COLLABORATION, TEAMWORK, AND TEAM COHESION IN A *STARCRAFT 2* DIGITAL GAME-BASED COURSE

By

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To my Mom and Dad

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As fair warning, this section of the dissertation will read like a bad Oscar acceptance speech…I would like to thank my parents first and foremost for helping me get to the place where I am today. The countless hours my dad spent trying to help me understand AP Calculus and all the grammar advice my mom gave me have all played an invaluable role in shaping my identity as a designer, scholar, researcher, and teacher. I want to thank my grandmother for being so supportive as I waited almost an entire summer before I heard that I had gotten accepted into my doctoral program. Oftentimes it is easy to take things too seriously and in the process of losing focus one tends to forget to have some fun and enjoy the moment. The path towards a doctorate is not an easy one. If it were a digital game, a PhD would entail beating countless bosses, continually leveling up, exploring many different immersive environments, and slaying an infinite number of monsters of all sorts. In retrospect I would have to thank my middle school basketball "C" team teammates--Oliver Chiang, Tim Chan, and Rickie Hung...and Sam Lim who tried his best to help us develop our skills--for learning together with me that winning isn't everything and that sometimes the better path is to take everything with a grain of salt and to have fun. After all, we were a horrible basketball team, but we had a ton of fun and created many fond memories.

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By

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Innovative pedagogy is required if today's learners are to gain the crucial competencies necessary to succeed in tomorrow's increasingly interconnected and technological world. This mixed methods research examines the design, implementation, and study of an academic online digital game-based course developed around the popular commercial real-time strategy (RTS) game *StarCraft 2.* This undergraduate Honors course was offered over a two-year period at a major research university in the Southeastern United States and used a constructivist and experiential learning perspective to teach 21st century skills such as critical thinking, problem solving, and collaboration. More specifically, this research looks at how learners' attitudes, perceptions, and experiences of collaboration, teamwork, and team cohesion were influenced by participation in the course.

A modified quantitative instrument found the *StarCraft 2* course did influence learners' attitudes and perceptions regarding some of the facets of team cohesion. Qualitative interviews further helped explain the collaborative processes and leadership dynamics which were present in both the academic and digital game-play contexts of

the course. This research also discusses the *StarCraft 2* course design, the quantitative and qualitative instrumentation used, the sociocultural and equity concerns which arose during the course's design and implementation, the implications for different professional fields, and the recommendations researchers and educators interested in digital game-based learning (DGBL) pedagogical approaches should consider. As technology constantly evolves, pedagogies which harness its power such as online education and DGBL have great promise. This research aims to help guide researchers and educators in advancing the online education and DGBL fields so as to achieve that potential.

CHAPTER 1
INTRODUCTION

Research Context

In one of his most popular songs, the great American musician Bob Dylan sings that “the times they are a-changin'” (Dylan, 1964). At the time this song was released in 1964, American society was indeed being monumentally altered by the civil rights movement and the push for LGBT and women’s rights. These lyrics still hold true today as changes—both sociocultural and technological—continue to shape society by influencing how it behaves, communicates, interacts, and views itself as well as helping to define its values and perspectives. Dylan was not alone in recognizing the integral role change plays in human existence. The late influential Scottish psychiatrist R.D. Laing noted “we live in a moment of history where change is so speeded up that we begin to see the present only when it is already disappearing” (Laing, 1967, p. 1). These words perfectly capture the essence of today’s change-defined society. Digital and Internet technologies have profoundly altered and continue to alter the ways people live, work, learn, and play (Shafer, Squire, Halverson, & Gee, 2005). Smartphones and tablet computers are inextricably intertwined with daily life. Technological advances influence how businesses function and the competencies employees must possess. In an increasingly interconnected and technological world, workers need well-developed 21st century skills such as collaboration and teamwork skills since they must work with others—often across great distances and multiple time zones—to complete complex tasks. Today’s corporations and employers highly desire these skills in their employees (The Partnership for 21st Century Skills, 2013; Casner-Lotto, 2006) as they seek to succeed in an economic climate defined by change and interconnectivity.

