learning outcomes in relation to 21st century skills, which include topic-specific outcomes and meta-cognitive outcomes, such as problem solving, reflection, and critical thinking. These align with the grading rubric (Appendix M) that was used to score the Lesson and Assessments 4.0 – 4.4. I selected the LEPO model because it is flexible and not prescriptive and focuses on how “...learners and teachers interact with learning environments, processes and outcomes” (Phillips et al., 2012, p. 41). This analytical construct also aligns with Bransford et al.’s (2000) *How People Learn* framework and my proposed fifth lens as explained in Chapter 3. The LEPO framework (Figure 4.2) helped contextualize the data analysis in Chapter 7 and will be used in future analysis as discussed in the concluding chapter, Chapter 9.

Figure 4.2. Analytical framework: Learning environment, process and outcomes.

Online survey

The online survey was designed to establish descriptive participant information regarding demographics, experience levels, and meta-cognitive awareness. Results for the experimental group were used in the study reported in Chapter 7.

Lessons and assessments 4.0-4.4

The assessment section of Lesson 4.3 was scored by two teachers using a standard assessment rubric (Appendix M), which was purposefully created to measure achievement outcomes in areas of subject matter content, language, and meta-cognition. Results were scored as 1, .75, .6, and .5, in loose proximity to university letter grades A, B, C and D respectively. To establish inter-rater reliability, Lesson 4.3 was scored by me and the instructor of the control group. Test scores were compared between control and experimental group to see if the environment contributed to higher test scores in either group. Further investigation compared data from recorded observations to test scores of the experimental group to determine which affordances of the learning space (based on the matrix) may have contributed to achievement outcomes. For this study, I am interested in numeric data in relation to achievement outcomes but recognize opportunity for future qualitative analysis in terms of analyzing language output components, such as vocabulary.

Recorded observations

The recorded participant observations of Lesson 4.3 for the experimental group were analyzed for the study in Chapter 7 using the observational matrix (Appendix I). The matrix was designed to capture types and frequency of interaction depending on the task and location in 3DLVE space and was an outcome of an earlier pilot study (see

Chapter 5). The purpose of the recorded observations is to relate the affordances of the space to the achievement outcomes.

Field notes

Field notes were recorded within 24 hours of each Lesson. The following questions were used to guide my note taking:

- a. What happened with the screen capture technology that may or may not have impacted the data collection process?
- b. What happened with the 3D platform that may or may not have impacted the data collection process?
- c. What patterns of interaction occurred between students in the classroom space?
- d. What decisions needed to be made by teacher/researcher and students as a result of b and c, above?
- e. What was surprising and/or unexpected?
- f. What was said by a student(s) and how does it relate to research question?
- g. How will these observations help the practitioner?

This concludes the original 3DVLE study design. The next section describes the much simpler ePortfolio case study.

ePortfolio Study Design⁷

To address some of these gaps, the ePortfolio study in Chapter 8 uses Eynon, Gambino, and Török's (2014) *Catalyst for Learning* framework to help implement and assess ePortfolio practice at the course level. This framework was created in response to a need for evidence-based research and emerged from a survey of ePortfolio practices

⁷ The design described in this section pertains to the published manuscript appearing in Chapter 8.

across 24 campuses in the United States. Upon identifying strategies and approaches to successful implantation of ePortfolio practice, the researchers conceived the *Catalyst for Learning Framework* which identifies three levels of operation at the core of learning, including faculty and students, programs and majors, and the institutional culture. Further, it considers five interconnected sectors, such as outcomes assessment and integrative social pedagogy. To integrate these five sectors, the team identified three design principles including inquiry, reflection, and integrative or connective learning. The framework supposes that success depends on implementation at and across multiple levels – levels of operation, interconnected sectors, and design principles.

During the process of unravelling the complexity of the affordances in 3DVLEs, I began to experiment with ePortfolios in my teaching practice. This prompted the design of a second study to investigate ePortfolio practice in an EAP classroom. Despite the increased use of ePortfolios as a learning tool in North American higher education, there is still a paucity of research on what constitutes effective ePortfolio pedagogical practices (Eynon & Gambino, 2017; Fox, 2017). Therefore, the objective of the case study presented in Chapter 8 was to investigate how an ePortfolio practice confirmed, challenged, or improved upon the Catalyst for Learning Framework (Eynon & Gambino, 2017), which was created to guide the quality and effectiveness of ePortfolio best practices. Specifically, the study addressed the following research questions.

1. How do the ePortfolio pedagogical practices used in an EAP course align to the Catalyst for Learning ePortfolio framework?
2. To what extent do the ePortfolio practices used in an EAP course contribute to students' achievement of inquiry, reflection, and integration skills?

The methods and results of this case study are reported in Chapter 8 titled, *What is ePortfolio “done well”? A case of course level analysis*. Simply, we collected data in the form of 1) online survey responses from student participants 2) a short-answer questionnaire sent to the two course instructors, and 3) ePortfolio assignment descriptions and assessment rubrics. This research was approved by Carleton University’s Research Ethics Board, Ethics ID: Project 106605 (see certification of ethics, Appendix N). Full details of the study design, methods, and analytical procedures are outlined in Chapter 8.

This concludes the methods chapter. The next four chapters include manuscripts, published or not, that make up the dissertation. Refer to Table 1.1 for an overview of research questions and order of presentation within the dissertation. Chapters 5–8 begin with a forward to situate the manuscript within the progression of the dissertation.

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Chapter 5

Beyond the Survey: Observing Pedagogical Interactions in a 3D Virtual Learning Environment

Throughout the dissertation I have attempted to contextualize the trajectory of my thinking within a formal program of research. The manuscript which follows was submitted for publication to two separate journals and was rejected both times; however, this manuscript helped to guide the direction of my research at its early stages and so I have elected to include it as a unique, almost forwarding, chapter in this manuscript part of the dissertation.

The article was initially submitted to ReCALL, the journal for the European Association for Computer Assisted Language Learning, in late 2015. While the editor commented on the potential and value of the manuscript, the reviewers asked for substantial revisions, including updating the literature review section on 3DVLE studies, reorganizing subsections of the article, and refining the section on affordances. I made the necessary revisions and resubmitted the article in early 2016. In mid-2016 I received a notice that my revised submission had been sent to a third reviewer, as the first two reviewers had conflicting decisions. In the end, the two reviewers were satisfied with the updated literature review section, though one commented on an awkward shift from socio-cultural theory in the literature review section to a focus on space in the discussion section. The third reviewer felt that the methods section was weak and the expected learning objectives were undefined. Although the final decision to reject the manuscript was disappointing, the process of revision and the three reviewers' feedback was immensely valuable in directing my next steps—namely, clarifying the affordances of

space in relation to theory. The study design for this early manuscript was a useful pilot in preparing the ethics proposals for the larger 3DVLE and ePortfolio studies that followed (Chapters 6 and 7, and Chapter 8, respectively).

In late 2017, I submitted the revised article to a second journal. The editor immediately rejected the manuscript, commenting on a lack of a clear theoretical framework. Had the article been accepted for publication I would have been delighted, of course; but the editor's decision to reject the article reaffirmed my decision to focus on constructing a suitable theoretical framework for investigating 3DVLEs and the affordances of online learning spaces. Recall that this article was written in my first year of PhD studies, and so the lack of a clear theoretical framework is understandable, particularly since early on I struggled with the literature, which I felt did not provide suitable theoretical frameworks for my purposes. In response, the theoretical chapter of this dissertation, Chapter 2, is substantial and explains how and why I have worked to construct a theory to explain the role of space in learning. The revised manuscript—including the abstract, manuscript, and appendices—follows in the original format submitted to the second journal.

1 Beyond the survey: Observing interactions in a 3DVLE.

Abstract

3D virtual learning environments (3DVLEs) are increasingly used and studied for their pedagogical potential in language learning due to the affordances of the space and synchronous interaction. Studies to date have employed linear instruments like surveys and pre and post-tests to measure outcomes but have not yet examined how learners interact with and because of these spaces. This paper outlines the findings of an exploratory study that investigated the effectiveness of 3DVLEs as unique environments for English as second language (ESL) teacher training and for English as foreign language (EFL) learning. The purpose of this research is to understand the pedagogical potential of 3DVLEs and to explore potential methods of analyzing pedagogical interactions. A key finding was the need for and subsequent development of an observation matrix to facilitate the analysis of recorded observations. This paper focuses on the development and initial application of the matrix.

Keywords: 3DVLEs, qualitative exploratory study, English as a Second or Foreign Language, observation matrix

2 Beyond the survey: Observing interactions in a 3DVLE.

Beyond the survey: Observing pedagogical interactions in a 3D virtual learning environment.

Introduction

3D virtual learning environments (3DVLEs) create novel spaces for education and professional development. The rich affordances of space and real-time interaction within these environments create opportunities for online interaction with tasks, tools, and other users, and thus make them potentially viable contexts for language teaching and learning. Although research and literature in the area of 3DVLEs and computer assisted language learning (CALL) is indeed growing (Henderson, Huang, Grant, & Henderson, 2012; Molka-Danielsen, Mundy, Hadjistassou, & Stefanelli, 2012; Peterson, 2009, 2010), the focus is often on task outcomes determined by pre- and post-tests, or on learner perceptions based on survey responses. Few studies have analysed recorded observations of actual user interactions. Hence, the pedagogical role of these unique learning environments is still largely undefined in terms of how the users interact with and because of the space.

The aim of this exploratory study was to evaluate the pedagogical potential of 3DVLEs and to better understand how the spaces created in these environments facilitated opportunities for interaction. A secondary aim of the study was to explore possible methods of carrying out research in 3DVLEs. More specifically, it sought to develop a framework for analysing pedagogical interactions within these environments. Pedagogical interactions in this study are defined as any learner interaction observed during the process of working towards task completion. These interactions will be described in more detail in a later section of this paper.

To address the above research aims, this study examined the learning and teaching experiences of a small group of English as foreign language (EFL) learners from a Turkish university and two teacher-interns from Canada. Their interactions occurred in a purposefully

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designed 3DVLE where the teacher-interns prepared tasks and facilitated learning opportunities as part of a materials development project for their Certificate in Teaching English as a Second Language (CTESL) program. This paper primarily focuses on how the learners interacted with the teacher-interns and the space to accomplish a task, and the development and application of a matrix used to analyze these interactions.

Review of Literature

Kern and Warschauer (2000) consider third generation internet-based and computer mediated communication tools like 3DVLEs to be “newer areas” in CALL research because these tools promote social interactions that engage the learner in activities promoting knowledge construction (Blake, 2008; Chapelle, 2000). However, as empirical research in the area of Web 2.0 tools and 3DVLEs develops, it remains a challenge to classify new tools and define frameworks for language learning and pedagogy (Lomicka & Lord, 2009; Reinhardt & Sykes, 2012).

Language Studies in 3DVLEs

The most frequently studied 3D environment in the language learning literature is Second Life (<http://secondlife.com>) as seen in studies by Chung (2012), Henderson et al. (2012), Lan (2015) Lan, Kan, Hsiao, Yang, and Chang (2013), Peterson (2012), and Zhang (2012). Second Life is an immersive virtual platform developed by Linden Lab that includes virtual realstate, a virtual economy, and is a medium commonly used for entertainment, business, and education. Language learning studies typically identify features of immersion, interaction, and anonymity and claim that these qualities lead to increased feelings of motivation and satisfaction among students (Berns, Gonzalez-Pardo, & Camacho, 2013; Chung, 2012; Milton, Jonsen, Hirst, & Lindenburn, 2012; Peterson, 2012). However, many of these studies have very few participants

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and/or are of short duration, and provide little convincing evidence as to whether learning outcomes are achieved as a result of these features. Further, the actual learning platforms differ between studies, and so findings may not be generalizable.

Studies of 3DVLEs for language learning and teaching emphasize the role of time, space, and interaction; however, the researcher may not always explicitly state the significance of each of these. For instance, survey results frequently report on learner satisfaction and increased motivation in this non-traditional learning space (Berns et al., 2013; Milton et al., 2012; Peterson, 2012), but rarely account for the role of the space and tools in terms of user actions. In contrast, Sykes, Oskoz, and Thorne (2008) stress the importance of “immersive modalities”, such as 3DVLEs, for language socialization and comment on their effectiveness not just as a tool for learning, “but also as relevant interactive contexts in and of themselves” (p. 535). Lan’s (2015) recent large scale study succeeded in observing the behaviour of 132 primary school students in Taiwan in a physical and virtual teaching context. Her comparison of teaching spaces helped validate the affordance of space in promoting conversational skills and demonstrated the importance of observing actual learning behaviours. Future studies might further investigate 3DVLEs not merely as a place for learning, but also as a tool that helps mediate or facilitate learning (Blin & Munro, 2008; Jin & Zhu, 2010).

Affordances of 3DVLEs

The concept of affordances refers to how a tool facilitates or promotes interaction or learning, and can be defined as “...a quality of an environment which allows an individual to perform an action” (Molka-Danielsen et al., 2012, p. 3). Warburton (2009) claims the physical and social dimensions of 3DVLEs promote quality interaction and communication; as such, in

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the context of this paper the significant advantages of these environments are the affordances of space and real-time interaction.

The role of space. 3DVLEs are visually and spatially rich. They can be designed to replicate major urban centres (Harris & Rea, 2009; Ibáñez, Garcia, Galan, Maroto, Morillo, & Kloos, 2011; Milton et al., 2012) and physical spaces like classrooms (Author(s), Year; Milton et al., 2012). This immersive quality provides spaces for learner-teacher interaction that can foster types of social interaction familiar to users in face to face (f2f) contexts, such as restaurants and libraries (Lan, 2015). With appropriate task and space design, 3DVLEs can become visually realistic social contexts that promote learner interaction and collaboration (Ibáñez, et al., 2011; Iqbal, Kankaanranta, & Neittaanmaki, 2010; Lan, 2015; Peterson, 2006). Designers of these “open-ended” spaces (Warburton, 2009) have the freedom to include objects, such as a snowman or a refrigerator, that will complement a specific task or learning outcome. From this perspective, these spaces can be viewed both as mediums within which social interaction might occur, as well as spaces which of themselves mediate learning. Such spaces allow for authentic active interactions and provide a place in which users can have new experiences shaped by other users and by the environment; According to Ibáñez et al. (2011), “[o]ne of the best ways to learn a language is to be exposed to real situations in which it must be used to communicate” (p. 2).

Real-time interaction. In addition to the affordance of space, there is also the ability to interact in real-time –using voice, movement, and text– with users from any geographical location (Chung, 2012; Eschenbrenner, Nah, & Siau, 2008; Author(s), Year; Ibáñez, et al., 2011; Lan, 2015; Milton et al., 2012; Peterson, 2006; Warburton, 2009). This ability to interact in real time with other users in the target language may provide significant learning opportunities compared to asynchronous, online mediums such as blogs, because the immersive quality

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establishes a sense of community through socialized collaboration. In other words, there are greater opportunities for interaction in these environments because of the real-time interaction, and the expansiveness of space, tools, and objects provided therein.

Opportunities to interact frequently and synchronously allow learners to engage, negotiate, and participate in real social activities. According to Gee and Hayes (2011), learning a language in order to communicate is a social behaviour, “like learning a sport and joining a team” (p. 63). Blake (2008) likewise says, “a second language is best learned and taught through interaction” (p. 3). 3DVLEs allow multi-user voice over Internet protocol (VoIP), and synchronous communication and text, which lead to an increased number of interactions in the target language among users (Chung, 2012; Gee & Hayes, 2011; Ibáñez et al., 2011; Peterson, 2006, 2012; Warburton, 2009). Chung’s (2012) study claims that the above affordances are motivators; her study shows that learners reported being motivated because of the opportunities to interact with others in a game-like setting. Likewise, Peterson (2012) credits *Second Life* for decreasing learner inhibitions and thereby increasing the frequency of interactions. Peterson (2011) similarly claims that choosing an avatar persona helps users create a sense of partial anonymity, which facilitates greater risk-taking while interacting in the target language.

Logically, if the affordances of 3DVLEs promote learner interaction, and interaction is necessary for second language acquisition, then 3DVLEs might facilitate SLA through specific tasks. As expressed by Milton et al. (2012), “The challenge for language learning in these environments is to engineer tasks which require learners and native speakers to interact and where a condition of success in the task is the meaningful use of language” (p. 101). To truly benefit from the earlier noted affordances of the environment, teachers need to understand “how, when, where, and why they are put to use” in the process of task design (Gee & Hayes, 2011, p.

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4–5). Language teaching methodology and task design for 3DVLEs should take advantage of the expansiveness and affordances of space.

Description of the 3DVLE Spaces

To contextualize the findings discussed later in the article, this section provides a detailed description of the two 3DVLE spaces in which this study took place. The primary location was Virtual (CV), an Internet hosted platform supported by AvayaLive Engage (<http://avayalive.com/Engage/>), designed to closely replicate a university campus complete with lecture halls, campus buildings, and outdoor spaces. Other features included collaborative surfaces where users could share documents, webcams, and media (Figure 1), as well as a First Nations village and an archaeological dig site.

Figure 1. Collaboration board and writing pad in gallery building.

In subsequent design phases, a new building was added to include a classroom for small group work (Figure 2). Other additions included cultural artefacts selected to represent Canadian and local culture, such as maple trees, a snowman, and a skating rink (Figure 3).

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Figure 2. Classroom designed for small group work.

Figure 3. Main floor of new building with Canadian cultural artifacts.

The most recent design phase included the addition of a market area, café, and residential section (Figure 4). Like the immersive main campus area, this market space has several collaborative surfaces, including three side-by-side work surfaces (“graffiti boards”) to allow for synchronous group work, collaborative discussion, group editing, and access to other media, such as a web renderer and media players (Figure 5).

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Figure 4. Downtown market area with shops, café, and residential section.

Figure 5. Three work surfaces (“graffiti boards”) for collaborative work and idea sharing.

The secondary location (CV2) of the study differs from the space described above according to the physical representation of spaces, but includes the same avatar functions and operations. While CV replicates a university campus, downtown market area, and residential section, CV2 is more game-like, including a self-directed navigation maze, a campfire (Figure 6), several game-like areas, such as the word matching game for parts of speech (Figure 7), and an interactive Boggle game (Figure 8).

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Figure 6. CV2 campfire with images uploaded for specific activities.

Figure 7. CV2 word matching game for parts of speech.

Figure 8. CV2 interactive and collaborative Boggle game.

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In addition to the locations described above, the users' avatars have access to 10 gestures, including a wave and point option. Users can move their avatar in all directions, including a run and jump option. Avatar users can communicate through text chat, collaboration surfaces, and voice through a USB headset with microphone.

Methods

As discussed in the Introduction, this exploratory study was designed to help the researcher understand the pedagogical implications of 3DVLEs for language learning and teaching, and to understand how to best carry out research in these spaces. A significant finding of this study was the need for an observation matrix to facilitate an understanding of the role of space. The researcher designed a matrix to suit this need and found that user interaction became clearer as a result. The matrix design process is included in the description of study methods below.

Participants

There were two learner-participant groups: the first group included seven EFL students from an English medium university in Ankara, Turkey; the second group included two volunteer teacher-interns from a Certificate in Teaching English as a Second Language (CTESL) program at a university in Ontario, Canada. All EFL participants were under the age of 20 years old and in their first year of a five year university program in which the first year is intensive English. There was one male and six female participants. The two teacher-interns, one male and one female, were between the ages of 20 and 25 years old and in their final year of four-year university degrees. All participants reported intermediate to expert levels of computer expertise and various degrees of experience with virtual worlds and gaming.

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Procedures

The study spanned a period of six weeks. It included a pre-session online survey (see Appendix A) completed by all participants, one 45-minute orientation for EFL participants, five recorded teacher-intern-facilitated online sessions, and an informal follow-up meeting with the teacher-interns. The orientation was held prior to the teaching sessions and was facilitated by the researcher and a member of the design team.

Prior to the orientation, an email invitation to complete the online survey was sent to all participants. EFL participant invitations included an eight minute video (supported by text) of the researcher explaining the purpose of the study and survey. The video explanation was to account for differences in language levels by providing an alternate (to text) medium of explanation (Brown, 2001).

The survey instrument began with six questions about participant demographics. These were followed by 16 closed-response questions with a four-point Likert-scale that rated participants' expertise with technology and gaming, and learned about their attitudes and beliefs regarding the importance of technology and interaction for language learning and teaching. The teacher-interns completed the same online survey with four additional open-response questions about their anticipated experiences preparing materials and teaching in this non-traditional space versus a f2f context.

The 45-minute orientation for EFL participants was intended to mitigate the need for trouble-shooting and to boost user competence once the teaching sessions began. Several studies have commented on the benefits of such orientation activities that give opportunities to practice voice and other functions prior to taking part in any learning activities (Lan et al., 2013; Peterson, 2012). The orientation consisted of a guided "self-training" lesson whereby

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participants worked through a series of instructions posted throughout a Navigation Maze (Figure 9). In order to advance, participants had to successfully complete each task. Tasks were designed so that learners new to this 3D space could learn how to manipulate the appearance of their avatar, move their avatar, and use other functions unique to this platform. The orientation session culminated around a virtual campfire (Figure 6) where an informal discussion took place to check in with participants' comfort levels moving forward.

Figure 9. CV2 self-training lesson in Navigation Maze with step-by-step instructional boards.

One week after the orientation, the teacher-interns facilitated five successive language learning sessions. Table 1 provides a rudimentary outline of each teacher's session according to task, location in the environment, and the particular feature of the space with which the users interacted. Note that Sessions 1 through 3 were conducted concurrently, where each teacher-intern facilitated their own sessions in CV with approximately half of the EFL participants each. Session 4 was facilitated by Teacher A in CV with all EFL participants. Session 5 was facilitated by Teacher B in CV2 with all EFL participants. All sessions were between 60 and 90 minutes.

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Teacher-interns were free to develop their own materials and tasks based loosely on the themes, key vocabulary, and grammar of the Turkish syllabus. All sessions were recorded for later analysis using screen-capture recording software.

Finally, the researcher met with the two teacher-interns after all sessions were completed. This informal meeting inquired about teacher-interns' overall experiences and their joys and frustrations preparing and facilitating tasks in this new space.

Findings and Discussion

The pre-session survey showed that most participants reported an intermediate or higher level of comfort using new technology and an intermediate or higher level of computer expertise. Only four participants reported having any prior experience with 3DVLEs.

The first two open-ended questions for teacher-interns aimed to uncover the perceived pedagogical potential and anticipated complexity of task preparation for a virtual environment compared to a physical classroom. Both interns commented on the newness of the space as a key difference between a virtual and a physical classroom. For example, Teacher A anticipated that students might progress through tasks at a different pace depending on their familiarity with the environment. Teacher B noted that indeed the 3DVLE is a very different place from the traditional classroom and may be suited to different teaching ideologies, beliefs, or practices: "We overlook the physical environment of a classroom in lesson planning and tend to not realize that we have shattered it and its ideals once we have moved into the online world".

Question 3 asked teacher-interns about the anticipated benefits and challenges of teaching in the 3DVLE. Both teacher-interns appreciated the flexibility of time and space. As noted by Teacher A, "Time and space are crucial here," while Teacher B commented on the advantage of "freedom and imagination". However, their views differed regarding expected challenges.

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Teacher A highlighted challenges relating to technology and navigation in the space in relation to successful task completion. Meanwhile, Teacher B was more concerned with “breaking the norms” of current ESL methodologies, suggesting that current methodologies were not suitable for 3DVLEs as they did not adequately account for the benefits of the space. The results of these open-ended questions point to a need for further research in terms of pedagogy, methodology, and task design for 3DVLEs.

Matrix Design for Recorded Observations

To respond to the research question, “How do we analyse pedagogical interactions in these environments?” the researcher first reviewed the five recorded sessions to see what tasks the teacher-interns performed with the EFL participants. Table 1 describes the tasks, the location in the environment, and the tools and features used to complete the tasks.

Table 1

Teacher A and B's Session Overview

Session	Tasks	Location	Features of Space
1A	<ul style="list-style-type: none"> Focus on Winter Olympics and vocabulary Pre listening about the topic “snow” Instructions and comprehension questions posted 	<ul style="list-style-type: none"> CV Room 240 SLaLS building 	<ul style="list-style-type: none"> Chairs in grouped tables Web-renderer surfaces PPT surfaces

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	<ul style="list-style-type: none"> · Request to take notes while listening 		
1B	<ul style="list-style-type: none"> · Guided discussion of Olympics · Joins Teacher A's group to do read aloud 	<ul style="list-style-type: none"> · CV · Tour of downtown and residential area · Foyer in a building on campus · Auditorium of same building 	<ul style="list-style-type: none"> · Whole environment space · PPT surface · Media player · Movements ·
2A	<ul style="list-style-type: none"> · Animal testing (advantages and disadvantages) 	<ul style="list-style-type: none"> · CV · Room 240 in SLaLS building 	<ul style="list-style-type: none"> · Emailing written responses for group discussion · PPT · Internet search engine
2B	<ul style="list-style-type: none"> · Cover letters, job hunting, CVs, persuasive techniques · Posted examples of advertised jobs · Writing a collaborative cover letter 	<ul style="list-style-type: none"> · CV · Campus building foyer 	<ul style="list-style-type: none"> · Campus · Internet search engine · PPT surface · Text editor · Web-renderer surfaces
3A	<ul style="list-style-type: none"> · Lesson around food, grocery shopping, 	<ul style="list-style-type: none"> · CV · Market area 	<ul style="list-style-type: none"> · Graffiti boards

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	grocery lists, favourite dishes	· Bakery shop	
3B	· Poetry and metaphors	· CV · Use of auditorium in campus building · Full environment · Gallery building	· Full environment · Artefacts, images on walls, residential section, Indian village, Gallery, ambulance, etc. · PPT surfaces · Public notepad
4A	· Lesson around the dissemination of news through social media	· CV · Room 240 SLALS building	· Domes · Group work stations · Web-renderer surfaces · PPT surfaces
4B	No Lesson for Teacher B		
5A	No Lesson for Teacher A		
5B	· Occupational skills · Vocabulary · Sentence structure	· CV2 · Fire pit area · Word match station · Sentence combining station · Boggle-like game	· Chairs around campfire · PPT surfaces · Word match and sentence combining surfaces

station	· Boggle-style game and writing pad
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During this initial review, it became clear that the study’s original design did not provide an adequate framework for analyzing recorded observations. While Lan’s (2014) experimental study using a modified version of Moskowitz’s FLint System to observe behavioural interactions could have been used here, it did not suitably account for interactions in terms of features or objects in the space, teacher practice and student groupings, and learner’s interactional behaviour with other users or objects in the 3D spaces. Thus, the researcher designed her own observation matrix (Figure 11) that included things like: use of text function or collaboration surfaces; type of discourse and group configuration; and instances and types of interaction with other users, tools in the environment, and the space as a whole. Future studies of 3DVLEs could also make use of analytics in combination with a refined observation matrix such as the one provided here to help clarify the role of space.

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Learner's interactional behaviour		Teacher practice	Other features of space
Interaction with space or tools (including movement and gestures)	Interaction with peer	Interaction with teacher	Teacher discourse
High (5+ instances)	Low (3-4 instances)	Very low (0-2 instances)	Use of collaboration surfaces
Very low (0-2 instances)	High (5+ instances)	Whole group	Use of text function
Low (3-4 instances)	Very low (0-2 instances)	½ group +	Use of web renderer
High (5+ instances)	Low (3-4 instances)	Pairs	Use of writing pad
Very low (0-2 instances)	High (5+ instances)	Individual	
Low (3-4 instances)	Very low (0-2 instances)	Housekeeping/ technical support	
High (5+ instances)	Low (3-4 instances)	Task-based or instructional	
Very low (0-2 instances)	High (5+ instances)	informal	
Low (3-4 instances)	Very low (0-2 instances)		
High (5+ instances)	Low (3-4 instances)		
Very low (0-2 instances)	High (5+ instances)		
 		
Low (3-4 instances)			

Figure 11. Observation matrix for 3DVLE.

While designing the matrix, the researcher defined the primary unit of analysis as the duration of task. Further categories emerged through initial observations and subsequent rounds of analysis. Categories included those listed in Table 1 (task, location, features of space), as well as instances of observed teacher practice and learner's interactional behaviour, which served as impromptu first and second level coding (Saldaña, 2009). These categories were selected according to the emerging importance of space and interaction in the overall process of task completion, and in order to facilitate an analysis of selected sections from each of the five recorded sessions. Figure 11 shows the listed categories and matrix.

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Findings from Recorded Observations

Equipped with the observation matrix described above, the researcher analyzed the recorded participants' interactional behaviour in the 3DVLE. Due to time constraints, five individual recorded sessions were randomly selected. Early observations showed an expansive use of space as tasks were carried out throughout the environment, including the traditional classroom space, the market area, and other buildings in the virtual campus. Teacher-interns and students also made use of several collaboration surfaces –e.g., writing pad, web-renderer, and texting function (Figure 12). Further observation looked at the learners' interactional behaviour with their teacher, peers, and space, including choice of tools, movements, and gestures.

Student participants typically displayed five or more instances of interaction with their teacher, peers, or space during each task. In this case, "space" included the environment, collaboration surfaces, and replicated artefacts, as well as use of gestures, text, voice, and movement. For this preliminary study, the researcher calculated that 0-2 instances of interaction were considered very low, 3-4 instances of interaction were low, and 5 or more instances of interaction was high. This calculation was an arbitrarily determined calculation meant as a benchmark and requires validation in future studies. Duration and quality of interaction were not the focus of this particular study.

Teacher A made more frequent use of the traditional classroom settings, such as the new classroom that featured small group work stations and several collaboration surfaces for uploading instructions and accessing web-based tools or information. Teacher A confined three of four sessions primarily to this area with mixed observed outcomes in terms of level of learner interaction with space, tools, the teacher, and each other. For example, in Session 2, students read a text posted in the classroom on animal testing. This quiet and independent reading activity

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was followed by a shared discussion in which participants were asked to identify specific vocabulary in the text that suggested advantages of animal testing. While there were low instances of interaction with teacher and peers, students did interact with tools like the text function and the posted their responses on collaboration surfaces.

Conversely, in Session 3, students with Teacher A were tasked with preparing an itemized grocery list for a meal. This was held beyond the simulated classroom in CV and made greater use of the whole environment, including the café, market area, and graffiti wall. All participants were actively involved in the task outcome and made use of the collaboration surfaces, e.g., to share images of their food dishes. This was reported as the most satisfying session for Teacher A, who noted during the informal post-session meeting, “I remember them being really happy...really having fun”.

While Teacher A made more use of traditional classroom-style spaces, Teacher B tended to use the whole environment as a necessary function of the task. For instance, in Session 3, students started in one of CV’s auditoriums where they were introduced to several poems. The teacher made use of the collaboration surface and text functions to explore the meaning of two poems. Next, students were sent out in pairs to find examples of metaphors anywhere in the virtual space. This gave students the freedom to move, explore, and interact as they searched. Recorded observations showed that participants interacted with the full environment, including artefacts, images displayed inside the virtual houses, an accident scene, and the Gallery.

For Session 5, Teacher B ran a virtual fieldtrip in CV2 instead of the CV space. Again, the entire space was used for each of the four tasks, which played out in four different locations. Instances of observed interaction were high in terms of interaction with the tools, each other, and voice and movements. Coincidentally, the tasks that elicited the most spoken interaction were the

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three tasks that required more movement and interaction with tools. For instance, in the first task students were seated around a virtual campfire and were asked to predict the occupations and skills of characters depicted in cartoon images of various posted professions (Figure 6). While students appeared engaged, the instances of interactions with each other and the space was low compared to the Boggle-style game in which students were divided in two groups and had to come up with as many words as possible from the Boggle pad (Figure 8). Their Boggle words were recorded collaboratively on a notepad and then used to make meaningful sentences. The instances of observed interaction with the teacher, each other, and the tools were high.

Figure 12. Expansive use of the environment and interaction with space and tools.

Limitations

In reporting on these outcomes the researcher acknowledges that this study has limited generalizability due to the low number of participants and the short duration of the study. Additionally, participation rates were low inconsistent across the five sessions ($n =$ between 4 and 7). Moreover, survey anonymity made it impossible to connect results to observational data, and so only the observational data was comparable across sessions. Another limitation was the quality of some of the screen-capture recordings used for observation analysis: in some cases the recordings did not capture all of the users' speech, or all of the activities and interactions. Future recordings should include multiple vantage points and in shorter segments to avoid uploading

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complications. Nonetheless, as an exploratory and emergent research design, these preliminary results depicted some useful findings to guide future studies.

Conclusion

The growing popularity of 3DVLEs for language learning and teaching offers a relatively untapped area for research across multiple domains, including CALL, second language teaching methodology, and task design. Empirical studies are beginning to understand the role of these spaces for language teaching in relation to the many affordances of the space. Research should continue to assess learning and achievement outcomes, identify pedagogical frameworks for task design, and measure learner motivation and sense of identity in relation to these environments.

The findings in this exploratory study suggest an emerging need for theory that better explains interactions with the space and time and as a result of the task. Research should question the role of the environment as a mediator in the overall learning process. For instance, the matrix used in this study might be further refined to include time elements such as time spent troubleshooting, time running to new places in the environment, and time spent waiting for others or for teacher instruction. Similarly, elements such as requests for turn-taking and impromptu dialogues could further strengthen the matrix. While some of these elements may seem irrelevant, further analyses could consider the function of language and specific dialogue generated solely for these purposes.

This study serves as a prototype study for ongoing research. As a result of this exploratory process and because of the relative newness of this research area, new questions continue to evolve. Future studies should account for the role of task in relation to contemporary theories in CALL, CMC, and theories that are informed by time and space. As Reinhardt and

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Sykes (2012) point out, the trans-disciplinary nature of this research area depends on a clear taxonomy that classifies the actual environment (Second Life versus CV), the intended outcomes, and the pedagogy or methodology.

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Appendix A

Pre-Session Online Survey

Part 1 Demographic Information

1. I am:
 - a. CTESL student
 - b. TED University student
 - c. Other
 2. I am
 - a. Male
 - b. Female
 - c. Other
 3. I am
 - a. Less than 20 years old
 - b. Between 20-25 years old
 - c. Between 26-30 years old
 - d. Over 30 years old
 4. I live in:
 - a. Ottawa area
 - b. Other
 5. My first language is
 6. My area of study or major is _____
-

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Part 2 Comfort, level, & experience

1. I am comfortable trying new technology

Not at all	Somewhat	Mostly	Very
1	2	3	4

2. I would rate my level of computer expertise as

Beginner	Intermediate	Expert
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3. My experience with 3D worlds/ environments like Second Life, is

None	Beginner	Intermediate	Expert
1	2	3	4

4. My experience with computer gaming like World of Warcraft, is

None	Beginner	Intermediate	Expert
1	2	3	4

5. I use Social Networking sites like FaceBook, Twitter, LinkedIn

Not at all	0 - 30 minutes a day	30 - 60 minutes a day
65 - 120 minutes a day	2+ hours a day	

6. I own a netbook, notebook, laptop, smart phone, personal computer, eReader, etc...

None of these	1	2 - 3	4 or more
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Part 3 Confidence and beliefs

Use this scale to answer the following questions:

On a scale from 1 (Not at all) to 4 (very), rate the following statements (these measure confidence)

No, not at all	Sometimes	Often	Very
----------------	-----------	-------	------

1	2	3	4
---	---	---	---

7. I expect 3D virtual environments to be difficult.

1	2	3	4
---	---	---	---

8. I expect 3D virtual environments to be fun.

1	2	3	4
---	---	---	---

9. I expect learning/teaching in a 3D virtual environment to be socially interactive.

1	2	3	4
---	---	---	---

10. I expect speaking as an avatar to be difficult.

1	2	3	4
---	---	---	---

11. I expect communicating with the 3D virtual student/ teacher avatar to be easy.

1	2	3	4
---	---	---	---

12. Computer skills are necessary for language learning.

Strongly disagree	Somewhat disagree	No opinion	Somewhat agree	Agree
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13. A 3D immersive course will provide a learning experience similar to the classroom.

Strongly disagree Somewhat disagree No opinion Somewhat agree Agree

14. A 3D immersive online course allows for social interaction.

Strongly disagree Somewhat disagree No opinion Somewhat agree Agree

15. I believe simulation and role playing should be a component of learning.

Strongly disagree Somewhat disagree No opinion Somewhat agree Agree

Part 4 Teacher-intern participants only

1. How do you think that preparing teaching tasks for a 3D virtual environment context will be the same or different as for a regular classroom context?
2. How do you feel about teaching in this type of environment compared to a traditional face to face context?
3. What do you expect will be one of the biggest benefits of this environment for language teaching and learning?

Chapter 6

Investigating research approaches: Classroom-based interaction studies in physical and virtual contexts

The manuscript in this chapter was submitted to a 2018 special issue of the journal *ReCALL*, titled "Interactions for Language Learning In and Around Virtual Worlds" (volume 30, issue 2, pages 161–176). The call for papers requested research that explored theoretical frameworks related to practice, and/or outlined methodological approaches in social virtual worlds. The published manuscript follows in its original format and has been reprinted with the permission of Cambridge University Press granted on August 9, 2018.

Investigating research approaches: Classroom-based interaction studies in physical and virtual contexts

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Abstract

This article investigates research approaches used in traditional classroom-based interaction studies for identifying a suitable research method for studies in three-dimensional virtual learning environments (3DVLEs). As opportunities for language learning and teaching in virtual worlds emerge, so too do new research questions. An understanding of research design benefits and limitations is timely for those exploring how interaction occurs between users, and users and the virtual space, and how these interactions make sense within a broader theoretical framework. As a first step, the article describes the types of interaction that are significant to classroom-based research studies, such as learner–learner. This is followed by a historical overview of research approaches and methods used in interaction studies, from early quantitative, to descriptive and qualitative, to mixed-method approaches. Following this overview, the author critically surveys research approaches, methods, analytical tools, and data collection techniques used in physical and virtual second language classroom interaction studies. The article concludes by highlighting the implications and research considerations for the design of new research studies in 3DVLEs.

Keywords: 3DVLEs, interaction studies, research methods, language learning, data types

1 Introduction

Doing research, whether formal or informal, primary or secondary, has the potential to positively influence teaching practice and learning outcomes. Classroom research helps bridge the gap between theory and practice as researchers try to make sense of what is going on in different teaching contexts in order to inform new practices. But what research approaches have been used to investigate classroom-based interaction in both physical and virtual settings, particularly in the context of language teaching and learning in and around virtual worlds? What are the benefits and limitations of these approaches? The purpose of this article is to survey the types of classroom-based research approaches used in physical and virtual contexts to guide research in three-dimensional virtual learning environments (3DVLEs).¹ Of interest is investigating how interaction occurs among users, and between

¹ 3DVLEs are online spaces designed to replicate real places and objects. They provide users the opportunity to interact with other users synchronously and are not limited by geographical boundaries (Hartwick, 2015).

users and the virtual space. This focus is motivated by personal experiences with my own learners and the desire to systematically document what was going on as students were observed interacting with and in these 3DVLEs. These early experiences prompted me to survey research methods, not necessarily findings, in second language acquisition (SLA) and computer-assisted language learning (CALL) literature that could help in research design. The ever-growing popularity of 3DVLE technologies for language learning and teaching offers an exciting area for research opportunities across multiple domains, including CALL and second language methodology; thus, exploring effective research design is timely and important. This article explores methodologies used in classroom-based interaction studies to understand which methodologies may best apply to research in 3DVLEs. As empirical research in 3DVLEs develops, this article includes an overview of research approaches and methods in the area of second language classroom interaction in both physical and virtual contexts to inform research practice.

To begin, I provide a description of both the physical and virtual classroom context and classify the types of interaction more commonly found in second language studies and as highlighted in Gass and Selinker (2008). This is followed by a historical overview of research approaches and methods. Next, I briefly survey certain studies in the role of physical classroom settings in classroom interaction, followed by studies in virtual classroom settings. The purpose of this literature review is to identify common research approaches, methods, analytical tools, data collection techniques and types, and their benefits and limitations in physical language classroom interaction studies in SLA and to compare them to those approaches used in CALL 3DVLE studies.

2 Definitions

This section defines the classroom context and specifies the types of classroom interaction typically investigated in second language learning and classroom interaction studies.

2.1 Classroom context defined

Research in the area of language teaching and learning and classroom interaction typically investigates what contributes to successful learning outcomes; however, many other variables can be the focus of classroom interaction research, such as the beliefs, attitudes, and personalities of participants, or the social contexts in which the research takes place (Brown & Rodgers, 2002; Chaudron, 1988). The article considers the online and virtual classroom space as a newly defined social context in which learning and, subsequently, research take place.

In his book *Second Language Classrooms: Research on Teaching and Learning*, Chaudron (1988) addresses the complexity and breadth of the second language learning context. Broadly, he identifies the foreign language (FL) and the second language (L2) context as variables. He describes the FL context as one in which the learner is assumed to have little exposure to the target language outside the classroom, compared to the L2 context in which the target language is the content and medium of instruction. Chaudron does not specify in which context an online or virtual classroom best fits; however, based on his explanation of FL and L2 contexts, one might infer that an online context is a context variable. Although these context variables are necessary as measurable variables, as

described, they fail to explain what's going on in the classroom context, such as behavior. These behaviors, such as interaction, are what Chaudron describes as *process variables* and are important elements in qualitative research approaches.

As such, based on the above description, the classroom is a context in which interaction is a process that can be observed qualitatively, and learning is an outcome or product that can be measured quantitatively. Yet this interpretation may not accurately depict an understanding of the online or virtual classroom as a necessary component of the process variable and not simply the context variable, as I experienced with my own students in a 3DVLE. For instance, Chaudron (1988) writes that the process variable includes observable behaviors of both the teacher and the learner; this description does not account for the different kinds of interactions that occur in a virtual space compared to a physical space (Hartwick, 2015). Chaudron's description of process variables also fails to account for the multi-dimensional, fluid interactions that often occur in 3DVLEs or other online spaces and which are rich sources of data for qualitative, quantitative, and mixed-method approaches. Thus, although conversations and instructional interactions in a target language of instruction are commonly researched qualitatively, it remains unclear in such studies what role interaction with space plays in influencing learning outcomes. Consequently, understanding space as both a context variable *and* a process variable has the potential to enrich research, because these can be explored qualitatively and/or quantitatively. This understanding necessarily frames my rationale and perspective throughout the rest of this article.

2.2 Interaction defined

The significant role of classroom interaction is well known in SLA and development studies and has prompted research focused on constructs such as negotiation of meaning, comprehensible input, recasts, repetition, instruction, and feedback (Brown & Rodgers, 2002; Chaudron, 1988; Ellis, 1988; Gass & Selinker, 2008; Hall & Verplaetse, 2000; Long, 1996). Gass and Selinker describe the interaction approach to classroom research as "learning through input (exposure to language), production of language (output), and feedback that comes as a result of interaction" (2008: 317). Similarly, Ellis (1988) suggests that language classrooms must facilitate a need to communicate while simultaneously providing opportunities for comprehensible input and practice. At the same time, exposure, feedback, and interaction contribute to SLA, and SLA research considers the many constructs of interaction, which can be clearly delineated according to categories of classroom interaction, such as teacher–learner, learner–learner, and learner–text (Brown & Rodgers, 2002). In addition to these categories and based on an unpublished exploratory study I conducted, I propose a new category, *learner–space*, stemming from the observed affordances of virtual worlds. This category of interaction considers how teachers and learners and/or participants interact with each other and the learning context, space, or objects in the space in which they are engaged.

3 Historical overview of research approaches

The practice of observing teachers' and learners' behavior is a long-standing method for collecting data and analyzing constructs in classroom-based studies (Brown & Rodgers, 2002; Chaudron, 1988). This practice is suitable for qualitative studies wherein the researcher is very often an active participant in the research process (Creswell, 1998). Yet,

as research perspectives and trends in CALL (Peterson, 2006) and second and foreign language teaching and learning (Long, 2015) continue to develop, research design needs to be clearly defined according to a specific tradition, perspective, and context (Brown & Rodgers, 2002). CALL researchers advocate for continued exploration of methods in computer-mediated contexts in order to truly understand the complexity of these innovative spaces for language learning (Blake, 2008; Chapelle, 2000). Ultimately, as stated by Chaudron, “the fundamental goal of most such research has, of course, been to determine which variables best, or more frequently, lead to academic achievement” (Chaudron, 1988: 1). Consequently, selecting the best research approach, method, and tools should be considered with respect to research purpose, research questions, and context, along with a good understanding of potential limitations. A historical overview of similar research processes and contexts is a first step.