Technology can also help enable education to move beyond the boundaries of the physical classroom and the time constraints of the traditional class period. Online education is increasingly prevalent and accepted (Allen & Seaman, 2008) and has been shown to be as effective as traditional face-to-face instruction (Bernard et al., 2004; Johnson, Aragon, Shaik, & Plama-Rivas, 2000; Carey, 2001; Dutton, Dutton, & Perry, 2001; Lam, 2009). The educational field has come to recognize the social and economic potential of using new digital and Internet technologies—especially online learning and digital game-based learning (DGBL)—to help facilitate teaching and learning. Online education continues to become increasingly accepted and implemented at all levels of education from K-12 classrooms to large state research universities and Ivy League institutions with many even offering entirely online degrees.

Technological advances are also shaping entertainment. Digital gaming has become an extremely prominent socioeconomic force as shown by the Entertainment Software Association's 2011 report. The digital gaming industry is now a $25.1 billion dollar business and 72 percent of all American households play digital games (Entertainment Software Association, 2011). There is also increasing crossover between education and digital gaming with the rising prominence of digital game-based learning (DGBL), where digital games are used to help facilitate learning. Shafer, Squire, Halverson, and Gee (2005) note digital games can help facilitate meaningful learning in an increasingly complex and technological world. Digital games "are sites of naturally occurring, intrinsically motivated learning" (Squire, 2006) and it makes sense to merge this motivation with academic content (Prenksy, 2003). As such, DGBL is a field full of promise and potential.

Research Problem

One of the major challenges continually facing educators is just how to prepare people for success in a society defined by continuous technological change. This concern was evident even during the mid-20th century when McLuhan and Fiore (1967) memorably wrote that people "trying to do today's job with yesterday's tools" (p. 8) has caused much tension. Such words certainly still ring true and researchers and educators play pivotal roles in helping ensure learners are well-equipped to face the challenges ahead. Many researchers and educators have come to realize that perhaps one of the best ways to prepare learners for a technological society is to use new technological approaches to facilitate teaching and learning. Digital game-based learning (DGBL) is just one avenue being explored by educators seeking to ensure that learners are equipped to succeed and thrive.

As digital games become increasingly popular and ingrained in contemporary society, more and more people across demographics are now seeing them as acceptable forms of entertainment. Traditional stereotypes of gamers as invariably being young socially awkward adolescent males are giving way to the perspective that anyone can be a gamer—from the woman in line at the grocery store playing games on her phone, to the businessman sneaking a few minutes of his favorite title on his work laptop, to college students sitting amid empty pizza boxes glued to the gaming consoles in their dorm rooms Noting this, game developers are continuing to create a wide variety of games for a wide range of genres—many of which overlap—and for a wide range of devices including computers, consoles, and smartphones.

As educators continue to teach and train future generations, they must consider how they will reach and engage learners who have or are growing up with a sometimes

overwhelming number of different technologies and digital entertainment and communication options. They are faced with the question: How can you connect with learners who are accustomed to instantaneous anytime, anywhere access to information and who are used to highly engaging and immersive multimedia? This research proposes that using digital games in education—especially commercial-off-the-shelf (COTS) games—is one possible answer. Interactive and experiential digital games have the potential to appeal to and engage learners. Well-designed DGBL approaches using COTS games are promising because they blend sound pedagogy with the high quality and immersive multimedia environments to which many of today's learners are accustomed. These digital games can act not only as the "hook" to get learners engaged in the learning process, but can also provide the multimedia and technologically rich environments which they can relate to and connect to their everyday lives. One of the best ways to reach digitally connected and multimedia shaped learners is through digital technologies and multimedia. Media-centered educational approaches like DGBL can meet learners where they are rather than continuing to have them sit passively in increasingly alien and one-dimensional classroom settings that bear declining resemblance to the technologically interconnected real world in which they are living. After all, it really does not make much sense to continue to apply 19th century pedagogy to 21st century learners. Despite the immense promise and potential of merging digital games and pedagogy, there needs to be more work focusing specifically on DGBL approaches and courses to enable researchers and educators to better understand the use of digital games, their potential, their implications, best practices for their use in education and training, and how to evaluate their effectiveness. DGBL is a

way forward in the field of education and researchers and educators must continually design and study new ways to move ahead.

Purpose of the Study

This research proposes a possible way forward that researchers and educators can follow and use for guidance or reference as they continue to create, design, and study education for the 21st century. The purpose of this research is to document and examine the effectiveness of an innovative DGBL instructional approach. More specifically, the purpose of this sequential explanatory mixed methods study is to look at the ways participation in an online digital game-based course influences learners' perceptions of collaboration and teamwork as expressed and measured by learners' perceptions of team cohesion. Examining perceptions of team cohesion, which is a related aspect of collaboration, can help shed light on learners' perspectives of and experiences with collaboration and teamwork in the *StarCraft 2* course context. Collaboration and teamwork can be difficult to measure because they involve complex interpersonal interactions and are dynamic multidimensional constructs. It is therefore beneficial to the inquiry process to utilize a research-documented concept related to collaboration and teamwork that is capable of being measured. In this research the concept is team cohesion. Carron, Brawley, and Widmeyer's (2002) Group Environment Questionnaire (GEQ) specifically measures team cohesion. This research includes two phases. The first consists of administering a modified version of the GEQ as a pretest and posttest to measure learners' perceptions of team cohesion. The second phase consists of individual qualitative interviews to examine learners' attitudes and perceptions of collaboration, teamwork, and team cohesion. The rationale for using both

quantitative and qualitative data is that the individual interviews may help inform understanding of the quantitative data.

Online learning, DGBL, and mastery of skills such as teamwork and collaboration are increasingly relevant and important in today's academic and professional worlds. This research specifically focuses on an implemented online digital game-based course designed to help prepare undergraduate learners for the fast-paced technological world they will soon be entering. This sequential explanatory mixed methods study uses a questionnaire and individual qualitative interviews to examine learner perceptions of collaboration and teamwork as measured by team cohesion. The study aims to look at team cohesion and how it relates to enrollment in an online digital game-based course and to learner characteristics. Examining team cohesion can help inform the understanding of the collaboration and teamwork that occurred in the *StarCraft 2* course.

Research Question

Using the diverse concepts of online education, DGBL, constructivism, experiential learning, team cohesion, and 21st century skills such as collaboration and teamwork as guides to inform inquiry, this research study focuses on the following research question:

RQ: In what ways does participation in an online digital game-based course influence learners' perceptions of collaboration and team cohesion?

Hypotheses

Based on the growing body of research regarding digital games and DGBL and also on the complex and collaborative nature of modern digital games, it is predicted that enrollment and participation in the *StarCraft 2* DGBL course will increase learners'

perceptions of collaboration and team cohesion. The course was designed to be highly collaborative. For the entire duration of the 8-week course, learners will be working with their assigned group to complete academic projects and participate in collaborative game-play. The collaboration duration, intensity, and level of immersion should result in increased positive perceptions and attitudes towards working with others.

It is also predicted that the *StarCraft 2* course learners' characteristics will positively correlate to their perceptions of collaboration and team cohesion. For example, learners with more college experience and more experience playing digital games and *StarCraft* should have more positive perceptions towards collaboration and teamwork than their less experienced peers. Learners with more college experience would most likely have more experience collaborating at the college level. Those with more digital gaming and StarCraft experience should have more experience collaborating with other digital gamers. This prior experience should translate to there being a positive correlation between learner characteristics (e.g. digital game experience, *StarCraft* experience, and college experience) and their perceptions of collaboration and teamwork.

Research Significance

This study is significant because it presents and examines an educational approach that seeks to help bridge the gap between learners' rich, immersive multimedia-based world and the world they experience in the classroom. This research aims to help create more suitable 21st century pedagogical strategies to help reach and engage 21st century learners. It is also significant because it details the design, development, implementation, and study of an innovative DGBL course that was implemented at a major research university. While COTS games have been and are

used in both K12 and higher education, DGBL courses—where the entire course is taught using a digital game—are exceedingly rare. This research was able to be conducted because of the extensive amount of freedom and autonomy the researcher/course designer had in creating both the DGBL course and the following research study specifically tailored to examine that course. Fairly or unfairly, digital games have often been seen in a negative light as mindless entertainment that only promotes violence and antisocial behavior. However, this perspective is extremely limited and inherently ignores the fact that there are many popular high quality digital games that do not involve meaningless violence and instead have many positive characteristics. This *StarCraft 2* course research seeks to help bolster DGBL's credibility and acceptance, add to the research literature, and show that when designed and implemented correctly by knowledgeable researchers and educators, digital games can be leveraged for learning and the teaching of important real-world skills.