In the last 50 years, research perspectives in the domain of SLA have shifted from mostly quantitative, behaviorist, and product-only studies to more of an appreciation for the role of communication and interaction – more of a focus on process has meant that research became more qualitative in nature (Antón, 2015; Chaudron, 1988; Long, 2015). Understandably, this varies according to the theoretical perspective of the researcher, as their perspective, or frames of reference, determines how data are to be classified, coded, and subsequently understood (Green, Castanheira, Skukauskaite & Hammond, 2015). Similarly, Gass and Selinker (2008) note how learning theories help to contextualize the frame of reference.

In Chapter 4 of *The Handbook of Classroom Discourse and Interaction*, Long (2015) provides a historical overview of language classroom interaction studies from the early 1960s to the present. He identifies four sequential and overlapping phases of research. Early studies in the first phase were comparative and quantitative and focused on the product or outcome as opposed to analyzing teaching and learning processes. Conversely, the second phase of studies in the 1970s and 1980s were more descriptive as researchers focused on teaching and learning observations – a qualitative trend that continues today (Antón, 2015; Long, 2015). According to Long, descriptive studies, although data rich, can be time consuming (e.g. transcribing data such as *classroom talk*) and overwhelming in terms of segmenting and coding data. According to Long, the problem with this second phase was that this research lacked both focused and contextualized research objectives as well as clearly articulated and anticipated learning outcomes. This prompted a third phase, which Long refers to as “process–process, descriptive and correlational” (2015: 63). In this phase, research tended to focus on how the teacher’s behavior directly correlates with the quality and quantity of student learning. This gave way to the fourth and most recent phase, which Long considers to be focused on the impact of variables such as language use on learning outcomes. Studies in this so-called “process, product, quasi-experimental and experimental” phase (Long, 2015: 64) tend to have fewer participants, be shorter in duration, and have a more limited scope; however, they can also be more easily duplicated and generalizations can be made based on multiple studies. Further, these types of studies allow for greater control of variables, such as context, learner, and type of interaction. This latter phase shares the characteristics of mixed-method research as defined by Creswell and Plano-Clark (2011).

These historical approaches to SLA research focus mainly on types of interaction and the discourse that evolved from these interactions, arguing that L2 acquisition was a direct result of these interactions (Hall & Verplaetse, 2000). However, these approaches may not adequately account for interactions in non-traditional classrooms spaces, such as 3DVLEs.

This shortcoming is an important consideration for current research studies, as an understanding of interactions in an online space might help to explain how or, in fact, if this newly defined context for interaction is related to SLA. Antón explains how more contemporary social approaches to language learning have motivated newer trends in research, including dynamic assessment, which is “... inherently interactive” (2015: 79). This trend focuses on classroom-based, formative assessment and includes observation of collaborative interaction and learner behavior. However, it still does not adequately account for interaction within what Phillips, McNaught and Kennedy (2012) describe as an *interactive learning system* and the potential impact on SLA.

Empirical research in CALL and 3DVLEs is an exciting new research domain that has been met with both skepticism and praise. In 2000, Kern and Warschauer considered computer-mediated communication tools, like 3DVLEs, one of the newest areas in CALL research reported to promote social and engaging learner interactions (Blake, 2008; Chapelle, 2000). Over a decade later, Peterson (2012a) commented on how 3DVLEs are pushing the boundaries of contemporary language education, as digital learning platforms drive new CALL research. Similarly, Reinhardt and Sykes (2012) point out the transdisciplinary nature of this research area, which depends on a clear description of the intended outcomes, pedagogy, and methodology. Owing to the affordances of these spaces in language learning contexts, research in this area of CALL is growing exponentially and investigates a myriad of topics, including 21st century competencies, teacher education, and promotion of language fluency (Dooly, 2015).

The next sections survey classroom interaction studies in both physical and online classroom contexts. The purpose is to uncover the various research methods, tools, and analytical processes used in understanding physical and virtual classroom interaction and SLA.

3.1 Researching interaction in second language studies in the physical classroom

Simply, classroom-based research traditionally investigates the ways in which students and teachers interact to hypothesize what contributes to successful language learning. Due to the enormity of empirical research in second language classroom interaction, studies referenced herein were selected based on studies cited or understanding garnered in Chaudron (1988), Markee (2015), Long (2015), Gass and Selinker (2008), and Brown and Rodgers (2002). These five were the primary sources for this article – further review is outside the current scope.

Research methods, tools, and analytical processes used in classroom interaction SLA research vary tremendously. A brief survey of research studies about second language classroom interaction reveals that research approaches range from experimental and quasi-experimental (Spada & Tomita, 2010), to naturalistic² (Bailey & Nunan, 1996), to case studies and action research (Tsui, 1996), to simulated classroom data and discourse analysis (Ellis, 1988), to stimulated recall (Gass & Mackey, 2000; Nunan, 1996). These approaches vary from purely qualitative or quantitative to mixed-method studies. Yet Chaudron (1988) claims that the research is not about a quantitative “versus” qualitative paradigm, but rather about finding complementary approaches to scientific inquiry. For example, studies investigating learning outcomes, correlation, and

² Bailey and Nunan describe naturalistic research as “a research paradigm in which naturally occurring events are studied” (1996: 1), wherein language learning and teaching experiences from the field are reported by the practitioner, not the researcher.

inference are typically quantitative, whereas descriptive and observational style studies are often more qualitative in nature (Chaudron, 1988).

Regardless of approach, defining a research process is what is important, including specifying conventions such as research tools and data analysis techniques. Although not an exhaustive list, the research tools, techniques, or data sources in classroom interaction studies include surveys and questionnaires, transcripts, pre- and post-tests, participant interviews, observations, and field notes (Bailey & Nunan, 1996; Brown & Rodgers, 2002). The breadth, variety, and range of data collection techniques help determine the approach, and quantitative measurements necessitate clearly defined units of analysis, such as grammatical (word level) or interactional (turn-taking) features. Chaudron suggests that the “unit of analysis is a crucial aspect of observational instruments, in that the specification of a period of time, or of an analytical linguistic or pedagogical unit, involves basic assumptions about the nature of the classroom interaction” (1988: 20).

Units of analysis in quantitative classroom interaction studies include, but are not limited to, language-related episodes (LREs), time units, private speech, and moves (Chaudron, 1988; Ohta, 2000; Swain & Lapkin, 1998). Swain and Lapkin (1998) describe LREs as instances where learners use language to talk about or reflect upon their own or others’ language use, hypothesizing that these episodes of interaction will lead to greater SLA. They further classify the LREs according to lexical items (vocabulary) and form (structure) at the discourse level. Another study by Kim (2013) uses LREs as a unit of analysis to understand the importance of task design factors, such as sequencing and task repetition. Discourse used in analysis depends on units such as the utterance, turn, or function, quotes from dialogue, features of language, repetitions, type of feedback, teacher talk, and types of strategies (Chaudron, 1988; Hall & Verplaeste, 2000).

Whereas Tsui (1996) transcribed interactional extracts to improve teaching strategies, Ohta’s (2000) qualitative study analyzed the private speech utterances as a unit of analysis. In this discourse-analytic approach, Ohta studied the effect of corrective feedback based on student to teacher interaction in the form of recasts. Like Tsui, she used audio and video recordings to collect and later transcribe data; however, data were analyzed through discourse analysis as opposed to teachers’ interpretations of selected extracts of interaction. Further, and equally important to most interaction studies, is that “what is ultimately salient, or what ultimately becomes the focus of attention, is likely to differ significantly from learner to learner” (Ohta, 2000: 67).

As noted earlier, although classroom observation is a common method for collecting rich data about types of interaction, transcription is time consuming and results are hard to compare due to the range and type of instrumentation or tools used in studies of classroom interaction (Brown & Rodgers, 2002; Markee, 2015). As such, researchers should consider how they will proceed with data analysis.

In addition to observation, other instruments used in second language classroom-based research include journals, field notes, interviews, questionnaires, checklists, etc. (Brown & Rodgers, 2002). These are often combined with data results from observational data. Moreover, to understand the impact of interaction on learning outcomes, some classroom interaction studies employ pre- and post-tests to quantitatively measure change in performance. For example, to show the importance of language and interaction linguistically and cognitively, and in relation to task completion and learner proficiency measurements, Swain and Lapkin (1998) administer pre- and post-tests in addition to videotaping and transcribing

specific language features. This process points to the complexity, challenges, and limitations of classroom-based interaction studies of which the researcher must be fully aware.

As reported by Chaudron (1988), other methodological limitations are sample size, inability to generalize, laboratory versus classroom contexts, and variance in factors like teacher behavior, learner behavior and characteristics, and types of interaction, or unreliable and incomplete measures of learner development. Further confusion stems from conflicting procedures, definitions, and analytical constructs or theoretical perspectives (Ellis, 1999). Ellis also lists some of the limitations of research with respect to interaction and second language learning, including a tendency to measure explicit knowledge of language in use rather than demonstrated acquisition. Interestingly, he further suggests that research fails to examine the "... kind of learning (implicit or explicit)" (1999: 237) that is a result of opportunities created to interact in L2. This is relevant to research in virtual worlds if we consider that 3DVLEs may provide an opportunity to interact in ways that otherwise might not have been possible.

3.2 Researching interaction in second language studies in the 3DVLE classroom

As highlighted in the previous section, traditional language classroom interaction studies analyzed the oral language data derived from learner or teacher production or output resulting from the process of negotiating, typically to complete a task. Frequently, language was analyzed according to specific constructs, features of the language, or functions. This section surveys research approaches, tools, and data analysis techniques used in 3DVLE interaction studies.

In addition to the studies already discussed, six additional studies were considered (Collentine & Collentine, 2015; Jauregi, Canto, de Graaff, Koenraad & Moonen, 2011; Liou, 2012; Mroz, 2015; Peterson, 2010, 2012a). These six studies were selected according to the following process. First, the keywords *interaction* and *3D* and *language* were used to search abstracts in Scholars Portal and Academic OneFile library repositories. The search was limited to articles published after January 1, 2010, and to these journals: *Computer Assisted Language Learning* (CALL), *ReCALL* (the journal of the European Association for Computer Assisted Language Learning), and *CALICO* (Computer Assisted Language Instruction Consortium) *Journal*. A total of 16 studies were found, two from each of *CALL* and *ReCALL*, and 12 studies in *CALICO*. As it was not possible to restrict the keyword search in *CALICO* to the abstract, all 12 abstracts and introductions were scanned using the same keywords, resulting in a total of two articles. Although this process has certain limitations, the selections are motivated to better understand 3DVLE interaction research design, especially pertaining to methods and analytical procedures that may lead to a better understanding of the role of space in 3DVLEs in relation to language learning.

Empirical research studies related to 3DVLEs and specific to interaction as a feature of language learning are emerging; however, research pertaining to 3DVLEs in CALL has been criticized as being largely under-theorized, anecdotal, exploratory, and descriptive (Peterson, 2012b; Twining, 2010). The survey of research approaches for this section includes empirical studies in motivation, vocabulary development, collaboration, and task design (Berns, Gonzalez-Pardo & Camacho 2013; Chung, 2012; Ibáñez, Garcia, Galan, Maroto, Morillo & Kloos, 2011; Milton, Jonsen, Hirst & Lindenburn, 2012; Peterson, 2006, 2012a; Zhang, 2012), as well as the six interaction studies identified above. Case study design is commonly reported in these contexts (Berns *et al.*, 2013; Jauregi *et al.*, 2011; Liou,

2012; Peterson, 2010; Zhang, 2012), and Second Life is the most featured platform used in approximately 60 percent of studies (Reisoğlu, Topu, Yılmaz, Yılmaz & Göktaş, 2017). Peterson's (2012b) meta-analysis of three learner-based studies was useful in that it investigates three constructs of interaction, including negotiation of meaning, strategies used during task-based interaction, and participation patterns during voice chat.

Whereas physical classroom interaction studies often focus on language output during interactions in terms of features and function, earlier studies related to language learning in 3DVLEs often hypothesized that the affordances of the space are what contributed to language acquisition. However, these claims generally assumed language acquisition was achieved because of interaction with native and non-native speakers and meaningful engagement with a task (Molka-Danielsen, Mundy, Hadjistassou & Stefanelli, 2012; Peterson, 2012b). Earlier studies suffered from low number of participants. For instance, Carter and Elseth's (2009) descriptive and qualitative study focused on the vocabulary development of only three beginner learners of German engaged in simulated field trips in Second Life. Similarly, Zhang's (2012) exploratory study, which investigated the barriers participants faced while attending to learning activities in Second Life, was limited to 10 participants. However, in a meta-analysis of studies in 3D virtual worlds, Reisoğlu *et al.* (2017) report a growing trend in sample sizes. In 167 studies analyzed, 32 employed between 51 and 100 participants. These authors speculate that low participation rates contributed to higher incidences of case study in past 3DVLE research.

In addition to low participant numbers, studies were often limited in terms of duration. For example, Peterson's (2006) study investigated interaction management patterns of 24 EFL students across three separate tasks. This two-phase study took place over a five-week period, but was limited to only three one-hour sessions, making results tentative and largely ungeneralizable. For this study, Peterson collected and coded text chats according to 11 specific discourse management strategies (e.g. requests for clarification). He then used an online concordancer to search for instances of the coded strategies. In lieu of a pre-test, participants were selected according to a pre-specified TOEFL score. Field notes and pre- and post-questionnaires were also used; however, no quantitative measurement was applied. A recent study by Liou (2012) examined the extent to which affordances of Second Life are perceived by students as beneficial in terms of language learning. This case study of 25 participants was longer and spanned 18 weeks.

Methodologically, research around 3DVLEs has since expanded to employ mixed-methods approaches, resulting in more robust discussions. Although the studies surveyed above were largely qualitative and descriptive, Chung (2012), Berns *et al.* (2013), Lan (2015), and Mroz (2015) used mixed methods in their research design. Specifically, Berns *et al.*'s (2013) case study was designed to investigate the role of game-like scenarios in vocabulary development while using a 3D platform called VirtUAM. This mixed-method study used several data collection instruments, including a questionnaire, and pre- and post-test results. The questionnaire was used to qualitatively assess students' perceptions of learning and levels of motivation, while researchers used a Wilcoxon test (Berns *et al.*, 2013) to analyze test scores to measure the impact of selected games on learning. In much the same way, Chung's (2012) quasi-experimental study compared achievement outcomes in vocabulary, grammar, and reading achievement. Control group participants were exposed to the same teaching materials in a traditional classroom as their experimental group counterparts, who participated in Second Life with the added interaction of virtual

characters. Test scores and questionnaire results were analyzed and pointed at a positive correlation between the learning context and levels of motivation, and the context and test scores. Finally, Lan's (2015) study succeeded in observing the behavior of 132 primary school students in Taiwan in a physical and virtual teaching context. Her comparison of teaching spaces helped validate the affordance of space in promoting conversational skills. This larger scale study demonstrates the importance of observing participants' learning behaviors in addition to using pre- and post-tests.

Further, 3D research is beginning to investigate the role of the online space through recorded observations. Deray and Simoff (2009) investigate ways in which interactions unfold in real time during the learning process of 3D design students to representing interactions visually to provide feedback. While the participants are not language learners, the study is useful for 3DVLE research in that it seeks to measure interaction processes by recognizing that interaction goes beyond the types described in Section 2.2 and which are common to traditional classroom-based interaction studies. Hence, although Deray and Simoff recognize the importance of interaction between learners, they also understand the role of the environment as an alternate channel of input.

Considering the motivation for this article was to understand how interactional behavior in and with 3DVLEs was captured, documented, and analyzed qualitatively and/or quantitatively, Jauregi *et al.*'s (2011) case study was particularly relevant. This study used recorded observations to analyze how task design and affordances contributed to authentic social and intercultural interactions in Second Life compared to affordances of a 2D environment. Researchers used the recorded data from Second Life interactions to understand the type of interactions elicited by the different tasks and to see if tasks adequately made use of the affordances of space. Mroz's (2015) mixed-method study also used video recordings of interactions and student logs as secondary data to triangulate primary data sets of student chat logs in Second Life. These recordings helped researchers interpret interactions such as turn-taking.

To account for limitations of this review, I include relevant results from a meta-analysis of 167 studies intended to identify design and research trends in 3DVLEs (Reisoğlu *et al.*, 2017). This analysis, based on studies found in two databases considered pioneers in educational technology, used keyword searches and word combinations relating to 3D virtual worlds. The researchers' analysis reveals the following trends to be considered in future research design: descriptive research tends to be more popular than experimental; research contexts are largely in Second Life; research objectives include learning support, simulation, and social interaction; environments are generally designed to support collaborative, explorative, and task-based learning; language learning topics are the most heavily researched in 3DVLEs, followed by science and health; and case study, quasi-experimental, descriptive, and mixed method are the most commonly reported methods.

Much like physical classroom contexts, surveys, questionnaires, field notes, and recorded observations continue to be used for data collection in these online spaces, yet newer techniques have evolved. One such technique is called *dataveillance*,³ which can quantitatively measure and track a user's actions. Although Ross, Castronova and Wagner (2012)

³ "Dataveillance" was originally coined to refer to the systematic use of personal data obtained from credit card and other digital data systems. In this context, the term refers to data obtained based on user behavior, such as movement, in the 3D world.

define this term in the context of game-based scenarios, it could be extended to studies in 3DVLEs. However, the problems associated with this technique are "... managing the sheer quantity of data captured and the need to develop an elastic yet rigorous structure in which to organize and analyze it" (2012: 285). Ross *et al.* comment on the importance of identifying categories and setting parameters in advance of data collection to avoid the onerous task of post-hoc data organization. This process can also be time consuming; learning how and which data to mine is necessary for researchers wishing to take advantage of this rich data source. One way to mitigate these challenges is by using an observation matrix,⁴ as in Table 1, to better understand the categories and to facilitate managing the sheer quantity and breadth of data. The next section considers possible methodological approaches, data collection techniques, and units of analysis as previously discussed.

4 Implications for research design in virtual worlds

The process of researching for this article has helped illuminate an important trajectory for future research agendas while stressing the continued need for research in these new learning contexts. This includes an understanding of the implications of the features of space in addition to the features or constructs of language. Indeed, future research in this area may consider both to be important.

As previously noted, earlier research in CALL and specifically 3DVLEs tended to be highly descriptive and qualitative and lacking in experimental studies (Genc-Ersoy & Ersoy, 2013). Peterson remarked on how "the new forms of interaction made possible by virtual worlds remain, to a significant degree, unexplored" (2012b: 78), but the potential for exploratory research in this area is exciting. As noted by Ross *et al.*, "the use of virtual worlds as experimental environments, or even as platforms for observation, coupled with dataveillance and survey tools has such powerful implications" (2012: 307). In an earlier article, Chapelle (1998) warns researchers of the strong data collection capacity of CALL platforms like 3DVLEs at the research design stage, and states to proceed with caution as the process for describing and interpreting data is still in development. Similarly, although 3DVLEs are potentially rich learning contexts, the challenge is knowing how and what to analyze regarding the interaction process in these ever-changing spaces (Deray & Simoff, 2009).

Understanding whether and how 3DVLEs as classroom contexts promote and facilitate interaction in a second language assumes that social interaction leads to developing language proficiency (Ellis, 1999). Further, it assumes that learning is a result of engagement and experience in an environment or context (Twining, 2010). As such, observing learner interaction, as mediated by the task, with the space itself, the tools and objects in the space, and with other users in the space is likely important. The role and type of the task is important as these help determine how learners engage with the environment; the learners' behavior as a consequence of the task becomes the learning process that could be observed qualitatively (Phillips *et al.*, 2012).

User interactions in these new contexts are perhaps best observed through screen-captured and recorded observations as an important component of the research design. These recorded observations capture participant behavior within and because of the space,

⁴ I developed a research matrix as a result of an earlier study and in the absence of a practical tool for recording what was going on between the user and the space in recorded interactions (see Table 1).

Table 1. *Observation matrix*

Learner interactional behavior	Interaction with teacher	High (5+ instances) Low (3–4 instances) Very low (0–2 instances)
	Interaction with peer	High (5+ instances) Low (3–4 instances) Very low (0–2 instances)
	Interaction with space or tools (including movement and gestures)	High (5+ instances) Low (3–4 instances) Very low (0–2 instances)
	Other	
	Task grouping	Whole group ½ group+ Pairs Individual
Teacher practice	Teacher discourse	Housekeeping/technical support Task-based or instructional Informal
Other features of space	Use of collaboration surfaces	
	Use of text function	
	Use of web renderer	
	Use of writing pad	
Location in space		
Task/activity		
Recording and time		

although screen-capture and recording software should be rigorously tested to avoid faulty recordings. Additionally, recordings should ideally be done from multiple views in the space and in shorter segments to avoid missed perspectives or views and uploading complications. This is especially important, as observations ideally should capture the behavior of all simultaneous user actions, regardless of the location in the space. Further, multiple views will provide rich data in which analysis can investigate interaction in terms of features of the space, such as location and tools used, as opposed to just the features, constructs, and functions of spoken language analyzed from text-chat transcripts (Garrison, Anderson & Archer, 1999). Thus, depending on the research problem, in terms of language acquisition the features of space may be a dependent variable in a mixed-method design.

These observed interactions with the space could be first analyzed qualitatively according to an observation matrix, such as the model in Table 1. Next, these results can be further enriched qualitatively through observer field notes and participant questionnaire results in order to understand participant perspectives. Similarly, with the development and improvement of data or engagement analytics built into many of the 3DVLE platforms, quantitative data might be readily available in terms of measuring frequency and duration of interactions according to the same categories established on the matrix. These categories may include actual location in space or use of a specific tool, like collaboration surface or teleporting function. This process could help triangulate data with observation matrix categories and better clarify the role of 3DVLE spaces in promoting user interaction.

Regarding a designated unit of analysis for future 3DVLE studies, the use of non-traditional units of analysis in interaction studies, such as location in space, might contribute to a better understanding of SLA in these contexts. In her research, Nocchi (2017) classifies the actual language task as a unit of analysis, whereas Mroz (2015) identifies units of meaning realized in analysis of conversation. This decision depends on the exact focus of study as it develops during the design phase. However, based on earlier exploratory research (Hartwick, 2015), units of time, such as time spent interacting in a specific location or with a specific object in the space, might be a logical choice.