This research is also significant because it examines collaboration, teamwork, DGBL, and online education and how all of these elements relate to an innovative DGBL intervention. Each of these areas has many implications for professional fields such as education, business, social science, and government. While there is an extensive and growing body of research examining each of these separate threads, there is much less that looks at the effects, results, and implications of the cross-pollination of the different strands. If the current pace and convergence of technological advances is any indicator, there is and will continue to be a great need to study how these threads interact and what it means for education and training.

There are three other main areas where this research is especially significant. First, it describes some of the design, practical, and theoretical perspectives of an academic course that uses a digital game as the primary mode of instruction. This description is necessary to better understand the context behind this study which looks at learner perceptions of collaboration, teamwork, and team cohesion in the DGBL course. Designing entire academic courses around digital games is a relatively new development in the field of education. It is an instructional approach that is not yet widely used much less studied and evaluated. One of the challenges to the wider adoption of DGBL courses is their relative scarcity and lack of knowledge of what they look like, how they function, what theoretical perspectives they are based on, and how they could be designed. The course description detailed in this research aims to provide some answers to these questions and can help serve as a resource for educators and researchers interested in designing and implementing future DGBL courses.

Second, a number of researchers have noted serious methodological flaws such as a lack of systematic approaches that adequately examine and take into account a wide range of different variables (i.e. different age groups, tasks, and types of games) (Hays, 2005; Mitchell & Savill-Smith, 2004; Kirriemuir & McFarlane, 2004). There is clearly a need for researchers interested in DGBL to produce more robust and systematic research. This requires the development of a greater number of validated and reliable research instruments and robust research frameworks and processes. This research uses a mixed methods approach to look at the *StarCraft 2* DGBL course and uses a quantitative research instrument exhibiting some preliminary evidence of validity developed in a previous partial validation study to examine the academic course. Both

the quantitative and qualitative aspects of this research aim to provide a richer exploration of learner perspectives of team cohesion, which can inform the understanding of learners' collaboration and teamwork—two skills on which the *StarCraft 2* course focuses. Overall, the research design, theoretical perspectives, and methods of this study can provide one way how researchers can more systematically study DGBL courses and DGBL in general.

Third, this research is significant because it discusses some of the potential shortcomings when it comes to DGBL approaches—namely those related to sociocultural and equity factors. Researchers and educators may often find that it is all too easy to get caught up in the excitement to incorporate innovation into the curriculum or get lost in the headlong rush to jump on the technological bandwagon. When it comes specifically to DGBL, it may also be tempting to take a hugely popular digital game that on the surface seems like an ideal pedagogical tool and to incorporate it into instruction without adequate consideration of the game's genre and audience demographic. This research cautions that researchers and educators must be socially responsible by not only considering the actual design and pedagogy of DGBL courses, but also the games and game genres themselves in order to be as fair and equitable as possible. DGBL holds much promise and potential, but its design and implementation should be accessible and not only restricted to a privileged few. This research is significant because it consciously steps away from simply heralding the unlimited potential of innovative educational technology approaches and instead takes a more balanced and equitable perspective that researchers and educators should carefully design and implement their DGBL approaches.

Definition of Terms

- Digital game-based learning—refers to using digital games in teaching, learning, and instruction (Prensky. 2003).
- Digital game-based course—is an academic course that uses a digital game as the primary method of instruction.
- Real-time strategy game (RTS)—refers to a genre of digital games where the main goal is for players to create bases, create units, and gather resources. RTS games are military strategy games. The end goal is to win by either forcing opponents to surrender or by completely destroying their bases and units.
- StarCraft 2—is the second game in the extremely popular StarCraft RTS franchise.
- Team cohesion—is how a group feels and thinks about itself and sticks together as it works towards completing its common goals (Carron, Brawley, & Widmeyer, 1998).