It is difficult to label the exact research approach. Whereas Bailey and Nunan suggest that a naturalistic-ecological perspective for analyzing behavior is best and state that "... as its central tenet, the belief that the context in which the behaviour occurs has a significant influence on that behaviour" (1996: 2), identifying a specific research approach for 3DVLE research remains challenging. As the study of interaction in virtual worlds is clearly multifaceted, perhaps adopting a more pragmatic approach is reasonable. As a world view, pragmatism is an approach to inquiry that believes in doing what works best for the given context (Creswell & Plano Clark, 2011; Teddlie & Tashakkori, 2010). Characteristically, pragmatism views the role of experience, agent or organism, environment, and interaction as highly important; further, this view recognizes the benefit of drawing on multiple theoretical lenses to best account for what is going on (Johnson & Onwuegbuzie, 2004). Pragmatic research is just that: a pragmatic, sensible, workable approach to inquiry. A pragmatic, mixed-method approach could help to triangulate multiple data sources to better interpret the research phenomenon, specifically by combining the strengths and offsetting the weaknesses of both qualitative and quantitative methods, providing more and more diverse forms of evidence, and helping to address more complex research questions that could not have been addressed as effectively by one method alone (Creswell, 2015; Creswell & Plano-Clark, 2011; Dörnyei, 2007). Further, mixed-method approaches may enhance the researcher's understanding of a relatively new phenomenon, as in virtual worlds, and strengthen their theoretical stance or understanding of a concept.

Regardless, conceptualizing the design framework or agenda is an important first step for virtual world research. Creswell (2015) suggests a *convergent design* in which both qualitative and quantitative data are analyzed purposefully with the intention of comparing results. Accordingly, mixed-method design should begin with a specified theoretical understanding of language learning and learning in general. Further, an analytical framework, such as the learning environment, learning processes and learning outcomes (LEPO) framework proposed by Phillips *et al.* (2012) could help to capture the virtual environment, 3D or otherwise, as a necessary component of learning.

5 Conclusion

Although this review of literature is based on only a sample selection of studies, it might help demonstrate the changing landscape of research methodologies in 3DVLEs and CALL. In future studies, researchers should consider broadening the search criteria to include terms like *virtual* and include a range of databases and conference proceedings from a breadth of locations. It is an interesting and fulfilling time to be involved in research about 3DVLEs as an innovative digital and online learning space. There are many unanswered questions and different research methods and approaches that need applying. The use of analytics in

combination with observational data in future studies could help clarify the role of space through the lens of different learning theories. Research should appreciate and understand the role of the environment as a mediator in the learning process and use 3DVLE analytics to measure duration and frequency of interaction to understand the impact of space on performance. Similarly, new studies might continue to include elements such as requests for turn-taking and impromptu dialogues as valuable data. Further analyses could consider the function of language and the specific dialogue generated solely for these purposes; in this case, discourse analysis might be a worthwhile approach. Ultimately, these studies have simply scratched the surface for this new area and serve as important prototypes for ongoing research.

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Chapter 7

Integrating Virtual Spaces: Connecting Affordances of 3D Virtual Learning

Environments to Design for Twenty-First Century Learning

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Chapter 6

Integrating Virtual Spaces: Connecting Affordances of 3D Virtual Learning Environments to Design for Twenty-First Century Learning

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ABSTRACT

This chapter explores perspectives from general learning theories in relation to affordances of 3D virtual learning environments (3DVLEs) in order to substantiate a theoretically informed pedagogical design process. Following this review, the authors describe 3DVLE space and task design used as part of an English for Academic Purpose (EAP) course at a Canadian university. The design process is then contextualized according to a Phillips, McNaught, and Kennedy's (2010, 2012) learning framework called Learning Environment, Learning Processes, and Learning Outcomes (LEPO). The authors share sample tasks and screen shots of the 3DVLE, as well as teacher and designer recommendations for future designs. In conclusion, the authors stress the importance of drawing on multiple learning theories to illuminate the affordances of the space. Further, they call for empirical research that makes use of telemetric data in the assessment of learner interaction in relation to achieving learning outcomes and predicting learner success.

INTRODUCTION

The 21st century student is evolving to include both digital natives and lifelong and global learners. Academic content is not limited to knowledge acquisition, now extending to include skills and competency development. Meanwhile, classrooms are no longer confined to four walls as a result of new online learning environments. Consequently, teaching is not simply the synchronous transmission of information; rather, it includes the facilitation of learning opportunities in multiple learning environments, some

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unrestricted by time and place (Bransford, Brown, & Cocking, 2000; Haythornthwaite & Andrews, 2011; Illeris, 2003; Prensky, 2006). The delivery of post-secondary education has shifted to include a myriad of online spaces, such as multi-user 3-dimensional (3D) virtual learning environments (3DVLEs) in which users communicate in real-time in an Internet-hosted virtual environment. An understanding of how the affordances of 3DVLEs contribute to general learning may help educators develop more meaningful activities to be carried out in these learning spaces. Reflecting on the teaching and learning experiences in terms of how learners interact with in these online spaces has the potential to positively influence teaching practice and learning outcomes. Such knowledge could contribute to students' overall success in achieving 21st century learning outcomes, including mastery of subject content, and 21st century skills, including critical thinking, communication, and problem solving (Dede, 2010).

This chapter is motivated by the authors' experiences using 3DVLEs and will address the following two questions: (1) what are the pedagogical perspectives that inform instruction in 3DVLEs based on the affordances of the space? And, more specifically, (2) how might 3DVLEs be used to enhance 21st century skills in English for Academic Purpose (EAP) classrooms? To address these questions, the authors situate the key affordances of 3DVLEs outlined by Dalgarno and Lee (2010) in relation to general and specific learning theories. To accomplish this, they provide a broad review of traditional and contemporary learning theories in order to understand which theoretical approach (or combination of approaches) best supports learning in 3DVLEs based on the affordances of the space. To contextualize the learning process in relation to said affordances and activity design, the authors introduce a general learning framework proposed by Phillips, McNaught, and Kennedy (2010, 2012) called *Learning Environment, Learning Processes and Learning Outcomes* (LEPO). The authors then provide definitional context for a 3DVLE uniquely designed for an EAP course at a Canadian university (i.e., the *Learning Environment*). Next, they situate and describe a series of tasks (i.e., *Learning Processes*) specifically designed for and carried out in this context. The tasks could be replicated in most undergraduate university level courses, as the focus is on practicing research skills and facilitating the achievement of 21st century skills development through learning experiences (i.e., *Learning Outcomes*). The authors selected this framework as it blends characteristics from multiple learning theories. The framework also reflects the importance of environment and affordances of space reviewed in this chapter.

The chapter calls for ongoing research about 3DVLEs in order to substantiate teaching practice and space design in well-grounded theory. Specifically, it recommends empirical studies that measure levels of engagement in relation to achievement outcomes through the use of telemetrics that focus on frequency of interaction and communication in space. Overall, the chapter aims to contribute to a better understanding of how learning theories help to guide space and task design for 3DVLEs to best promote unique opportunities for learning through interaction and experience in and with the space in order to achieve 21st century learning outcomes.

BACKGROUND

A recurrent theme in academic literature on emerging pedagogies is a call for a modified or new learning theory to reflect learning in the many new online teaching spaces (Bransford et al., 2000; Dewey, 1938; Harasim, 2012; Haythornthwaite & Andrews, 2011; Illeris, 2003; Loke, 2015; Phillips et al., 2012; Savin-Baden, 2008; Savin-Baden, Gourlay, Tombs, Steils, Tombs, & Mawer, 2010). Historically well-known learning theories, while critical in accounting for how people learn generally, are problematic

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when applied to these new learning environments because many fail to account for how people learn with respect to the affordances of online space. To illustrate, behaviourists like B. F. Skinner argue that learning is a behaviour that can be changed by external stimuli, such as reward and punishment; cognitivists like Robert Gagné claim that learning is related to mental processes; and constructivists, like Vygotsky, understand learning in relation to personal, social interaction (Ally, 2008; Dede, 2007; Harasim, 2012). None of these adequately account for the affordances of online learning spaces, however, and so understanding and identifying relevant characteristics from existing theory and applying them to these ever-changing learning contexts proves challenging. Further, it is difficult to work within a strict dichotomy of learning theories, because learning depends a number of variables, such as technology, learner, expected outcomes, and defined space.

To capture these variables and to contextualize the learning processes described herein, the authors chose to employ the LEPO framework as a flexible and pragmatic approach. This framework helps clarify how learners learn in a range of environments and views learning as a social process in which the learner and teacher are active participants. Phillips et al.'s (2012) framework draws on characteristics from constructivist learning theories and other models of learning that emphasize interaction, student and teacher knowledge, experience, and reflection. For instance, the learning processes component of the framework draws on Bransford et al.'s (2000) four lenses of learning which include the learner's beliefs and knowledge experiences and, importantly, an understanding that learning activities create increased learner awareness through feedback. Under this framework, learning outcomes are based on demonstrated knowledge and skills acquired through the learning processes whereby the learner has engaged in the learning environments. The authors selected this framework because it helps capture their view of how people learn and it is broad enough to allow for a range of learning outcomes, including 21st century skills like problem solving and critical thinking. The following review identifies a range of relevant learning theories and helps substantiate the authors' decision to work within the LEPO framework.

General Learning Theories and Approaches

This section begins with a review of learning theories that have guided 20th century teaching practice—namely, behaviourism, cognitivism, constructivism, and socio-cultural theory—followed by a review of more contemporary 21st century approaches to learning. The purpose of this review is to relate theory to practice in 3DVLEs based on the key affordances of these unique online learning spaces. The authors explore key characteristics from traditional and contemporary theories to speculate whether, or if, the affordances of 3DVLEs facilitate achievement of learning outcomes. It is hoped that this section will illuminate the importance of drawing on diverse learning paradigms to inform 3DVLE space and task design.

Behaviourist, Cognitivist, and Constructivist Learning Theories

Behaviourist learning theory came to the forefront in education in the early 20th century and stems from the work of psychologists such as B. F. Skinner. Behaviourists believe that the correct instructional stimuli will elicit the desired learning outcomes, with an emphasis on practice and performance (Ally, 2008; Harasim, 2012). Behaviourism has a role in the understanding and design of learning spaces today, as certain basic learning outcomes depend on practice and repetition (Harasim, 2012). For instance, in current digital learning contexts, the act of accessing, manipulating, and adapting to online learning

contexts to complete a task requires the learner to become adept at negotiating the space. This adeptness happens in time and with practice.

Moving away from behaviourist accounts, cognitivist learning theorists do not entirely reject the notion of stimulus and response, but rather seek to understand the intervening mental processes. Whereas behaviourists reject the unobservable components of thinking and learning, cognitivists view the mind as an information processor (Ally, 2008; Clark, 2001; Harasim, 2012) and understand learning and knowledge in terms of dynamic schematic representations of concepts that an individual shapes in their mind. Psychologist and instructional designer Robert Gagné specified a learning taxonomy based on anticipated outcomes (skills and strategies) and events of instruction. Though occasionally prescriptive and deliberate in practice, cognitivist learning theory and certainly Gagné's taxonomy contribute important theoretical elements for understanding online spaces. For instance, some of Gagné's *events of instruction*, such as providing feedback, can help explain the affordance of real-time voice and movement in terms of giving instruction, assistance, and feedback (Harasim, 2012).

Theories have moved on to consider learning more holistically and inseparable from the learner and social environment. Coinciding with the social movements of the 1970s, constructivist learning theorists view the learner as an active participant in their own learning process and the teacher as a facilitator of knowledge making. A prominent theorist of this school, Vygotsky, believes that knowledge is more than passive reception and memorization of information; he holds that learning occurs because of active engagement or experience in a social context. This approach departs significantly from behaviourist and cognitive views in which "...the lecture notes of the instructor get transferred to the notebooks of the students without passing through the brains of either" (Mazur, as cited in Harasim, 2012, p. 59).

Vygotsky (1986) stresses the social context in which the learning occurs and places great importance on interaction, communication, and experience. According to Vygotsky's concept *zone of proximal development* (ZPD), an individual's learning potential is reached with the assistance of a more capable peer through active problem solving and interaction (Ireson, 2008; Vygotsky, 1986). In keeping with the ZPD, it can be argued that, like a "more capable peer", the affordances of 3DVLEs provide the assistance needed for learning to occur, particularly as users collaborate in the online space with artifacts or objects (described by Vygotsky as *tools*). Indeed, both the virtual space and the objects within the space can be viewed as culturally created artifacts that shape the activity or task at hand.

Characteristics of constructivist and socio-cultural theory are evident in 21st century pedagogies. For instance, active learning and learning-by-doing (such as role-play), as well as scaffolded, experiential, and collaborative learning (Harasim, 2012) are all based on the premise that learning is an active process. Vygotsky's view continues to be influential today and underlies other approaches to learning. A notable adaptation is activity theory, which understands learning as a socially constructed process where learners interact in pursuit of a shared goal (Engeström, 2001; Ireson, 2008; Kaptelinin & Nardi, 2006). Importantly for 3DVLEs, activity theory extends beyond basic bi-directional interaction to consider the complex social context and the technologies in and with which subjects act. These multi-directional interactions are a key premise of the LEPO model.

Learning Into the 21st Century

While the abovementioned theories help account for how people learn more generally, Dede (2003) calls for a new model of education to better suit 21st century learners who are competent digitally and have high collaboration and critical thinking skills. Savin-Baden (2008) suggests that digital spaces have

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brought about new types of literacy, communication, and pedagogy. Loke (2015) advocates for a modified learning theory that better accounts for students' physical experiences, especially in 3DVLEs. According to Siemens (2005), contemporary learning theory needs to better reflect learners' needs and today's trends such as life-long learning, and broad competencies with technology and tools. Siemens proposes a connectivist theory that presupposes that the learner can make critical judgments in the knowledge making and acquisition process, and learning is about making connections between large amounts of information and decisions about what needs to be learned for tomorrow. Accordingly, connectivism is about knowing how to access new knowledge through technology and has relevance in that students need to be resourceful and take advantage of tools inside and outside of the 3DVLE to meet learning outcomes. For example, students working on a collaborative writing document in the environment can simultaneously access an online dictionary or website to gather more information about the topic.

A gap in connectivist theory with respect to 3DVLEs is that it places little emphasis on the role of the collective group and the activity and its mediating tools (a tenet of activity theory), such as language and space. Newer learning theories should continue to focus on aspects of socio-cultural theory, but also recognize the role of mediating tools. Scardamalia and Bereiter (2006) attempt this integration with respect to learning in relation to the Internet and technology. They comment on the range and diversity of learning approaches, including situated cognition and social constructivism. Scardamalia and Bereiter believe that learning occurs socially, and add the dimension that members are connected through and with technology. Essentially, learners are members of a community wherein understanding emerges through collective problem solving and is not confined to a classroom or individual—in other words, ours is a "... knowledge creating culture" (p. 97). Their beliefs are applicable to learning afforded by and in 3DVLEs.

In keeping with Siemens' (2005) and Scardamalia and Bereiter's (2006) push for new learning theories, Dede (2007) points out that models of education need to shift to keep up with a changing landscape of teaching and learning as emerging technologies are used in and as the classroom. His focus is preparing 21st century learners with skills such as critical thinking and problem solving. He challenges educators and institutions to transform education in terms of what we already know about learning and cognition and claims this transformation should include the delocalization of the classroom community as technologies help to distribute knowledge outside of the traditional classroom space. While he agrees that traditional pedagogies are still important, Dede believes that situated learning is the best theoretical approach to technology enabled collaboration: "Fortunately, emerging information communication technology that enable immersive, collaborative simulation now offer the capability to implement situated learning environments in classroom settings" (p. 23). The central notion of situated learning is that learning is an active process whereby cognition is shared and learning is achieved through collaboration and co-participation (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991; Rogoff, 1990). The assumption is that knowing how and knowing what are inseparable; further, it is through the collective act and use of authentic physical and social spaces that learning occurs, where "Learning and acting are interestingly indistinct, learning being a continuous, life-long process resulting from acting in situations" (Brown, Collins, & Duguid, 1989, p. 33).

Despite the importance placed on the needs of 21st century learners, skill development, and the incorporation of technology in education (Prensky, 2006), neither the connectivist nor the focus-on-skill approach adequately accounts for what is happening in terms of user interaction in and with the learning space. Gee (2007) claims, "Traditional views of learning stress the mind and not the body" (p. 71). He argues that traditional pedagogy continues to focus on the dissemination of content, concrete stages of development, and rigid curricula instead of emphasizing the strength of the space and the activity, such

as collaborative problem solving. Gee (2004) and Gee and Hayes (2011) argue that traditional definitions of literacy and knowledge are overly rigid and do not account for technical and creative expertise, which are characteristics of 21st century learners. With respect to space, Gee and Hayes (2011) describe any virtual or physical learning space as an *affinity space* in which participants share the same interest and passion (affinity) for whatever activity they are embarking on together. As described, affinity spaces reflect many of the same theoretical constructs mentioned earlier, such as situated and experiential learning, guidance from a more capable peer, and shared or distributed knowledge (Gee, 2007; Gee & Hayes, 2011).

Savin-Baden (2008) likewise explores the notion of space in connection to learning. She explains how space affords opportunities for reflection, critique, and learning. She reflects on how digital spaces have provided novel opportunities for learning and knowledge building; these are characterized by the freedom to move and explore. Drawing on this and many of the characteristics from the above noted learning theories, this chapter's authors use Phillips et al.'s (2010) LEPO framework as a way of conceptualizing and understanding learning in 3DVLEs. This framework reflects the authors' shared understanding of the importance of space in affording learning opportunities by virtue of the learner's experiences interacting in and with these spaces. Importantly, this model describes learning as facilitated by an environment in which an activity is acted out and learning outcomes are subsequently demonstrated or achieved.

Under this broad framework the environment provides the context in which learners engage in learning processes and where learning outcomes are demonstrated. This model pertains to physical and digital learning environments, curriculum, and task design, and is underpinned by a view that learning is an interactive system. This framework is in line with the authors' views that learning is a social process in which the learner is engaged as an active participant. Learning is a process and outcomes are achieved because the activity and the affordances of the environment help the learner to achieve learning outcomes.

Affordances of 3DVLEs

The term *affordance* in relation to learning was first coined by James Gibson and described as "... whatever it is about the environment that contributes to the kind of interaction that occurs" (as cited in Greeno, 1994, p. 338). Gibson (1979) defines an affordance as an *action opportunity* provided by the environment; while not always acted on, an affordance is the potential for action. Norman (2002), on the other hand, defines affordances in relation to an object and according to what is perceived or actual regarding the characteristics of the object or thing. From a design perspective, Norman claims an affordance pertains to what people see; he argues that if the user does not see or perceive the affordance, then it is not so. The notion of affordance is important in the context of 3DVLEs and in relation to the many characteristics revealed in learning theories wherein the learner (perceiver) interacts with the environment. For instance, opportunities for learning experiences, collaboration, and knowledge construction are presented in the environment and because of the affordances. According to the LEPO framework, the environment is an integral component of the learning process.

While much of the literature on 3DVLEs refers to the affordances and benefits of these spaces, Dalgarno and Lee (2010) argue that research pertaining to their educational uses and benefits is largely anecdotal. Their article conceptualizes the interactive nature of these environments in terms of affordances and explores the relationships between learning benefits and 3DVLEs' key characteristics. They propose a learning model for 3DVLEs that classifies affordances with respect to facilitating learning

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through task design. The model focuses particularly on the qualities of presence and immersion, which afford opportunities for user interaction and experience. Dalgarno and Lee claim that a so-called *fidelity of space* leads to users' sense of "being there" (presence), which subsequently increases user interaction. By theorizing the affordances of space this learning model helps distinguish 3DVLEs from other physical or online classroom spaces.

Affordance of Authentic Space

3DVLEs can be designed to replicate authentic geographical places like London and Madrid (Ibáñez, García, Galán, Maroto, Morillo, & Kloos, 2011; Milton, Jonsen, Hirst, & Lindburn, 2012), or authentic physical spaces like a classroom, archeological dig site, or nightclub (Arya, Hartwick, Graham, & Nowlan, 2012; Milton et al., 2012). The visual and spatial richness of 3DVLEs affords opportunities for experiential learning shaped by other users and by artifacts or 3D objects in the environment. In this way, 3DVLEs are mediums within which social interaction may occur. Further, learning opportunities can be mediated not just by the space, but through virtually rendered artifacts and non-player avatars, which are not controlled by a user, but rather purposefully designed for the activity (Dalgarno & Lee, 2010; Warburton, 2009). For example, in the 3DVLE the authors used in their EAP classrooms, non-player avatars are manipulated to the extent that they have pre-recorded dialogue that is not necessarily part of task instructions. The depth of space and range of artifacts, such as refrigerators in the houses, contribute to the fidelity and authenticity of space, affording learners experiences in both the visual and physical realm and facilitate social interaction and construction of knowledge through language. The representational authenticity of space in 3DVLEs is one of most significant and distinguishing characteristics of these learning spaces (Dalgarno & Lee, 2010). Not only is interaction with and because of the space meaningful, but the affordance of real-time, synchronous interaction are significant catalysts for learning. This fidelity leads to a true perception of immersion and "being there" for the user.

Affordance of Immersion

The rich fidelity of space gives users a sense of real-time presence or immersion. Dalgarno and Lee (2010) describe the sense of presence and co-presence as a consequence of the characteristics of the environment. The affordance of immersion includes the user's ability to personalize their own avatar according to traits like hair and skin colour, height, and weight, resulting in a 3D self. Contributing further to a sense of presence is the ability for avatar users to perform gestures, such as a hand-wave or shake, or bow, and even make facial expressions and head movement (Peterson, 2006). Further, the ability to create new avatar identities may differ from the user's "real-world" identity and provide them with new opportunities to interact socially while hiding behind an avatar persona (Wigham & Chanier, 2013). This is likely to contribute to increased self-efficacy and willingness to communicate, increased motivation, and increased risk-taking (Peterson, 2010; Peterson, 2011). Owing to the realistic and immersive qualities of the space, users feel that they are extensions of themselves as their avatar-self is genuinely engaged in completing the task. This extension of self helps users concentrate and focus on the task as opposed to focusing on themselves (Csikszentmihalyi, 2014). In this way, the affordance of immersion relates to the learning approaches highlighted earlier in terms of social interaction, experience, negotiation, and collaboration.

Implications

Understanding the many salient relationships between learning theories and the affordances or benefits of 3DVLEs is critical in terms of practical implications. For instance, if the benefits of 3DVLEs as defined learning spaces afford opportunities for synchronous interaction and mediation through tools and collaboration with others, then it is possible to contextualize these as learning spaces based on the learning principles from the previously mentioned theories, including negotiation of meaning and development of skills as a result of external social processes, influences, and interaction (Harasim, 2012; Kaptelinin & Nardi, 2006; Prensky, 2006; Vygotsky, 1986). These social processes are collaborative and interactive and hence promote learning as a result of the affordances of the space. Tasks Two through Five were designed so that users would make use of the space and tools within the space by clicking, moving, and gesturing to accomplish a task. Ideally, these experiences would lead to outcomes.