Organization of the Study

This is a sequential explanatory mixed methods study. Chapter 1 of this study provides the research context, the research problem, the purpose of the study, the research questions, the research significance, and a brief definition list of important terms. Chapter 2 of this study includes a literature review of all related areas and theories. Chapter 3 details the methodology of the study. Chapter 4 provides the research findings and analysis of the data. Chapter 5 discusses the conclusions and implications of this study.

CHAPTER 2
LITERATURE REVIEW

Organization

This *StarCraft 2* research draws upon a wide range of theory and practice. With so many interconnected threads of knowledge, it is easy to get confused or sidetracked. To help minimize this, the literature review for this study is conceptually organized into 5 main sections and visually represented by the image shown below in Figure 2-1 on the next page. The first section discusses this research's overall constructivist and experiential research lenses and why they can provide useful insight into the study of the *StarCraft 2* course. The second section discusses digital gaming and includes an overview and sections on constructivism, experiential learning, and DGBL in education. The third section provides a brief overview of online learning. The fourth section revolves around the online *StarCraft 2* course and includes an overview of the game as well as an overview of the course. The fifth section outlines the different skills that learners are expected to experience and learn such as 21st century skills including collaboration and teamwork.

Constructivism and Experiential Learning as Research Lenses

Constructivism and experiential learning are closely related. While constructivism is a broad philosophical and epistemological perspective, experiential learning can be seen as more of a method or approach that specifically looks at how constructivist philosophy can be translated and applied to teaching and learning. Please see Figure 2-2 for a visual representation of the relationship between constructivism and experiential learning. Both focus on individuals creating knowledge through experience and personally making sense of the world around them. Constructivism is an

epistemological perspective—which explains how we know what we know—where learners create their own meaning and knowledge as they as take new information and compare, contrast, and synthesize it with prior knowledge.