In sum, the conceptualization of the classroom has changed with the provision of online spaces and due to the learning affordances of these spaces, but how do these perspectives inform space and instructional design? The authors hold that these unique learning contexts may have the potential to facilitate learning for some learners in a blended context by creating alternative learning spaces. Similarly, the potential for distance language learning in these spaces is significant, as made evident by the number of studies involving virtual worlds and online language education (Kim, Lee, & Thomas, 2012). The next section provides a definitional framework of a unique 3DVLE used to carry out a series of tasks designed to achieve specified learning outcomes in an EAP classroom.

DESIGN PROCESS

With the addition of technology as an alternative space for teaching and learning, the practical implications of new online teaching and learning spaces are far-reaching and should consider the affordances, features, and benefits of each unique space in relation to established learning theories and understanding of how people learn. While 3DVLE platforms are easy to use, the shift from instruction in a physical or online space to a 3D space is challenging. A difficulty for educators is knowing how to create scenarios that will facilitate the achievement of specified learning outcomes in these new contexts. This section describes the design of a 3DVLE for a course and its associated activities that evolved from the authors' shared understanding of the affordances of space in relation to 21st century learning theories and is framed by LEPO, an integrative and flexible framework. The section first contextualizes the course and the rationale for using a 3DVLE, and then provides a definitional framework of the space (Learning Environment) and provides illustrative descriptions of specific spaces and sample tasks that were developed to help promote critical thinking, problems solving, collaboration, and effective communication (Learning Processes and Learning Outcomes), some of the 21st century skills identified by Dede (2010).

Course Context

The activities below were designed as part of an advanced level EAP course at a Canadian university. These courses are for students who have an English as a Second Language requirement as determined by a recognized English Language Proficiency test such as IELTS. Students achieving a mid-range score

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are placed in one of three levels of this program designed to refine academic English skills and language proficiency. Typically, students at the advanced level take up to three courses in their degree program at the same time; in this case, the EAP course outline states that the course is designed to “enhance academic language skills”, while “developing critical thinking and problem solving skills.”

While the course physically takes place on campus twice a week for three hours, a major component is a *Research Project*, worth 40% of the course grade, which includes 16 separate activities, four of which take place in a 3DVLE. Students access the 3DVLE from a lab on campus during regular class time. Throughout the term and as part of the *Research Project*, students are expected to demonstrate evidence of personal learning as they do preliminary research related to a commercial sustainable initiative and the overarching theme of “sustainable development” and based on their experiences interacting in a 3DVLE. Over the 12-week course, students are evaluated according to whether their chosen initiative meets its sustainable development goals according to suitable indicators derived from teacher-assigned sources. Of the eight learning outcomes for the *Research Project*, the outcomes most related to the students’ experiences completing tasks in the 3DVLE include: describing in detail their major, program of study, and main topics from required courses; recognizing and interpreting career and educational preferences; evaluating the sustainability of their chosen sustainable initiative based on select indicators; and showing academic written and oral communication skills.

The rationale behind using a 3DVLE for these activities was to increase the potential for users to experience interactions made possible specifically due to the affordances of the environment and to observe how learners interact in and with these spaces. The authors believe that the 3DVLE experiences described below helped facilitate and enhance learning outcomes due to the affordances of the virtual space and the design of the tasks.

Definition of Whole Space (Learning Environment)

The following is a description of the 3DVLE and associated tasks. For context, 3DVLEs are Internet-hosted environments, which can be designed to graphically replicate real world places or scenarios and wherein users manipulate an avatar to purposefully communicate with other user avatars using voice over Internet protocol (VoIP). Users can also interact with physically represented artifacts like chairs and tables and use web-based tools, such as collaborative writing surfaces and text functions. The purpose of the interaction is determined by the assigned activity and desired learning outcomes (Hartwick, 2015).

The 3DVLE described herein originally replicated a university campus, including campus buildings and classrooms (Figure 1) and was a browser-based 3D platform by AvayaLive Engage. Over a four-year period, the space evolved to include new spaces, including an orientation maze. New space designs resulted from a recursive process involving a multidisciplinary team of 3D technical designers, educational designers, and subject matter experts. Importantly, the design team had support from managers, directors, and faculty deans. Each iteration of the space was determined by the design team and involved matching teaching objectives to space design and identifying how the space would help learners achieve outcomes that might not otherwise be possible in a physical classroom space. In line with the LEPO framework, this included developing the learning outcomes, authentic virtual world characteristics, options, and objects needed for successful activity implementation. Each activity-specific location is connected to the main university virtual campus.

Figure 1. Screenshot of university virtual campus

LEPO Framework: Learning Environments, Learning Processes, and Learning Outcomes

Phillips et al. (2012) credit the success of a well-designed learning environment to the relationship of activity design and learning design. For example, the design of an activity should prompt the learner to engage with the design of the environment. As noted above, the purpose of the *Research Project* is for students to do preliminary research related to the overarching theme of sustainable development. During regular class time, students develop language and academic skills through the same topic, such as by reading and learning about related sub-topics like sustainability indicators and the pillars of sustainable development. In addition to thematic content, students learn and practice academic skills, such as citing and referencing sources and reflective writing. The tasks described below are the result of the design team's more than four years of experience and modifications. The recursive process allowed team members to systematically account for the affordances of space and characteristics of how people learn, such as practice, collaboration, and interaction. Hence, tasks designed for this particular course and the 3DVLE were intended to help students achieve specified learning outcomes related to language, content, and skill and because of their experiences in class and in the 3DVLE. Tasks were intended to increase technical proficiency and elicit critical thinking and problem solving, which are to be demonstrated through actions and written language. This section describes five interrelated and sequential tasks, the latter four of which played out in the 3DVLE described above. The tasks designed and described in this chapter made use of five locations in the 3DVLE campus, namely *Orientation Maze*, *Career Island*, *Residences*, *Campus* and *Rainbow Stage*, and *Native Village* and *Market*. The tasks were designed to target students' content knowledge regarding an understanding of their majors and disciplines and thematic topic; language in terms of topic specific vocabulary; and self-awareness regarding their ability to make connections between experience and knowledge.

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Activity One: Holland Code Assessment

Learning Environments

Although Activity One did not take place in the 3DVLE, it helped students develop an awareness of their interests, values, and possible major; it was also a necessary step to guide Activity Three by providing vocabulary related to personality traits and career preferences. Activity One was done in the physical classroom during class time and consisted of students taking a modified version of the Holland Code Assessment to identify personality traits, skills, and career preferences.

Learning Processes

Students ranked their top three personality traits (realistic, investigative, artistic, social, enterprising, and conventional) in relation to their choice in major and career preferences. The purpose of this activity was to assess language, content, and metacognitive skills based on use of specific vocabulary and ability to articulate traits, skills, and career preferences. This process promotes language use, while simultaneously having students predict, monitor and reflect on their learning trajectory. These processes are congruent with behaviourist, cognitive, constructivist, and 21st century learning theories.

Learning Outcomes

The students' metacognitive ability or self-awareness was reflected in their ability to make connections between the outcome of the Holland Code Assessment and their choice of major and experiences to date both in and out of class and in response to the following prompt: *Explain how the results of your Holland Code (category) related to your major. Use vocabulary from question 2 above. Your explanation should include your experiences to date.* As a result of this activity, students were able to articulate in writing their own personality traits as in, "I'm a curios person. Every time a question popped up in my head, I always right away looking for the answer." Further, they could reflect on choice of major in relation to Holland Code results as in, "The career possibilities described by the Holland code for the Investigate traits suits my current academic career and even my career plan. I'm currently in Biology major and I want to be a surgeon." Students also predicted future careers options, as in, "Also, I would like to work in a bank, so the computer skills that I am learning and the math course that I am study will help me in this career."

Activity Two: Spatial and Technical Orientation

Learning Environments

As previously mentioned, the *Orientation Maze* (Figure 2) was designed to give students a spatial and technical orientation to the environment before tackling other tasks. It was also used to determine which types of strategies students relied on to efficiently complete an activity (e.g., asking peers for help or going back and starting the maze again). The *Orientation Maze* is a virtual path that progressively guides students through the functions of the platform so they can be technically and spatially prepared to engage in upcoming tasks. Each of the seven maze sections is connected by a gate that students can

Figure 2. Screenshot of orientation maze

open only by performing an activity accurately, such as a movement or a gesture. The maze is designed to be followed without a facilitator. By the end of the maze, students will have successfully performed the most common features of the 3DVLE platform, thereby reducing technical and spatial barriers in future activities. Students can practice these skills until they feel confident enough to leave the maze and proceed to other tasks. Students can advance through the progressively more complex steps of the maze as they read directions and solve problems along the way.

Learning Processes

Understanding how to use the technology, reading to inform, and the ability to problem solve in authentic, new environments are considered important 21st century skills (Dede, 2010; P21 Partnership for 21st Century Learning, n.d.). In each of the seven maze sections, students are expected to perform a series of interactions by following posted written instructions and solving the challenge of opening the gate to advance to the next section of the maze. One such interaction has students attempt and practice various gestures to advance. This interaction is in line with behaviourist theories with regards to repetition and memory and importantly contributes to students' ultimate success in these environments with progressively more complex tasks. Further, each station of progression and instruction throughout the maze acts to scaffold the technical skill. Upon completion of the *Orientation Maze* and by way of the post orientation survey, the teacher helps students reflect on whether they made use of meta-cognitive skills and the available supports.

Learning Outcomes

Phillips et al. (2012) define learning outcomes as things that are demonstrable as a result of engagement. Upon successfully completing each section of the *Orientation Maze*, students were expected to demonstrate achievement of technical outcomes, reading comprehension, and problem solving by following a set of instructions. These instructions required that the student manipulate their avatar by using

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gestures (e.g., wave, nod), movement (e.g., left and right), changing their avatar appearance, and texting the teacher. By responding to the question below, students reflected on their personal learning strategies:

Which strategies did you use to complete Activity Two (circle as many that apply)?

1. I asked another avatar by using my headset and voice
2. I went back to the maze
3. I worked with another avatar
4. I followed/ watched a peer avatar
5. I did not use any strategy(ies)
6. Other
7. I gave up/ logged off

Activity Three: Explore Your Career

Learning Environments

Career Island represents a self-sustainable island in which learners explore various professional roles represented by non-player avatars positioned throughout the island in virtual rooms reflecting their role, such as a nurse in a small clinic (Figure 3) and a biologist in a research lab (Figure 4). The virtually rendered rooms further reflect the careers through animated artifacts, such as a patient in the clinic. This environment, while not authentic, may contribute to a sense of immersion and real-time presence. The non-player avatars, if clicked on, provide information about the type of person that might be suitable for the careers and present challenges typical to that field. For instance, in the research lab, the biologist has crumpled paper all over the floor and around the garbage bin, indicating the biologist is frustrated with

Figure 3. Screenshot of nurse's clinic on Career Island

her research. In the nurse's clinic, a patient appears to be having an allergic reaction. *Career Island*, as a learning environment, was designed to support the activity, while the activity purposefully made use of the artifacts and rooms in the environment. The objects and non-player avatars helped to scaffold the content-specific vocabulary and stimulate the learners' prior knowledge of these different career roles in order to facilitate the activity.

Learning Processes

For Activity Three, students chose two of eight possible careers based on the results of Activity One and their choice in major. Upon landing in *Career Island*, students looked for the area representing their career choice, e.g., *Town Centre Building* (engineer, Figure 5) or *Clinic* (nurse). Once they found the most relevant location, students were instructed to notice, observe, and interact with the space, including the non-player avatars who talked about the selected careers. In these spaces students are encouraged to observe the space and listen to non-player avatars talk about their profession. Upon leaving the space students completed a brief survey to challenge their observational skills and encourage them to think critically about both careers. The survey is provided within the virtual environment via web board where it can be answered within the virtual environment while their experience is still fresh. From both a constructivist and a connectivist perspective, these instructions assume that learners will actively collaborate and be resourceful by taking advantage of the objects and tools within and outside the environment in order to successfully complete the activity.

Learning Outcomes

Students ultimately had to explain how their experiences interacting in the career spaces related to what they had found out thus far about their own choice of major. The following is one student's response to her experience in the clinic:

Figure 4. Screenshot of biologist's lab on *Career Island*

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The second career that I chose is nursing because I want to help people and know how to treat sick people, and give them the right medicine. According to Holland Code, the nursing area of study of social but I am not a social person but I like this career. According to 3D lesson, the nursing in the video talk about how to help people and you need to be attention to details.

This comment demonstrates her awareness of her personality traits as she justifies how nursing is a suitable career choice although she is not social. Additionally, students were asked to respond to two questions that targeted critical thinking. For example, students who selected the nurse career and who explored the clinic were asked to respond to the questions:

1. What do you think is wrong with the female patient in the clinic?
2. Have you ever cared for a sick animal?

Because of this interaction and drawing on personal, real-world experiences, one student responded as follows, “My friend used to have a dog before finally the dog died because of the inflammation of the pancreas and I used to help her.”

Activity Four: Defining Sustainable Development

Learning Environments

In addition to *Career Island* and the *Orientation Maze*, the 3DVLE has two main functional areas, a downtown area with shops, a café, and three houses, and a virtual university campus. Each of the houses in the *Residences* section can be designed and textured to reflect the eating, consuming, and cultural habits of the hypothetical inhabitants. As such, walls, refrigerators, furniture and level of cleanliness can be textured to suit the learning task and outcomes. Figure 6 is a screenshot of a university student

Figure 5. Screenshot of engineer's work site

inspecting virtual refrigerator contents in a virtual house to get insight into residents' consumption habits. Activity Four was designed so that users would move and interact in these two main areas; learning became situated and outcomes were the result of the user's experiences interacting with and in the space. The *Campus* area and buildings are designed around a central courtyard and replicate, for the most part, a university in Ottawa, Canada. The area includes a library, virtual classrooms, and offices. To take advantage of the expansive space and users' perception of being outside, more recently an open-air classroom, called *Rainbow Stage* (Figure 7), was added. This space is ideal for group work as it includes six breakout stations complete with work surfaces and contained sounds.

Learning Processes

During class, students were given a worksheet on writing formal academic definitions. This included a list of definitions of sustainable development from which they were to identify specific details or characteristics that recurred across all definitions. The purpose of the worksheet was to scaffold the learner toward writing their own definition of the term. After completing the worksheet, students were tasked with exploring the *Residences* and making recommendations to a hypothetical family as to how they could be more environmentally sustainable in their home based on what they observed, such as recycling habits and refrigerator contents. This active exploration of the space, not an option in a physical classroom environment, was intended to promote collaboration, experiential learning, and learning-by-doing, which are especially characteristic of socio-cultural and 21st century pedagogies. Next, students were asked to individually explore the *Campus* and *Rainbow Stage*, and then in groups identify two sustainability initiatives from an economic and social perspective. As 3DVLEs allow for movement and exploration, ideally learners can connect these virtual experiences to learning; learning is therefore situated. This ability to move, explore, and create are related to Savin-Baden's (2008) notion of space and learning.

Learning Outcomes

Demonstrated outcomes for this activity included the use of formal and content specific language and proficiency in defining a term. Further, expected outcomes included problem solving and the ability to

Figure 6. Screenshot of virtual refrigerator contents

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Figure 7. Screenshot of Rainbow Stage

think critically based on experiences in and within the space. One student's response clearly demonstrates the value of movement, exploration, and experience in the *Campus* space, "Firstly, we can use the new type energy. The sunlight is enough, so it is able to install some solar panel to collect solar energy." In this case, the student links their experience in the 3DVLE to sustainable initiatives from the class readings and course content. This experience would not have been possible in a traditional classroom space; this would have necessitated a tour of library or other campus building.

Activity Five: Applying Sustainable Development Indicators

Learning Environments

The 3D model of *Native Village* (Figure 8) was designed by the authors' university's multimedia students and includes an animated dance that allows users to experience an authentic part of Canada's First Nations culture. *Native Village* is a good entry point for stimulating discussion, the basis for task design, as it invokes opportunity for experiential learning. The *Market* (Figure 9) design is based on design-team members determining the need for any tasks related to food, shopping, and health. In connection with the theme of sustainable development it was expected that as students interact with the space, students may notice variation in products and costs, as well as ethical considerations such as fair trade items, thus prompting critical thinking and problem solving. These skills are compatible with previously identified 21st century skills.

Figure 8. Screenshot of native village

Figure 9. Screenshot of market

Learning Processes

In Activity Five, students were asked to explore the *Native Village* and *Market* in groups. As they explored the two areas, students were tasked with answering questions related to sustainable development using a collaborative writing surface. The affordance of real-time voice allowed for peer feedback, or what cognitive theorists might call an *event of instruction*; theoretically, the stance is that learning is a social

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process in that successful completion of the task may be due to interaction with a more knowledgeable peer. This assumption draws on socio-cultural, connectivist, and 21st century learning theories. More specifically, successful completion of the activity depended on students' collaboration, freedom to move and create, and a certain level of proficiency using a collaborative writing tool and moving and exploring in the 3DVLE. Writing prompts included reporting on the observed culture's social, environmental, and financial goals and practices based on a shared understanding of the topic and course readings.

Learning Outcomes

Demonstrated outcomes included evidence of topic-specific vocabulary and content knowledge in the shared written document. The ability to achieve outcomes successfully included demonstrating connections between experiences in and because of the space and due to collaborative thinking and problem solving. Ideally, students could account for their experiences by including references to the input of peers and the space. In response to the prompt, *Identify possible trade-offs, as defined in the reading, in terms of access to food in the Native Village compared to the Downtown market area*, one group responded collaboratively (as indicated by different coloured text-based responses):

Access to food is much more easy in Downtown because of the shops available. In the village they have to hunt to get the food, which is dangerous. Furthermore, people who live in downtown can try multi-cultural food and it is more convenient, but the people living in the village have access to specific food.

In this response, students demonstrate connections between their experiences exploring the space and have worked collaboratively in producing a relevant response. Also, there is evidence of attempts at using comparative language and examples, which are academic conventions expected at this level.

RECOMMENDATIONS

This section includes recommendations for designing a learning space and tasks in a 3DVLE based on the authors' collective experience and from the point of view of the teacher as designer. To date and as illustrated above, the authors have approached the task and space design for 3DVLE by systematically drawing on various learning theories, particularly as they pertain to the affordances of the environment and the promotion of learning experiences that may lead to the development of learning outcomes, such as critical thinking and collaboration. The authors have used Phillips et al.'s (2012) LEPO framework to demonstrate the potential of five tasks designed for a unique learning environment, processes, and expected outcomes.

The authors suggest making use of the affordance of real-time, multi-user, synchronous interaction through first-person voice, text, and movement in task design. This helps establish a sense of presence and facilitates opportunities for sharing and exchanging information, co-constructing meaning, and practicing newly acquired skills. These are characteristics of many learning theories addressed in the first section of this chapter and align with 21st century learning trends and constructivist perspectives.

To further support an authentic experience and promote engagement, entertaining design elements can be used throughout the 3DVLE, such as musical instruments in *Career Island*. The success of Tasks three, four, and five was due largely to the fidelity of space, which led to strong student engagement

and interaction with other users and the space as students worked through problems and demonstrated critical thinking in order to respond to the task. The focus was on making sense of information through interaction, reflection, and learning about learning (Ally, 2008). These are possible because of the immersive and authentic affordances of the space.

According to Bransford et al. (2000), knowledge-centeredness refers to how the environment is organized so that it contributes to knowledge growth and skill. From this perspective, the authors recommend designing activities that consider a learner's prior knowledge, typically gathered by means of an introductory activity such as the *Orientation Maze* (Figure 10). The authors suggest that such preliminary activities be easily accomplishable in a reasonable amount of time so as not to discourage first time users. The authors further suggest that task design take advantage of such things as the authentic quality of 3DVLE spaces and their ability to promote content and skill development by means of tools and artifacts available in the space. For example, visual cues, including multiple collaboration surfaces and objects throughout the environment may help trigger memory and prior knowledge. The implication is that learners are free to explore, gather, select, and evaluate information anytime and from anywhere (Ally, 2008).

The authors recommend that a well-crafted 3DVLE educational space should provide tasks related to 3D-rendered, high-quality artifacts that learners can interact with – for example, custom designed non-player avatars with clickable voice options to create a truly immersive experience. Further, the design of a 3DVLE space for learning requires a strong understanding of the educational material and frequent collaboration between members of the design team. In this case, Career Island used non-player avatars to provide different career roles based on Holland Code vocations. The vocabulary used in non-player avatar recordings while explaining their career aligned with students' language level, the instructors' vision, and learning objectives of the activity. Importantly, 3DVLEs are living spaces that should continuously adapt to the design team's experience; thus, a good platform should support all abovementioned

Figure 10. Screenshot of an introductory activity in orientation maze

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features, as well as be easy to modify and deploy on a server that students and instructors can access without difficulty.

The implications for learners in these 3D spaces extend to becoming more selective and critical of information, as well as more collaborative, yet at the same time more autonomous. Due to the complex nature of the space, the learner becomes more accountable and responsible for their own learning. However, considering that technology is a medium for instructional practice, it is ultimately what educators do with technology that matters: the designer is responsible for creating spaces that are motivating and engaging (Ally, 2008; Clark, 1994). Adding entertaining elements of surprise, such as musical instruments that can be played in the music room on Career Island (Figure 11), reminds student to be observant and investigative. As such, in addition to designing tasks that foster experience, interaction, and collaboration, the implications for design include ensuring a high-quality VoIP as a critical component of a successful 3DVLE. Further, based on the affordances of authentic space and immersion, a chosen 3DVLE platform should support avatar customization for students to personalize their own avatar, along with non-player avatar usability. Designers should be able to create spaces that are populated with non-playing avatars that are animated and include voice to create realistic opportunities for engagement.

Despite the complexity of design and opportunity for technical skill development, interaction, and collaboration, the authors noted in their course that their students worked through tasks at very different levels and speeds, and often students were observed working independently, even in tasks designed for collaboration. Students with stronger technical adeptness tended to move through the instructions very quickly and wander off task, while not necessarily benefitting from the spatial cues and experience. High flexibility and ease of user management capabilities should be considered when choosing a 3DVLE platform. Selected platforms should therefore support password-controlled authentication and group access control, volume, and interaction support.

Figure 11. Screenshot of music room on career island

FUTURE RESEARCH DIRECTIONS

It is an interesting and fulfilling time to be involved in 3DVLE research. This chapter has attempted to understand how the affordances of the space relate to characteristics of 20th and 21st century learning theories and how these can guide space and task design. Further research is needed in the area of curriculum and task design. The authors suggest the use of analytics in combination with observational data to clarify the role of space. Accordingly, research should appreciate and understand the role of the environment as a mediator in the learning process and use 3DVLE analytics to measure duration and frequency of interaction to understand the impact of space on performance. The authors are investigating the reliable use of learning analytics, defined as “the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs” (LAK ’11, 2017). The use of learning analytics, or *telemetrics*, in 3DVLE contexts will help predict students’ success and aid students in performing learning activities in the 3DVLE. This process will lead to more efficient assessment and provide timely feedback to students to increase the likelihood of successful learning outcomes. Knowledge obtained from telemetric data combined with student surveys, teacher observations, and task outcomes will help guide research, design, and practice in these unique online learning spaces.

Additionally, research in this area will contribute to decision-making in terms of supporting the development and use of these spaces as an extension of post-secondary institutions’ physical classroom space. The potential for 3DVLEs in EAP and other learning contexts is exciting and a better understanding of these spaces will help target niche markets for post-secondary, online, and distance education. These spaces provide a rich and safe opportunity for learners to continue to develop technical skills, gain content knowledge, and practice meta-cognitive skills. Future research will help determine how and which tasks will help contribute to the achievement of learning outcomes and 21st century skills as an experience of interaction with the space.

CONCLUSION

Upon examination of the key affordances of 3DVLEs—namely, authenticity, immersion, and real-time interaction—it is evident that characteristics from a range of learning theories can be applied to a conceptualization of 3D classrooms. Concepts like *connected*, *experiential*, *collaborative*, and *interactive* are shared between the learning theories and approaches discussed above. Overall, a consideration of the role of space in learning, whether physical or virtual, is often overlooked and yet especially pertinent for understanding how people learn in 3DVLEs. As stressed throughout this chapter, understanding what is happening in and because of the space is critical to any theoretical approach to learning online and specifically in 3DVLEs.

Drawing on well-known learning theories and approaches is important as theories help to illuminate the path to proceed in our practice: “To move forward, to know where to invest our energies, we have need of theory” (Kaptelinin & Nardi, 2006, p. 23). And so, while the notion of online classrooms fits nicely within constructivist and socio-cultural learning theories in terms of their technological affordance of providing an environment or learning space where learners can collaborate, problem solve, and grow conceptually, these theories do not adequately capture the role of 3DVLE spaces in the active process of learning. Thus, a blended learning theory could help practitioners better understand how the affordances

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of the space contribute to qualities of active, collaborative learning. In other words, it should account for how learning takes place because of the affordances within a socially and culturally mediated system. It would be counter-productive to ignore earlier theories of learning in consideration of these spaces; moving forward, a blended model should consider the key affordances, learning outcomes, and the actual space and artifacts within the space.

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KEY TERMS AND DEFINITIONS

Affordance: The quality or characteristic of the environment that contributes to increased opportunities for interaction or engagement, thereby contributing to learning.

Artifact: A 3D rendered object that exists in a digital environment designed to complement the space and/or task.

Avatar: A virtually rendered 3D self that can be personalized by the user according to the user's choice of certain traits, like clothing and hair color, height, and weight.

Learning Analytics: The measurement and collection of learner telemetric for optimizing 3DVLE task and space design.

Metacognition: A critical awareness of one's own thought process and understanding.

Non-Player Avatar: Virtually rendered avatar artifacts with which users can interact through clicking to prompt a voice or movement response.

Telemetric: 3DVLE user activity data that is captured remotely and logged for analysis.

Three-Dimensional Virtual Learning Environment (3DVLE): An internet-hosted space designed to replicate real places and objects and provide online users with the opportunity to interact with other users synchronously with voice, movement, or text.

Twenty-First Century Learning: The acquisition of content knowledge and skills, including critical thinking, problem solving, and collaboration.

Chapter 8

What is ePortfolio “Done Well”?

The co-authored (with J. McCarroll and A. Davidson) manuscript in this chapter was accepted as a chapter in an edited book, *Catalyst in action: Case studies of high-impact ePortfolio practice* (pages 185–196), in press. This volume, edited by B. Eynon and L. M. Gambino and published by Stylus Publishing (Sterling, Virginia), provides evidence-based research that helps confirm or challenge the notion of ePortfolio as a social pedagogy. Our chapter uses the Catalyst Framework (Eynon & Gambino, 2017) as a framework to test ePortfolio practice “done-well” at the course level. In Chapter 1, I address the need for more evidence that links the perceived affordances of ePortfolios (as defined in Chapter 2) in relation to the achievement of learning outcomes. The in-press manuscript follows in its original format and has been reprinted with the permission of Stylus Publishing granted on August 7th, 2018.

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WHAT IS EPORTFOLIO
“DONE WELL”?

A Case of Course-Level Analysis

Peggy Hartwick, Julie McCarroll, and Allie Davidson, Carleton University

This case study describes an ePortfolio practice as part of an undergraduate-level course concentrating on language and skill development. The authors focus primarily on the Integrative Social Pedagogy sector of the *Catalyst Framework*¹ highlighting the formative role of the Inquiry, Reflection, and Integration design principles throughout the ePortfolio practice description and explaining how these practices elicit high-impact behaviors as described by Kuh and O'Donnell.² The authors demonstrate the connection between the Integrative Social Pedagogy, Technology, and Professional Development sectors, detailing how they complement each other and intersect throughout the practice. Following, evidence from student surveys provides insight on the impact of these practices. Finally, we share lessons learned based on experience implementing ePortfolio practice at the course level and propose connections to the Outcomes Assessment and Scaling Up sectors. Readers are provided practical descriptions of what an ePortfolio practice “done well” looks like through applied examples as evidence to indicate which practices generate high-impact behaviors.

Institution Profile

Institution Name: Carleton University, Canada

Enrollment: 29,000

Scale of ePortfolio Practice: Course

Discipline of ePortfolio Practice: English as a Second Language for Academic Purposes (ESLA)

Scale of Overall ePortfolio Project: Institution-wide

ePortfolio Developmental Trajectory Quadrant: III

Catalyst Framework Sector: Integrative Social Pedagogy

Connection to Other High-Impact Practices: First-Year Experiences

Institution Description

The case study focuses on Carleton University in Ottawa, Canada, a public institution with over 29,000 enrolled students.³ Carleton's electronic portfolio system, cuPortfolio (powered by Mahara), was first introduced at the university in 2014. As of June 2017, approximately 5,000 students have used the tool and more than 70 instructors have integrated it into their courses.

To encourage effective ePortfolio practices at Carleton, the university's Educational Development Centre (EDC) works closely with instructors, providing pedagogical and technical support. The adoption of cuPortfolio is primarily a grassroots effort; instructors choose to integrate ePortfolio and have complete autonomy when deciding how to implement ePortfolio in their course.

Two main goals of using cuPortfolio at Carleton are to support teaching and learning practices and program-level assessment. Because ePortfolio is relatively new to Carleton, there is more adoption of the former, with program-level assessment still in the emergent stage.

This case study describes teaching, learning, and course-level assessment of student ePortfolio work in an English as a Second Language for Academic Purposes (ESLA) course. On the basis of the results of an English proficiency exam, international students are placed in one of three levels of ESLA at Carleton University. Capped at 30 students, classes are full-credit (six hours of instruction weekly) and aim to improve students' academic language and research skills. The course described herein is the advanced level.

Students at this advanced level may enroll in up to three additional classes in their academic discipline. Presented with such a rich opportunity for integrating ePortfolio with other courses, ePortfolio practice centers around a process-based research project that prepares students for success in their degree programs.

ePortfolio Practice Detailed Description

This case study focuses on the Integrative Social Pedagogy sector of the *Catalyst Framework*. The ePortfolio practice outlined in Table 14.1 spanned the Winter 2017 semester and included four submissions approximately three weeks apart, totaling 43% of the final grade. The ePortfolio was introduced in January and used throughout the course, culminating with a presentation and final submission in April. The authors attribute the success of this practice to the instructor's pedagogical strategies, support provided by the institution, and curiosity and willingness of students to embrace this work.

The first experience students had with ePortfolio was a workshop led by Carleton's ePortfolio support staff to explain the purpose and function of an ePortfolio. Following the workshop, and with ongoing support, students began Activity 1, preparing a brief self-introduction that identified their major and career aspirations. In addition, students included a supporting original artifact or digital representation of self. For the purpose of this practice, the instructor defined an artifact as any digital

TABLE 14.1
ePortfolio Practice Outline

Activity	Activity Description	Due Date
1	Introduction to ePortfolios	January 12
2	Explore Major	January 17
3	Holland Code	January 24
4	Topic Choice	January 31
<i>Submission 1 January 31 (10% of final grade)</i>		
5	Library Workshop Preparation	February 7
6	Library Workshop	February 9
7	Informal Topic Exchange	February 16
8	Research Proposal	February 28
<i>Submission 2 February 28 (15% of final grade)</i>		
9	ePortfolio Sharing	February 28
10	Reflection	March 7
<i>Submission 3 March 14 (8% of final grade)</i>		
11	Oral Presentation	April 4 and 6
12	Academic Outline	April 7
<i>Submission 4 April 7 (10% of final grade)</i>		

content demonstrating learning and critical thinking, including images, RSS feeds, and news articles. Students were also asked to share something interesting from an online news site, briefly summarizing and explaining its relevance.

This first activity was designed to engage students in purposeful self-authorship through a written biography and original artifact, complemented by a chosen news piece reflective of their interests and experiences. The ePortfolio technology enabled students to integrate meaningful topics from outside the classroom, thereby constructing an understanding of themselves and making connections between their interests and course concepts. This process of integrative reflection allowed students to make connections between personal life and coursework, described by Rodgers as reflection as a meaning-making process.⁴

Five days later, Activity 2 required students to explore online sources and incorporate those sources in a description of their major. This activity prompted an important introduction to the necessity of citing websites in academic texts. Students supported this text-based ePortfolio entry with an original artifact, ranging from JPEG images to the use of digital tools, such as JuxtaposeJS.⁵

Students in ESLA may study concurrently in their degree programs, taking foundation-level courses, yet rarely do they fully comprehend what their major entails, the types of courses they will take, or the careers they may work in. For these

reasons, the instructor designed this activity to make integration visible as students explored their majors and made connections across courses. Furthermore, Activity 2 presented students with an opportunity to share their work and observe peers' work, thereby communicating their understanding to an authentic audience and prompting the process of Inquiry, Reflection, and Integration. As students *inquire* about their classmates' responses, they receive informal feedback from peers, prompting *self-reflection* on strengths and areas for improvement. This is important to foster early in the term, so that students can *integrate* improvements in subsequent activities. The informal connective and social reflective practice of Activity 2 was designed as an introductory step to Activity 3, scaffolding a deeper understanding of students' chosen majors.⁶

The next week, Activity 3 required students to complete a Holland Code Assessment designed to match personality characteristics with careers.⁷ The instructor asked students to reflect on their Holland Code results with respect to their chosen major and personality. By making connections to other experiences, this reflective practice allowed students to examine academic goals and consider their academic identity as learners and emerging professionals, as noted by Eynon and Gambino.⁸ As in Activity 2, students were asked to include a written response with an original artifact to make visible connections between their chosen major and their personality traits.

Following completion of Activity 3, student groups brainstormed possible research topics connected to their academic major. Students were prompted with questions like “What would an engineer want to know more about?” and were encouraged to explore potential topics online. Students then met with the instructor to narrow down a research topic. Group collaboration and the subsequent instructor feedback, a high-impact behavior as identified by Kuh and O'Donnell,⁹ prompted engagement with topics and provided direction for upcoming research projects.

In Activity 4, students self-author an audio post explaining their topic choice, what they knew about that topic, and its connection to their major and course theme. The instructor uses these posts to provide early feedback to each student. The requirement to connect their research topic to the current ESLA theme and their major encouraged students to take ownership of their learning as they *inquire* about topics of interest, *reflect* on how key concepts learned in the ESLA topic connect to their major, and *integrate* their ideas, research questions, and preliminary research into Activity 4. These align with Bass's ideas of constructing and communicating understanding to an authentic audience¹⁰ and with Rodgers's criteria of reflection as a meaning-making process and reflection in community.¹¹

After working on this first set of activities for approximately three weeks, students submitted their ePortfolio for a total grade of 10 (Submission 1). Consistent with Kuh and O'Donnell's claim that frequent, timely, and constructive feedback, as well as interactions with faculty about substantive matters, generates high-impact behaviors,¹² the instructor provided individualized, detailed feedback using screen-recording software. This feedback highlighted strengths and areas for improvement for students to *reflect* on their performance and *integrate* changes in subsequent submissions.

In preparation for Submission 2, students completed a second series of activities over the next three weeks of the course. Using an inquiry process, Activity 5 tasked students with conducting preliminary research to identify keywords and reflect on issues related to their topic in preparation for the library workshop, Activity 6. During this workshop, students learned to locate and evaluate academic sources. Applying this knowledge, students were required to locate and evaluate a library source related to their topic with the assistance of the librarian and instructor. Finally, students communicated their topic understanding to the instructor or authentic audience (peers or librarian) and documented this in their ePortfolio. This prompted self-reflection provided another opportunity for more timely feedback.¹³ Activity 6 culminated with an ePortfolio entry where students reflected on their workshop experience, noting the evolution of their topic, and summarized and cited their source. These steps were designed to encourage students to narrow down their topic, begin developing questions, and demonstrate appropriate use of academic conventions.

Next, students began to formulate tentative research questions. Activity 7 included an informal information exchange in shared topic groups. Referencing their ePortfolio, students presented what they learned and articulated preliminary research questions to their peers, thereby providing opportunities for collaboration, inquiry, self- and peer-reflection, and feedback.

Activity 8, a research proposal and the last step for Submission 2, was worth 15 marks. Students found and summarized three academic sources related to their research questions, demonstrating source evaluation and citing skills. The proposal was posted in a newly created ePortfolio page and included an original artifact representative of their perception of the inquiry and research process to date.

This second submission required a significant investment of student time. Forming the research component of the ePortfolio process, the activities were connective and structured to allow for “iterative cycles of engagement.”¹⁴ Students regularly interacted and collaborated with faculty and peers about substantial matters, thereby receiving periodic and constructive feedback, both practices that generate high-impact behaviors.¹⁵ Furthermore, with the reflective activity scaffolded “into the ePortfolio-building process,... students (were led to) sustain their focus on learning, make integrative connections, and find larger meaning in their educational experiences.”¹⁶ Achieving learning outcomes in these research-based activities, students contextualized and connected learning to what will be required in future, discipline-specific courses, aligning with Rodgers’s notion of systematic, persistent, and social reflective practice.¹⁷

By midterm, students had submitted their ePortfolio twice for assessment and feedback. Submission 3, consisting of Activities 9 and 10, was worth eight marks. Activity 9 was designed to provide students another opportunity to reflect and integrate learning with an authentic audience through informal sharing and observation of peer learning artifacts. Engaging in collaborative inquiry and learning in a supportive context continued to broaden each student’s perspective as to what makes a strong artifact.

The goal of Activity 10 was to author an academic reflection supported by an original artifact. As formal reflective writing was new to most students, the instructor began by scaffolding the activity, asking students to relate the following quote by K. Patricia Cross (as cited by Eynon, Gambino, and Török) to their ePortfolio experiences:

What we really need for citizens and workers of the twenty-first century is people who can conduct a lifelong conversation between their own experience and learning—who can use their experience to enhance learning and their learning to enrich application.¹⁸

Following, the instructor stressed the importance of connecting, synthesizing, and evaluating the self in reflections. The reflection prompts were designed to have students reflect on and articulate their learning experiences, while identifying potential obstacles and plans to overcome these in future iterations. Students were asked to be honest, academic, concrete, and critical, aiming to generate “reflection that is guided by wholeheartedness, directness, open-mindedness, and responsibility... [therefore] broadening one’s field of knowledge and awareness.”¹⁹ Activities 9 and 10 helped students become agents in their own learning through the “integration of inner and public self,”²⁰ guided by a “systematic and scaffolded inquiry”²¹ process outlined by the instructor.

Submission 4, including Activities 11 and 12 and worth 10 marks, was submitted at the end of term, allowing for final improvements. Activity 11, an oral presentation, provided students an opportunity to share, often with peers from unrelated disciplines, what they had learned about a real-world issue, whereas Activity 12 required students to prepare a formal academic outline for a hypothetical academic paper, developing a supported thesis based on preliminary research. While students were not expected to write a full research paper, they included findings in the outline. This fostered opportunities to practice academic skills and language. In Submission 4, a newly created page in their ePortfolio, students provided an example of how instructor feedback led to change in their final submission, their formal outline, and the PowerPoint slides from their Activity 11 presentation.

Spanning the last three weeks of class, students worked with the instructor and shared their ePortfolio progress with peers. This provided students with “frequent, timely, and constructive feedback,” as well as an opportunity to interact “with faculty and peers about substantive matters,” both identified by Kuh and O’Donnell as high-impact behaviors.²² Furthermore, these activities fostered social learning interactions and aligned to the core elements of social pedagogy, namely, construction, communication, and authenticity, described by Bass.²³

Across the course, the instructor intentionally scaffolded pedagogical strategies that aimed to generate high-impact behaviors, including “significant investment of time and effort by students over an extended period of time”; “interactions with faculty and peers about substantive matters”; “frequent, timely, and constructive feedback”; “periodic, structured opportunities to reflect and integrate learning”; and

“public demonstration of competence.”²⁴ In the Evidence of Impact section later in this chapter, we examine student survey responses assessing the impact of this strategy.

Connections to Other Framework Sectors

This section describes the connections between this ePortfolio pedagogical practice with the Technology and Professional Development sectors of the *Catalyst Framework*.

ePortfolio technology provides students the ability to use external technological tools to design original artifacts, thus allowing a transformation of student learning from traditional, text-based responses to multimodal approaches. The aesthetic customizability of the Mahara platform allows students to creatively express their individual identities, building a sense of agency and ownership of their own learning.²⁵ In each activity, as noted by Clark and Rodriguez, ePortfolio technology afforded students the opportunity to synthesize text-based content with multimedia artifacts, “lead(ing) to new discoveries: educational, artistic, intellectual and personal.”²⁶

ePortfolio technology can help promote student ownership and agency. Activities 2, 5, 7, and 9 afforded students the opportunity to share the development of their ePortfolio, prompting informal peer feedback and self-reflection. During these learner-centered activities, the instructor observed a shift in role from student to instructor as student experts instructed peers on how to leverage technological tools to enhance their ePortfolio by creating original artifacts. Complementing Eynon and Gambino’s claim that “using ePortfolio technology in conjunction with effective pedagogies helps students take ownership of their learning and become more active agents in the learning process,”²⁷ we posit that this role shift led students to take ownership of, and become engaged in, their own and their peers’ learning.

Moreover, the integrative space provides immediate and visible access to previous learning and feedback, thereby facilitating connections throughout the term as students reflect on personal and intellectual growth. ePortfolio technology allows these individual assignments to be easily rebundled, facilitating the achievement of pedagogical goals that are connected, systematic, and persistent.²⁸ In Activity 11, for instance, students select their best work from their ePortfolio, reflect on and integrate feedback, and then modify and present for assessment.

Conversely, poor pedagogical design can limit students’ meaningful use of ePortfolio technology, undercutting their learning experiences. Eynon and Gambino contended, “Ineffective technology or a poor fit between technology and pedagogy, can distract users and impede the digital advancement and demonstration of learning.”²⁹ To combat this, the instructor designed a low-stakes activity that introduced students to the technological functions and features of ePortfolio to enhance, rather than impede, the learning experience.

Another influential sector of the *Catalyst Framework* that intersected with this pedagogical practice was Professional Development. The ePortfolio assignment

described evolved during three years of iterative collaboration and professional development, including the instructor's attendance at ePortfolio workshops and related conferences, one-on-one assignment design and technology consultations with EDC support staff, participation in a cuPortfolio faculty learning community, and ongoing informal discussions with colleagues about ePortfolio teaching practices. These activities afforded the instructor opportunities to collectively inquire, reflect, and integrate ePortfolio pedagogy in collaboration with others at the institution, thereby contributing to a practice “done well.”

Evidence of Impact

Our evidence of impact is based on survey responses from 40 volunteer participants who responded to questions about their experience using cuPortfolio in this advanced ESLA course. While all students completed the online survey in the last week of the semester, only responses from participants who provided written consent are presented in this case study. Multiple-choice and short-answer questions surveyed students about their use of the cuPortfolio technology, time spent in cuPortfolio, and learning experiences and skills development related to the use of cuPortfolio. All multiple-choice responses were presented on a 5-point Likert scale from *strongly disagree* to *strongly agree*.

Significant Investment of Time and Effort by Students Over an Extended Period of Time

The instructor reported that approximately one third of class time was dedicated to ePortfolio work, and students were also expected to work on their ePortfolio at least once a week outside of class. This significant time commitment is reflected in participant responses. When asked, “When I logged into cuPortfolio I typically spent _____ hours dedicated to this course,” 60% of students logged one to four hours, and 25% logged five or more hours (see Figure 14.1). As explained in the ePortfolio Practice Detailed Description section in this chapter, students had multiple ePortfolio submission dates. The authors argue that this generated student awareness of the importance of early engagement with the practice. Participant responses support the assertions “Try to learn how to use cuPortfolio as soon as possible” and “Understand the basic concept at the beginning of the term.”

Interactions With Faculty and Peers About Substantive Matters

Students were given many opportunities to engage with their instructors and peers about substantive matters by sharing their ePortfolios (see Table 14.2). When asked about this social pedagogy practice, student feedback was positive. In response to the prompt “Using cuPortfolio helped me value peer feedback on my work,” 75% of participants agreed or strongly agreed. In addition, 66% agreed or strongly agreed that “Using cuPortfolio helped me learn from observing my peers’ portfolios.”

Figure 14.1 Time spent in cuPortfolio.

These responses indicate that being able to share and review portfolios positively impacted participants' learning experiences.

Participants noted appreciation for peer and instructor support. In response to the short-answer question "What advice would you give to students who will be using cuPortfolio for the first time in this course next year?" one student said, "Asking questions is helpful, do not be afraid to ask peers or instructors."

As per Kuh and O'Donnell's list of practices that generate high-impact behaviors,³⁰ this evidence suggests that cuPortfolio practices in this course afforded participants opportunities to interact "with faculty and peers about substantive matters,"³¹ ultimately contributing to their learning in the course. Valuing peer feedback suggests that the feedback participants received from their peers was constructive.