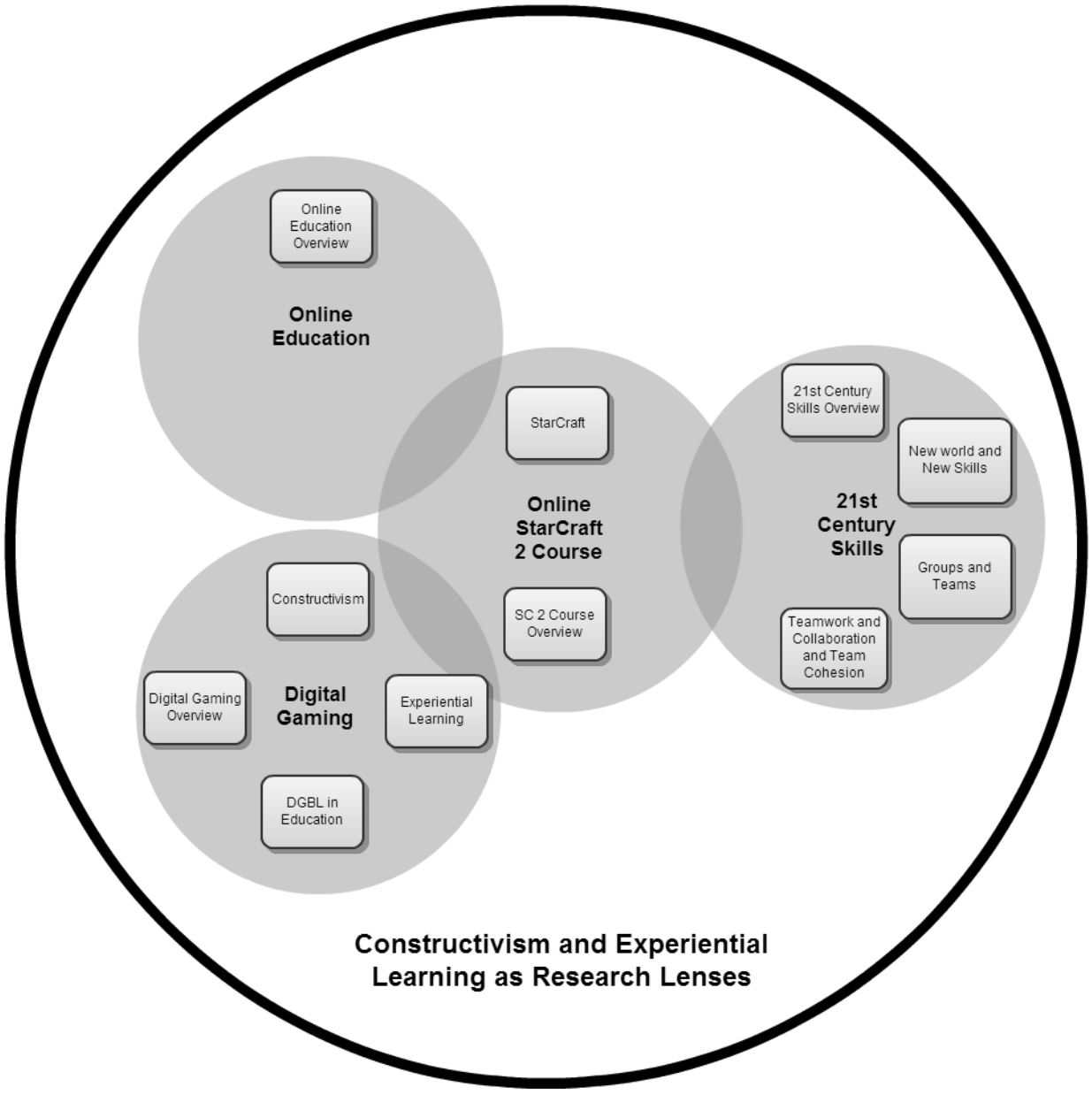

Figure 2-1. Organization of the literature review.

This stance is significantly different than behaviorist perspectives (Kolb, 1984). “Constructivism has come to serve as an umbrella for a wide diversity of views,” (Duffy & Cunningham, 1996, p. 6) which can include problem-based instructional methods which empower the learner and encourage them to take ownership of their own learning. It emphasizes the cognitive processes learners engage in as they evaluate, analyze, and assimilate information. In many ways, experiential learning can be seen as constructivism in action. It is a constructivist learning theory where learning “is the process whereby knowledge is created through the transformation of experience” (Kolb, 1984, p. 38). Experiential learning approaches place heavy emphasis on the learner, the cognitive and affective processes they engage in, and the meaning they create. These approaches encourage learners to go beyond simply focusing on the cognitive thought processes of knowledge creation and to also begin considering their experiences and feelings as they make sense of the world around them. The focus of experiential learning is on application and experience and learning as an ongoing process.

Constructivism and experiential learning can be informative lenses through which to view this research because of the experiential nature of DGBL and the learner-centered academic projects of the *StarCraft 2* course, which also includes the use of collaborative Web 2.0 tools. Constructivism serves as a broader lens while experiential learning helps more finely tune the focus of the research and analysis—much like how a telescope uses several lenses together to create a focused picture. The DGBL environment of this research has much potential because it taps into the power of digital games which often require not only complex cognitive processes, but also emotional

and affective processes. Gee (2003) notes well-made games can provide players and learners with the chance to engage in iterative cycles where they can create knowledge and synthesize meaning.