Periodic and Structured Opportunities to Reflect and Integrate Learning

This ePortfolio practice successfully contributed to student engagement through reflective thinking. For example, in response to the statement "cuPortfolio helped me reflect on my learning process/style," 78% of participants agreed or strongly agreed (see Table 14.2).

Participants also indicated that ePortfolio practices contributed to their integrative learning. For example, 75% of participants agreed or strongly agreed that "Using cuPortfolio helped me synthesize materials/ideas/concepts." Similarly, 81% of participants agreed or strongly agreed with the statement "Using cuPortfolio helped me connect course content to things outside of the class (e.g., personal experiences, materials in other classes, news stories, etc.)."

Responses to the previous statements indicate that ePortfolio practices in this course afforded participants the opportunity to *reflect* on and *integrate* their learning,

TABLE 14.2
Student Responses to “Using cuPortfolio Helped Me...” Prompts

Using cuPortfolio helped me...	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
Value peer feedback on my work	0%	5%	20%	65%	10%
Learn from observing my peers' portfolios	0%	3%	33%	58%	8%
Reflect on my learning process/style	3%	0%	20%	55%	23%
Synthesize materials/ideas/concepts	3%	0%	23%	60%	15%
Connect course content to things outside of the class (e.g., personal experiences, materials in other classes, news stories, etc.)	3%	0%	18%	68%	13%
Develop a deep knowledge of course content	3%	0%	18%	60%	20%

providing evidence to support *Catalyst* Value Proposition 2, “ePortfolio practice done well supports reflection, integration, and deep learning.”³² Moreover, as noted in the ePortfolio Practice Detailed Description section of this chapter, students had periodic and structured opportunities for reflection and integrative learning. This evidence extends the claim that not only was there an *opportunity* but also participants felt *engaged* in reflection and integrative learning as a result of ePortfolio use in the course.

Overall Effectiveness of the ePortfolio Practice

In addition to the evidence that speaks to High-Impact Practices and associated behaviors, participants reported on the overall impact of the ePortfolio practice in relation to their learning experience. For example, 80% of participants agreed or strongly agreed that “Using cuPortfolio helped me develop a deep knowledge of course content” (see Table 14.2).

Some participant responses suggested that ePortfolio practice extended beyond the course. When asked to provide advice to students using the tool for the first time, participants responded, “use the cuPortfolio as a way to improve writing skills,” “use it as a part of your study life... not only for ESL but also for other course(s),” and “try to develop some good learning habits by using cuPortfolio.” By recognizing the value of ePortfolio practice beyond this specific course experience, participants suggest ePortfolio can support learning, foster skill development, and transfer competencies to different contexts, ultimately serving them well as lifelong learners. Although the data collected did not explicitly measure student performance and success, participant responses support *Catalyst* Value Proposition 1 of the *Catalyst Framework*

that ePortfolio practice “done well” advances student success. Plans to examine and compare student outcomes are now being developed.

Lessons Learned

Developing and testing this ePortfolio practice underscore specific qualities of high-impact ePortfolio practice. One of the most significant lessons learned is the need for opportunities to publicly demonstrate competence. Participant responses revealed the desire for increased opportunities to present and/or observe peers. For instance, when asked “How else do you think cuPortfolio could be used in this class?” participants responded, “We can use cuPortfolio for preparing presentation,” “It can be used in our presentation,” and “cuPortfolio can be a way to present academic research.” Intentionally assigning one public presentation at the end of the term, the instructor was surprised by this feedback, particularly given the traditional assumption that second-language learners feel uncomfortable speaking publicly. The authors suggest this finding is evidence that students, taking ownership of their learning and using resources to perfect their ePortfolio, are proud to present their work generated through a significant investment of time and effort.

Another lesson learned is the value of appointing student experts in informal group work. During Activities 2, 5, 7, and 9, students were encouraged to share their ePortfolio development. The instructor observed student experts emerge, as peers looked to them to answer questions related to artifact use, layout, and so on. When asked “What advice would you give to an instructor using cuPortfolio in their course?” one participant replied, “The instructor can let the student who [is] good at designing cuPortfolio present their process on cuPortfolio in front of the class,” while another stated, “I think more presentation of my peers’ portfolio would help me more.” The authors suggest that instructors appoint student leaders or invite past students to visit the class as experts, if experts do not emerge organically in these informal sharing activities. This suggestion aligns with “Scaling Strategy 3: More Deeply Engage Students.”³³ As a new HIP at Carleton, ePortfolio is still in the early stages of Scaling Up. Moving forward, we intend to introduce student experts to relevant stakeholders.

As noted in the Connections to Other *Framework* Sectors section, we found that deliberately scaffolding a low-stakes, introductory assignment helps to quell student apprehension about the technology. Practices that introduce students to the various technological functions of ePortfolio software, graded or not, allow students to feel comfortable using the technology, take risks with the ePortfolio design, and integrate creative artifacts, thereby strengthening engagement and preventing technology from becoming a barrier to pedagogy.

The authors posit that to be “done well,” ePortfolio must be fully integrated into the course. As demonstrated throughout this case study, class activities were integrated, grades were significantly weighted, feedback was provided regularly, and class time was regularly scheduled. The authors suggest that it was a combination of these

factors that contributed to a successful implementation of ePortfolio in the course. ePortfolio was not added on, instead, it was intentionally integrated into the course, encouraging students to buy-in, thus promoting student ownership and agency.

Although the authors consider this case to be an example of ePortfolio “done well,” being a course-level adoption, the practice is constrained. Moving forward, the authors propose that Carleton could scale up from course level to program level in the ESLA program. Embracing the tenets of assessment *for* learning, we envision future ESLA students documenting, reflecting on, and integrating language learning over multiple semesters. In addition, striving for program accountability and connecting ePortfolio practice to the Outcomes Assessment sector of the *Catalyst Framework*, faculty could use ePortfolio as a platform to view authentic student work while demonstrating achievement of expected competencies as per program-level learning outcomes. This accountability may encourage faculty to ensure program-level learning outcomes are addressed in the classroom using the design principles of Inquiry, Reflection, and Integration.

Conclusion

Taking the narrow lens of a course-level case study, the authors provide a detailed description of pedagogical activities that constitute an ePortfolio practice “done well” and provide evidence from the student voice indicating which ePortfolio pedagogical practices help generate high-impact behaviors. While considering implications for future practice at the institutional level, the authors plan to explore the potential to facilitate the integration of student learning across time by expanding this practice to a program level. The authors acknowledge that to truly understand the effectiveness of this practice and others, further study should compare student performance post-completion of courses that employ ePortfolio pedagogical practices to courses that do not.

Notes

1. Bret Eynon and Laura M. Gambino, “Framework,” *Catalyst for Learning: ePortfolio Resources and Research*, accessed June 1, 2017, <http://c2l.mcnrc.org>.
2. George Kuh and Ken O'Donnell, *Ensuring Quality and Taking High-Impact Practices to Scale* (Washington, DC: Association of American Colleges and Universities, 2013).
3. “Facts and Figures: Carleton at a Glance,” Carleton About Facts, Carleton University, accessed June 14, 2017, <https://carleton.ca/about/facts/>.
4. Carol Rodgers, “Defining Reflection: Another Look at John Dewey and Reflective Thinking,” *Teachers College Record* 104, no. 4 (2002): 842–66.
5. JuxtaposeJS is an online interactive multimedia tool found at <https://juxtapose.knightlab.com/>.
6. Rodgers, “Defining Reflection.”
7. The Holland Code was created by Dr. John Holland as a way to cluster personality types.

8. Bret Eynon and Laura M. Gambino, *High-Impact ePortfolio Practice: A Catalyst for Student, Faculty, and Institutional Learning* (Sterling, VA: Stylus, 2017).
9. Kuh and O'Donnell, *Ensuring Quality*.
10. Randy Bass, "Social Pedagogies in ePortfolio Practices," in *High-Impact ePortfolio Practice*, Eynon and Gambino, chap. 3.
11. Rodgers, "Defining Reflection."
12. Kuh and O'Donnell, *Ensuring Quality*.
13. Kuh and O'Donnell, *Ensuring Quality*.
14. Eynon and Gambino, *High-Impact ePortfolio Practice*, 66.
15. Kuh and O'Donnell, *Ensuring Quality*.
16. Eynon and Gambino, *High-Impact ePortfolio Practice*, 61.
17. Rodgers, "Defining Reflection."
18. Bret Eynon, Laura M. Gambino, and Judith Török, "Reflective Learning," *Catalyst for Learning: ePortfolio and Research*, accessed June 1, 2017, <http://c2l.mcnrc.org>.
19. Rodgers, "Defining Reflection," 858.
20. Eynon and Gambino, *High-Impact ePortfolio Practice*, 59.
21. Eynon and Gambino, *High-Impact ePortfolio Practice*, 48.
22. Kuh and O'Donnell, *Ensuring Quality*.
23. Bass, "Social Pedagogies in ePortfolio Practices."
24. Kuh and O'Donnell, *Ensuring Quality*, 8.
25. Eynon and Gambino, "Framework," 126.
26. Bret Eynon, "It Helped Me to See a New Me: ePortfolio, Learning and Change at LaGuardia Community College," in *The Difference That Inquiry Makes: A Collaborative Case Study on Technology and Learning. From the Visible Knowledge Project*, eds. Randy Bass and Bret Eynon (Academic Commons, 2009), 7, <https://blogs.commonsgorgetown.edu/vkp/files/2009/03/eynon-revised.pdf>.
27. Eynon and Gambino, *High-Impact ePortfolio Practice*, 126.
28. Rodgers, "Defining Reflection."
29. Rodgers, "Defining Reflection," 124.
30. Kuh and O'Donnell, *Ensuring Quality*.
31. Kuh and O'Donnell, *Ensuring Quality*, 8.
32. Eynon and Gambino, *High-Impact ePortfolio Practice*, 16.
33. Eynon and Gambino, *High-Impact ePortfolio Practice*, 144.

Chapter 9

Conclusion

In this concluding chapter, I highlight the first four chapters of the dissertation (“What I did”) to contextualize the four manuscripts that make up Chapters 5–8 (“What I found”). In closing, I indicate the limitations of this research and propose future research directions (“Where I am going”).

What I did

The manuscript PhD has been a flexible and dynamic vehicle for me to explore several concurrent and consecutive research problems. What began as designing lessons for 3DVLEs and an exploration of the affordances of 3DVLEs, has expanded to include an investigation of the affordances of ePortfolios in connection with the achievement of learning outcomes. Throughout the dissertation process, I remained curious about the affordances of online learning spaces and the impact these spaces may have on learning and practice, particularly for the language learner and in relation to achievement of 21st century learning outcomes, like critical thinking and communication. This journey has pulled me in multiple directions as I moved between the roles of practitioner, researcher, and student. I attempted to pull it all together in this final manuscript for you, the reader, as I connect my research past to my research future.

Chapter 1 positioned me as a researcher, practitioner, participant, and student and provided a rationale for my decision to produce a manuscript PhD. The chapter also situated the dissertation within conceptualizations of the 21st learner. This led to Chapter 2, where I unpacked the concept of affordances according to the literature from fields like Computer Mediated Communication and Human Computer Interaction. Upon defining

affordances, I provided background and descriptive accounts of the 3DVLE and ePortfolio learning spaces in relation to their affordances. At this point, I argued that the affordances of 3DVLEs and ePortfolios facilitate learning providing the affordances, as described, can be clearly connected to theory. Upon examining the relevant characteristics of affordances (e.g., experiential and collaborative) as described in the literature (e.g. Dalgarno & Lee, 2010; Peterson, 2011), it was clear that a systematic drilling-down approach needed to happen on the multiple related theoretical domains, including education, SLA, and CALL. (In hindsight, perhaps I should have situated my program of research only in CALL rather than drilling down first into theories in education and then SLA. Regardless, this is the direction I pursued and it has no doubt influenced my understanding of learning theory.) Chapter 2 emphasized the importance of theoretically grounding my research and ensuring its relevance to practice.

Chapter 3 reviewed theories from education, SLA, and CALL to unpack elements that are connected to the characteristics of affordances. This chapter opened with an extensive overview of theoretical concepts from SLA, such as input and interaction. The second half of Chapter 3 focused on classroom-based implications according to the four lenses of learning proposed by Bransford et al. (2010): learner-centered, knowledge-centered, assessment-centered, and community-centered. I concluded Chapter 3 by proposing a hypothetical fifth lens, space-centered. I argued that this lens accounts for the affordances of online learning spaces, which I believe are not accounted for in the original four lenses that were presumably created with a physical space in mind.

Chapter 4 pertained to the overall study design for the larger 3DVLE study and included an explanation of the smaller ePortfolio case study. The results of these studies were reported in the manuscripts that make up Chapters 6–8.

What I found

In Year 1 of my PhD I designed a pilot study (see Chapter 5) to investigate participants' experiences teaching and learning in a 3DVLE. One outcome in terms of my research trajectory was the realization that existing literature did not provide an observational matrix for analyzing recorded participant interactions with and in 3DVLEs. This finding was significant and ultimately led me to design a matrix (Appendix I) in consideration of the affordances of space and in relation to student achievement.

More motivating yet for continuing in this trajectory was one of this study participants' post-study comments:

I think if I am a teacher of this 3D unit, I would choose the same function which made students do tasks as group, so even if they do not have enough time to complete a given problem, they are prepares to learn from the instructor feedback that always follows groups' task, both group study and activities of group study can train their interest and social experience, I think it really was inspired by the 3D unit spirituality series, which is wonderful.

This and other similar comments spoke to the importance of social interaction, task design, and teacher feedback, and prompted me to investigate characteristics of 3DVLE affordances like social interaction and collaborative learning. Certainly, the above comment illustrates elements from social learning theories and SLA theories, such as input and interaction.

Following this initial pilot study and in preparing follow-up research about 3DVLEs, I was challenged in part by the lack of clarity of concepts like affordance and by the lack of a clear theoretical foundation for language studies in virtual contexts. This prompted me to survey research methods used in virtual and physical classroom interaction studies. The results of this investigation are presented in Chapter 6. This chapter explored the methodological approaches used in social virtual worlds to highlight considerations for the design of future studies in 3DVLEs.

Following this publication, I continued to explore the relationship between affordances and learning theories. In Chapter 7 I reviewed general learning theories to further explain the affordances of 3DVLEs. Following this review, I used Phillips, et al.'s (2012) LEPO learning framework to assess the validity of a 3DVLE practice. This led to the in-press publication in Chapter 8, in which myself and my co-authors (McCarroll and Davidson) tested Eynon and Gambino's (2017) Catalyst for Learning Framework against our own ePortfolio practice to determine if our practice was "done well" based on teachers' experiences and students' survey responses. The outcome of this stage of our study shows evidence that our ePortfolio practice was in fact "done well" as a result of what I later identified as affordances in this dissertation (see Chapter 2). Students' survey responses indicated that ePortfolio pedagogy helped generate high-impact behaviours, as also concluded by Kuh and O'Donnell (2013).

Limitations

The most significant limitation throughout my program of research has been limited generalizability as a result of low participant numbers. The pilot study (Chapter 5) had seven EFL participants and the original 3DVLE study (Chapter 7) had ten

participants in each of the control and experimental groups. The low sample size reduced the generalizability and replicability of these quantitative studies and caused me to shift to a qualitative case study design from the original mixed-method design in the 3DVLE study (Chapter 7).

A further limitation in the pilot study was the poor quality of observational recordings. Often, audio recordings were inaudible, making transcription difficult or impossible. Or, the recorded sections did not capture the whole group's collaborative interactions, but rather only interactions observed from the perspective of the researcher doing the recording. This latter issue was somewhat rectified in the main 3DVLE study (Chapter 7) wherein each participant was instructed to record and upload their own interactions. Unfortunately, in some cases, the participant forgot to initiate the screen capture software, which meant their data was not usable.

Another limitation is the volume of data collected for the main 3DVLE study that remains to be analysed. Data were analyzed from Lesson 4.3 (Chapter 7), but data from Lessons 4.1, 4.2, and 4.4 remain untouched. Later in this chapter I share preliminary results of sample analyses from Lesson 4.3 outcomes and recorded observations that were presented at the 2017 and 2018 CALICO conference; however, there is much more in-depth analysis to be done for data from across all four Lessons. Moreover, teacher/researcher field notes are rich and have not yet been included in the analysis, results, or discussion sections of the 3DVLE studies; analyzing these teacher and student voices will add richness and depth to future work. I see this point as a limitation in my dissertation in the sense that my analyses and discussions may be limited in scope. The clarity with which I now understand the concept of *affordance* and the interaction of elements across

theoretical domains has emerged because of the completion of my dissertation. With this new knowledge, I feel that my interpretation of the remaining data will be enriched. This speaks to the learning benefits of doing dissertation research.

Other limitations include the organization of the matrix headings (Appendix I). As the matrix was designed early in my PhD program, I recognized only later the need to more clearly reflect the characteristics of affordances in the matrix' column headings. In addition, the matrix should include space for the researcher to note time spent troubleshooting, time running to new places, and time spent waiting. Similarly, including a matrix heading for elements such as requests for turn-taking and impromptu dialogues would yield valuable data. For instance, if immersion as an affordance leads to experiential learning, then how do we measure this in terms of observable interactions?

The grading rubric (Appendix M) also needs modifications based on my developing understanding of learning in the 21st century. For example, in the 3DVLE study I mention meta-cognition, and in the ePortfolio study we talk about 21st century outcomes like collaboration; how do we define these concepts more clearly and how can the criteria in the rubric, or any other rubric, better capture these outcomes?

Future directions

Bearing the above limitations in mind, this dissertation has led me to new insights regarding the potential of technologically enhanced learning environments in language learning and teaching; however, the achievement of learning outcomes in these online learning spaces “depends on a number of factors that prioritize pedagogy: how a teacher integrates and uses specific technological tools within her/his teaching practice and context” (Lawrence, 2017, p. 140). It is at the intersection of theory within a newly

defined concept of affordance that critical insights have emerged and which I will continue to explore in research and integrate into my practice.

As noted earlier, much of the data from the original 3DVLE study design remain to be analyzed. However, I would like to share some of my own recent insights which grew out of initial analysis and findings, and which were presented at two consecutive conferences, CALICO 2017 and CALICO 2018. These findings will be submitted for publication as two separate studies. At CALICO 2017, to demonstrate the affordances of 3DVLEs, I generated four participant profiles based on their English language placement tests (pre-test), survey information, assessment scores from Lesson 4.3 (post-test), and final course grades. At CALICO 2018, I presented a theoretical landscape, or *theory buffet* (Hubbard & Levy, 2016), that demonstrates where elements from multiple domains intersect in relation to their affordances of fidelity of space, real-time immersion, adaptability, persistence, and visibility (see Figure 9.1). I used the LEPO framework to show how affordances relate to learning achievement or progress towards achievement of learning outcomes. The presentation drew on three sample sets of data and will guide more thorough future analysis.

Theoretical landscape

Figure 9.1. Intersection of theory within the concept of affordances.

As noted previously, future studies in 3DVLEs and ePortfolios need to clearly specify criteria for what is to be measured in terms of 21st century learning outcomes, such as collaboration, critical thinking, and leadership (Dede, 2010). Further, while I have opted not to measure discrete linguistic features like vocabulary, future studies may include measurement of frequency or range of vocabulary used in text-based outcomes. Additionally, future studies may include 3DVLE system-generated analytics such as time spent on task to triangulate observational data. Learning analytics in combination with observational data can be potent, where “... the use of virtual worlds as experimental environments, or even as platforms for observation, coupled with dataveillance and survey tools has such powerful implications” (Ross, Castronova, & Wagner, 2012, p. 307).

While the results of the ePortfolio study presented in Chapter 8 were encouraging, there remains a lack of research that clearly connects the affordances of ePortfolios to the

development of 21st century learning skills, such as communication or critical thinking. Now that I more clearly understand the concept of affordances and have identified the related learning benefits, I will focus more on achievement of outcomes and less on practice as was the focus of the ePortfolio study. Owing to the relative novelty of the concept of affordances in relation to learning outcomes, language learning, and ePortfolios, a qualitative case study will be an appropriate method for future studies (Creswell, 2003).

Throughout this dissertation, I aimed to communicate the concept of affordances in relation to 3DVLEs and ePortfolios, where the affordances of immersion and visibility are of particular significance in terms of learning benefits. Additionally, I aimed to convey the importance of drawing on multiple theories from multiple domains. It is at the intersection of theoretical elements, characteristics of affordances, and classroom practices that research should be situated to increase our understanding of learning potential in online spaces. In my future research and practice, I will be guided by theories in education, SLA, and CALL that include descriptive elements that are *integrative*, *social*, *reflective*, *collaborative*, and *interactive*, as I continue to explore the affordances of these and other online learning spaces.

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Appendix A

Supervisor Letter of Permission

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July 30, 2018

To Whom It May Concern:

As Peggy Hartwick's doctoral supervisor, I attest that she is the author of this dissertation, and was the lead author in all of the published manuscripts included herein. She was fully involved in all aspects of the research that comprises this dissertation, specifically: in designing and conducting the studies; eliciting data: analyzing, presenting and discussing results; and, preparing and writing the material presented in both the solely-authored and co-authored chapters/article(s) integrated in this dissertation.

Further, I attest that I reviewed and confirmed information presented by Peggy Hartwick in this *Preface* with regard to her specific contribution and those of all other collaborators or co-authors of published manuscripts integrated in this dissertation.

Supervisor/Professor
Applied Linguistics and Discourse Studies

Appendix B

Co-Author Letter of Permission (Savaskan Nowlan)

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July 30th, 2018

To whom it may concern,

As per article 12.4, section C of Carleton University's Graduate Calendar, I hereby give Peggy Hartwick permission to use the published work entitled *Integrating Virtual Spaces: Connecting Affordances of 3D Virtual Learning Environments to Design for Twenty-First Century Learning* as a chapter in her dissertation. I can confirm that I contributed to the chapter as a co-author and assisted in the analysis of data and writing of chapter. I affirm that Peggy was lead author and fully involved in setting up and conducting the research, obtaining data and analyzing results, as well as preparing and writing the material presented in the article.

Nuket Savaskan Nowlan

Appendix C

Co-Author Letter of Permission (McCarroll)

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July 30th, 2018

To whom it may concern,

As per article 12.4, section C of Carleton University's Graduate Calendar, I hereby give Peggy Hartwick permission to use the published work entitled *What is ePortfolio "Done Well?" A Case of Course Level Analysis* as a chapter in her dissertation. I can confirm that I contributed to the chapter as a co-author and assisted in the analysis of data and writing of chapter. I affirm that Peggy was lead author and fully involved in setting up and conducting the research, obtaining data and analyzing results, as well as preparing and writing the material presented in the article.

Sincerely,

July 30/2018

Date

Appendix D

Co-Author Letter of Permission (Davidson)

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July 30th, 2018

To whom it may concern,

As per article 12.4, section C of Carleton University's Graduate Calendar, I hereby give Peggy Hartwick permission to use the published work entitled *What is ePortfolio "Done Well?" A Case of Course Level Analysis* as a chapter in her dissertation. I can confirm that I contributed to the chapter as a co-author and assisted in the analysis of data and writing of chapter. I affirm that Peggy was lead author and fully involved in setting up and conducting the research, obtaining data and analyzing results, as well as preparing and writing the material presented in the article.

July 31, 2018
Date

Appendix E

CUREB Ethics Clearance (September 7, 2016)

Peggy Hartwick

From: ethics@carleton.ca
Sent: Wednesday, September 7, 2016 5:00 PM
To: Peggy Hartwick (Student Research: Ph.D. Student)
Cc: Dr. Janna Dorothy Fox (Primary Investigator); ethics@carleton.ca
Subject: Ethics Protocol Clearance (Project # 104925)

Research Compliance Office
 511 Tory | 1125 Colonel By Drive
 | Ottawa, Ontario K1S 5B6
 613-520-2600 Ext: 2517
ethics@carleton.ca

CERTIFICATION OF INSTITUTIONAL ETHICS APPROVAL

Ethics approval for the following research has been cleared by the Carleton University Research Ethics Board-A (CUREB-A) at Carleton University. CUREB-A is constituted and operates in compliance with the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* (TCPS2).

Ethics ID: Project # 104925

Principal Investigator: Peggy Hartwick

Co-Investigator(s): **Dr. Janna Dorothy Fox (Primary Investigator)**
 Peggy Hartwick (Student Research: Ph.D. Student)
 Nuket Savaskan-Nowlan (Collaborator)

Study Title: Learning affordances of space, such as 3DVLEs, help ESLA students achieve 21st century learning outcomes: An integrated methods study.

Effective: **September 07, 2016**

Expires: **September 30, 2017.**

Restrictions:

This certification is subject to the following conditions:

1. Approval is granted only for the research and purposes described in the application.
2. Any modification to the approved research must be submitted to CUREB-A. All changes must be approved prior to the continuance of the research.
3. An Annual Application for the renewal of ethics clearance must be submitted and approved by the above date. Failure to submit the Annual Status Report will result in the closure of the file. If funding is associated, funds will be frozen.
4. A closure request must be sent to CUREB-A when the research is complete or terminated.

5. Should any participant suffer adversely from their participation in the project you are required to report the matter to CUREB-A.

6. Failure to conduct the research in accordance with the principles of the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans 2nd edition* and the *Carleton University Policies and Procedures for the Ethical Conduct of Research* may result in the suspension or termination of the research project.

Please email the Ethics Coordinators at ethics@carleton.ca if you have any questions.

APPROVED BY:

Date: September 07, 2016

Andy Adler, PhD, Chair, CUREB-A

Shelley Brown, PhD, Vice Chair, CUREB-A

Appendix F

Lesson 4.0

Lesson 4.0

1. Take the [Holland Code Assessment](#). This will help identify your personality traits, skills, and career preferences. Rank your top 3 categories from 1 (highest) to 3 (lowest) from the six categories below:

Realistic

Social

Investigative

Enterprising

Artistic

Conventional

2. **Vocabulary** related to career preferences. Circle as many words that describe you. Use a dictionary to help you.

Realistic :

Proficient / Tangible results / Persistence / Traditional / Straightforwardness / Goal Oriented

Artistic:

Unconventional / Intuitive / Innovative / Improvise / Diversity / Independence / Public recognition

Investigative:

Analytical / Methodical / inquisitive / Precise / Thinker/ Abstract / Insight

Social:

Patient / Empathetic / Influential / Encouraging / Impacting

Enterprising:

Agreeable / Optimistic / Extroverted / Ambitious / Persuasive / Assertive / Negotiating / Competition / Recognition

3. The **six categories** (realistic, artistic, investigative, social, enterprising and conventional) were created by Dr. John Holland as a way to cluster personality types and interests. Identifying personality traits and interests should help you select a possible major or area of study. Connect your 1st and 2nd choices from #1 above to your selected major or area of study (see lists below). The following recommendations are not absolute, but should show a connection between your Holland Code results, interests, values, and possible

major. These recommendations were summarized from the University of Oklahoma's Career Services website⁸ (Majors by Holland Code, 2014).

Realistic people tend to choose the following areas of study (see me if your major is not listed):

⁸ Majors by Holland Code (2014). Career Services, University of Oklahoma. Retrieved June 28th, 2016
<https://www.ou.edu/career/students/choose-a-major/explore/holland-codes.html>

- ✓ Aerospace Engineering
- ✓ Civil Engineering
- ✓ Computer Science
- ✓ Electrical engineering
- ✓ Environmental Engineering
- ✓ Industrial Engineering
- ✓ Mechanical Engineering
- ✓ Geology

Investigative people tend to choose the following areas of study:

- ✓ Anthropology
- ✓ Biochemistry
- ✓ Chemical engineering
- ✓ Chemistry
- ✓ Criminology
- ✓ Mathematics/ Math statistics
- ✓ Physic
- ✓ Sociology
- ✓ Women's studies

Artistic people tend to choose the following areas of study:

- ✓ African studies
- ✓ Architecture
- ✓ Art history
- ✓ English
- ✓ Religion
- ✓ International studies
- ✓ Journalism and Communication Studies
- ✓ Linguistics
- ✓ Music
- ✓ Philosophy

Social people tend to choose the following areas of study:

- ✓ History
- ✓ Health
- ✓ Education
- ✓ Human Relations
- ✓ Law
- ✓ Nursing
- ✓ Social Work

Enterprising people tend to choose the following areas of study:

- ✓ Communication Studies
- ✓ International Business
- ✓ Marketing
- ✓ Law
- ✓ Advertising
- ✓ Political Science

Conventional people tend to choose the following areas of study:

- ✓ Accounting
- ✓ Business
- ✓ Economics
- ✓ Finance
- ✓ Information Technology
- ✓ Management

4. Explain how the results of your Holland Code (category) relate to your major. Use vocabulary from question 2 above. Your explanation should include your experiences to date. Use back if needed.

Appendix G

Online Survey

Pre Lessons Online Survey

Demographics

1. I identify as
 - a. Male
 - b. Female
 - c. Other
2. I am _____ years old
3. My country of origin is
4. My first language is
5. My area of study or major at Carleton is _____
6. In the past, I have worked as a _____

Comfort, level, & experience

1. I am comfortable trying new digital technology and apps

Not at all	Somewhat	Mostly	Very
1	2	3	4
2. I would rate my level of computer expertise as

Beginner	Intermediate	Expert
----------	--------------	--------
3. My experience with 3D worlds/ environments like [Second Life](#) or [Sims](#), is

None	Beginner	Intermediate	Expert
1	2	3	4
4. Choose one question format a or b
 - a. My experience with computer gaming like World of War Craft, is

None	Beginner	Intermediate	Expert
1	2	3	4
 - b. How frequently do you play computer games like League of Legends, World of War Craft, Minecraft

Not at all	Infrequently	occasionally	somewhat frequently	very frequently
------------	--------------	--------------	---------------------	-----------------
5. Choose one question format a or b

19. I believe my major (area of study) is well suited to my personality type
 Strongly disagree Somewhat disagree No opinion Somewhat agree Agree

20. know what kind of job I will get when I graduate
 Strongly disagree Somewhat disagree No opinion Somewhat agree Agree

21. I understand how businesses can be sustainable economically, financially, and socially
 Strongly disagree Somewhat disagree No opinion Somewhat agree Agree

22. One can only be exposed to a different culture by visiting the country.
 Strongly disagree Somewhat disagree No opinion Somewhat agree Agree

Short answer

23. How do you feel about learning in this type of environment compared to a traditional face to face context?

24. What do you expect will be one of the biggest benefits of this environment for language teaching and learning?

Appendix H

Lesson 4.1

Lesson and Assessment 4.1

Spatial and technical orientation

Instructions

1. Class will be divided into 3 groups. Each group has **50 minutes** to complete the orientation task and the technical assessment posted in the quad area in 3D campus. Follow instructions:
2. Start your screen recording TechSmith Relay
3. Log into [LINK](#)
4. Complete the Navigation Maze.

Assessment

5. Upon completing the Navigation Maze and seeing the message 'Well Done'
 - a. Turn **left** and **walk** or **run** towards Azrielli Building (past Dunton Tower)
 - b. At Azrielli, turn **right** and walk down the stairs. You are in Quad (grass area)
 - c. Advance to the two Collaboration Boards on your left.
 - i. Follow instructions posted on right side. There are 4 slides with instructions.
 - ii. Record your answers here
 1. Is it possible to adjust your voice volume to a shout?
yes/ no
 2. How many houses are in the 'Residences' section?
 3. What colour are these houses? _____

Log out of 3D environment and **stop** recording. **Answer** questions 6 – 10.

6. I found navigation/moving around easy in 3D environment

Not at all	Somewhat	Mostly	Very
1	2	3	4
7. I found it easy to send text messages in the 3D environment

Not at all	Somewhat	Mostly	Very
1	2	3	4
8. I found using collaboration boards to surf on the internet easy

Not at all	Somewhat	Mostly	Very
1	2	3	4
9. I found gaming approach in the environment a fun way to review functions
10. Not at all

Somewhat	Mostly	Very
1	2	3

11. When you did activity (see 3 above), which strategies did you use to complete the task (circle as many that apply)?
- i. I asked another avatar by using my headset and voice
 - ii. I went back to the Navigation Maze
 - iii. I worked with another avatar
 - iv. I followed/ watched a peer avatar
 - v. I did not use any strategy(ies)
 - vi. Other _____
 - vii. I gave up/ logged off

Appendix I

Observation Matrix

Observation Matrix

Recording and time	Task/Activity	Location in Space	Other Features of space	Teacher practice		Learner's interactional behaviour				
				Teacher discourse	Task grouping	Interaction with teacher	Interaction with peer	Interaction with space or tools (including movement and gestures)	Other	
			Use of writing pad							
			Use of web renderer							
			Use of text function							
			Use of collaboration surfaces							
				Task-based or instructional informal	Individual	Very low (0-2 instances)	Very low (0-2 instances)	Very low (0-2 instances)	Very low (0-2 instances)	High (5+ instances)
					Housekeeping/ technical	Low (3-4 instances)	Low (3-4 instances)	Low (3-4 instances)	Low (3-4 instances)	Low (3-4 instances)
					Pairs	High (5+ instances)	High (5+ instances)	High (5+ instances)	High (5+ instances)	High (5+ instances)
					1/2 group +	Very low (0-2 instances)	Very low (0-2 instances)	Very low (0-2 instances)	Very low (0-2 instances)	Very low (0-2 instances)
					Whole group					

Appendix J

Lesson 4.2

Lesson 4.2

1. Select **2 of 8 possible careers** listed below
2. Start your screen recording TechSmith Relay
3. Log into [Opuses Island](#). This is the name of the 3D space you will be using today. I will be there to help you.
4. Visit and **explore** the 2 work areas you selected – what do you see and observe?
5. Listen to the avatar (take notes below/ focus on career traits, characteristics, and skills)
6. Take the survey as you leave each work area (pay attention to important vocabulary)
7. Log off and stop recording.
8. Answer the questions at end of this lesson

Career choices

Financial planner (Town Center Building):

organized, detail, viable, discipline, persistence, empathy, competency, sustainability

Community Entrepreneur (Town Center Building)

efficiency, sustainability, potential, effectiveness, appropriate, initiative, leadership, strategize, visionary

Farmer (Plantation)

independent, physically fit, adaptive, outside, initiative, environment, flexible

Marine Biologist (Research Centre)

data collector, observing, monitor, experiment, observant, detail oriented, problem solver, initiative, reading,

Nurse (Clinic)

compassionate, detail orientated, good listener, flexible, team player, record keeper, empathetic,

Chef (Culinary Centre)

management, creative, discovery, motivated, driven, conscientious, adaptability, communicator, cultural sensitive,

Music Teacher/ Coach (Music Studio)

creative, interactive/ loves all things art/ encourages all types of self-discovery and expression/ unconventional/ struggles with organizing

Engineer (Construction Zone)

variety of skills/ team work/ budget/ schedules/ supervise/ accuracy/ safety/ hands-on/ mechanical equipment/ attention to detail/ take instructions/ work outside/ uncertainties/ Take notes in space provided:

Career choice 1 _____

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. On the left side, there is a vertical margin line, creating a narrow left margin. The paper appears to be from a notebook or a standard ruled sheet of paper.

-

[illegible]

2. Do your best to answer ONLY TWO questions. Choose the **two questions that relate to the careers you visited and surveyed**. The answer may not be obvious.
- a) Financial Planner
 - a. Did you notice the accountant working on Opuses' budget and is the budget balanced?
 - b. What changes could help improve Opuses Island's budget?
 - b) Community Entrepreneur:
 - a. Based on your experience with the entrepreneur, suggest one way the island can be more financially sustainable?
 - b. What is the entrepreneur/ business women working on right now?
 - c) Farmer:
 - a. This farmer seems to be quite organized, why is it important for farmers to be organized in order to be successful?
 - b. Do you own any kind of plant?
 - d) Marine Biologist:
 - a. Based on your interaction with the marine biologist, do you think her work is going well and as planned?
 - b. Do you know the type of fish that was in the fish tank?
 - e) Nurse:
 - a. What do you think is wrong with the female patient in the clinic
 - b. Have you ever cared for a sick animal?
 - f) Chef:
 - a. What is your favourite dish to cook/ prepare?
 - b. Based on your interaction with the chef, what is he planning or cooking?
 - g) Music teacher:
 - a. What is the name of the instrument the teacher is listening to?
 - b. Would you find it difficult to plan an event such as he did?
 - h) Engineer:
 - a. Have you used any of the tools on the work site?
 - b. At the engineer's work site there was a plan for a 4-story building. Does it fit well with the overall architecture of the island and what do you think it will be?

Appendix K

Lesson 4.3

Lesson 4.3

At the end of the lesson, you should be able to

- define sustainable development in your own words
- demonstrate your understanding of the term SD and in relation to the three pillars
- demonstrate your understanding of the concepts by suggesting sustainable actions

Defining Sustainable Development

There are two types of definitions, informal and formal.

- i) Using *synonyms* and *antonyms* or *comparative* terms tends to be an **informal** way to define something. For example:

Synonyms Something that is a **hazard** means it is a **danger**.

Antonyms Something that is a **hazard** is not **safe**.

Comparative These glasses are used for vision as opposed to drinking.

- ii) **Formal** definitions are necessary at university to show your understanding of key concepts; you will need to demonstrate your understanding of concepts through applying and analyzing proposed situations. Formal definitions tend to follow a pattern: class or category + specific details:

Term	Class or category	Specific details	Formal definition
Society	All people	<ul style="list-style-type: none"> • a community • relationships • Interdependent individuals 	A society is a community of interdependent people from a set community.
Process	A particular method or ways of doing something	<ul style="list-style-type: none"> • Operation or process • Sequential steps 	A process is a method of doing something according to particular steps.

1. Read a selection of formal definitions for sustainable development (SD) below.

a. The Brundtland Commission report, Our Common Future, defines SD as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Oxford: Oxford University Press, 1987).

b. “SD is maintaining a delicate balance between the human need to improve lifestyles and feeling of well-being on one hand, and preserving natural resources and ecosystems, on which we and future generations depend” ([SD Features, n.d.](#)).

c. SD is “a process of change in which the exploitation of resources, the direction of investments, the orientation of

technological development, and institutional change are made consistent with the future as well as present needs” ([United States Census Bureau](#), 2016).

d. SD “...means adopting lifestyles and development paths that respect and work within nature's limits. It can be done without rejecting the many benefits that modern technology has brought, provided that technology also works within those limits” (Caring for the Earth, IUCN, 1991)

e. “The term SD refers to achieving economic and social development in ways that do not exhaust a country's natural resources” (Ashford, 1995).

2. Complete the chart by identifying **class or category** and **specific details** from each. The first is done for you.

	Class or category	Specific details, characteristics or features
Brundtland Commission Report (Oxford University Press, 1987)	<i>Development</i>	<ul style="list-style-type: none"> • <i>Meets needs of present generation</i> • <i>Does not hurt future generation</i>
SD Features, (n.d.)		
United States Census Bureau , (2016)		
Caring for the Earth, IUCN (1991, p. 8.)		
Ashford (1995)		

Experiencing Sustainable Development

- Start recording. Log into 3D virtual Carleton
- *Form groups of 3 and complete activity A and B in the 3D environment:*
 - Explore house #3 in the ‘Residences’ section. Based on your growing understanding of SD, the definitions above, and the 3 pillars, explain how this family can be more environmentally sustainable. Use examples in relation to your experiences in the house and from course content.*

- B) *Explore the campus area including the Rainbow Stage. In your groups, state two clear sustainability goals for making the campus more sustainable, especially from an economic and social perspective. Relate your goals to specific examples you observe in the environment.*
- C) **Log off and stop** recording.
- D) *Write your own formal definition of SD.*
- E) *Would you feel confident voicing your opinion in order to improve your own school or neighbourhood in terms of SD practices?*
- F) *In order to effectively contribute to 21st century society, how can we develop ourselves outside the classroom?*

Appendix L

Lesson 4.4

Lesson 4.4

This is a timed lesson. You will have 70 minutes to complete the task in an assigned group of 3 – 4 people.

1. Launch **TechSmith** in INTERNET EXPLORER
 - a. Username = *ESLA1900C*
 - b. Password = *recording*
2. Log into **3D Carleton** (Link in cuLearn) and meet your group.
3. **Explore** the Native Village and Downtown market area. In your groups, discuss answers to these questions/ steps.
 - a. Observe and interact with the culture in Native Village
 - b. Walk around the stores and market in the Downtown area
 - c. Identify possible trade-offs (Strange & Bayley, 2009) in terms of access to food (social) in Aboriginal Village compared to Downtown market area.
 - d. What can you report about this Native Village culture in terms of social, environmental and financial goals and practices (Kates, Parris & Leiserowitz , 2005)
 - e. Select one indicator from table on pages 25 & 26 of Kates, Parris & Leiserowitz (2005) that would most accurately measure sustainability in your assessment in d. above.
 - f. If this were a real community, what else would you like to include in the assessment?
4. Use the collaborative **writing** link for your group found on cuLearn under “Lesson 4.4 Collaborative Writing Groups”. Prepare a document with your group’s answers.

Lesson 4.4 Collaborative Writing Groups

5. Take a screen shot or photo of the final group document to use as an **artifact** in your ePortfolio.
6. Submit recording and Log off

Appendix M

Rubric for Lessons 4.0-4.4

Rubrics 4.0-4.4

Content				Language				Meta-cognition			
.5	.6	.75	1	.5	.6	.75	1	.5	.6	.75	1
Unable to demonstrate understanding/ explanation is missing or breaks-down/ no evidence of understanding content	Limited or superficial explanations and minimal use of examples / some connections to content in response to prompt	Competent and mostly logical explanations and use of some examples / connections to content in response to prompt require further development	Sophisticated and logical explanations and use of examples / clear connections to content in response to prompt	Limited use of keywords and vocabulary in response to prompt – many language errors	Adequate use of keywords and vocabulary in response to prompt; language errors	Competent use of keywords and specific vocabulary t in response to prompt – minor language errors	Consistently and with accuracy uses keywords and specific vocabulary in response to prompt	Limited or no awareness of own actions and decisions in relation to task	Early or superficial awareness of own actions and decisions in relation to task	Competent or developing awareness of own actions and decisions in relation to task	Superior or sophisticated awareness of own actions and decisions in relation to task

Appendix N

CUREB Ethics Clearance (March 31, 2017)

Peggy Hartwick

From: Sylvie.Jasen@carleton.ca
Sent: Friday, March 31, 2017 11:46 AM
To: Peggy Hartwick (Primary Investigator); Julie Lepine (Collaborator); Allie Davidson (Collaborator)
Cc: Ethics Mailbox; BrownShelley; Sylvie.Jasen@carleton.ca
Subject: CUREB-A Clearance Certificate (Project # 106605)

Research Compliance Office
 511 Tory | 1125 Colonel By Drive
 Ottawa, Ontario K1S 5B6
 613-520-2600 Ext: 2517
ethics@carleton.ca

CERTIFICATION OF INSTITUTIONAL ETHICS CLEARANCE

The Carleton University Research Ethics Board-A (CUREB-A) has granted ethics clearance for the research project described below and research may now proceed.

CUREB-A is constituted and operates in compliance with the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* (TCPS2).

Ethics Protocol Clearance ID: Project # 106605

Project Team Members: Peggy Hartwick (Primary Investigator)
 Julie Lepine (Collaborator)
 Allie Davidson (Collaborator)

Project Title: Catalyst in Action: A Case Study of the evolution of ePortfolio practices in an English as a Second Language for Academic Purposes course.

Funding Source (If applicable):

Effective: March 31, 2017

Expires: March 31, 2018.

Restrictions:

This certification is subject to the following conditions:

1. Clearance is granted only for the research and purposes described in the application.
2. Any modification to the approved research must be submitted to CUREB-A via a Change to Protocol Form. All changes must be cleared prior to the continuance of the research.
3. An Annual Status Report for the renewal of ethics clearance must be submitted and cleared by the renewal date listed above. Failure to submit the Annual Status Report will result in the closure of the file. If funding is associated, funds will be frozen.
4. A closure request must be sent to CUREB-A when the research is complete or terminated.
5. Should any participant suffer adversely from their participation in the project you are required to report the matter to CUREB-A.

Failure to conduct the research in accordance with the principles of the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans 2nd edition* and the *Carleton University Policies and Procedures for the Ethical Conduct of Research* may result in the suspension or termination of the research project.

Please contact the Research Compliance Coordinators, at ethics@carleton.ca, if you have any questions or require a clearance certificate with a signature.

CLEARED BY:

Date: March 31, 2017

Andy Adler, PhD, Chair, CUREB-A

Shelley Brown, PhD, Vice-Chair, CUREB-A