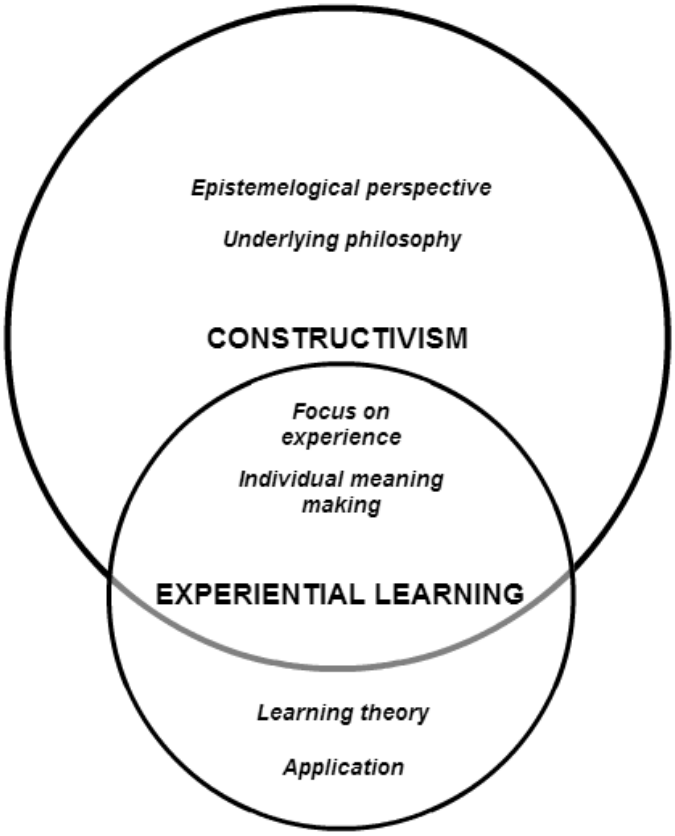

Figure 2-2. The relationship between constructivism and experiential learning.

Having learners actually collaborate to learn about collaboration—which this DGBL course emphasized throughout the semester—is also invaluable because it can help learners engage in meaningful experiences they can directly participate in and observe. Both in the game environment and the academic online course environment, learners were encouraged and expected to create their own meaning and understanding using a variety of media and resources in addition to *StarCraft 2*. Learners were exposed to Web 2.0 tools such as Google Docs, a collaborative online office suite as well as

creative Web 2.0 concept mapping tools such as Bubbl.us and Gliffy and online presentation tools such as Prezi to help them represent, organize, and disseminate information visually.

Using constructivism and experiential learning to examine the *StarCraft 2* course can be especially helpful in gaining better insight into digital game-based courses and DGBL in general. Well-designed digital games can have elements of effective learning (Gee, 2003). Digital games such as *StarCraft 2* encourage players to interact with the game environment and to synthesize understanding in a variety of areas such as game mechanics, game controls, strategy, and game storyline. Players immerse themselves in the game and learn by doing and through experience. They must constantly analyze, interpret, and synthesize their understanding. Players not only engage in many complex cognitive processes, but also experience affective processes as they react to the competitive nature of games and the desire to succeed and advance. Today's digital games often allow players to connect and play with others via the Internet and this brings a highly social aspect to the digital game play experience. This means players are not only experiencing cognitive and affective processes on their own, but they may also be doing so with fellow gamers—some of whom may or may not be strangers or real-life friends. Playing *StarCraft* and digital games in general not only encourages players to engage in thinking and reflection, but can also encourage them to experience different feelings such as team camaraderie, competition, satisfaction of winning or improving performance, control, challenge, discovery, exploration, thrill, fantasy, and fellowship (Squire, 2002; Wilson et al., 2009, Garris, Ahlers, & Driskell, 2002; Korhonen, Montola, & Arrasvuori, 2009).

The *StarCraft 2* course was designed specifically based from a constructivist philosophical perspective and heavily incorporates experiential learning educational approaches. This is another reason why examining it from a constructivist and experiential learning perspective can be helpful and informative. When it comes to digital game-play, learners constantly engage in constructivist and experiential processes where they create and synthesize understanding by combining prior knowledge with newly gathered information. They also formulate problem solving strategies, enact those strategies, and reflect upon the effectiveness of those strategies in order to inform future practice. At all levels, learners are encouraged to actively construct their own meaning through thought, analysis, reflection, and game-play experience and relate what they learn to their own individual professional and academic contexts.

Academically and professionally, the *StarCraft 2* course encouraged learners to create new knowledge by synthesizing what they know and learn in the game world with how they can apply those skills and concepts to their real-life professional world. It used *StarCraft 2* as a digital sandbox where they had to learn to work well with others in order to succeed. Assignments were varied and ranged from group projects where learners played collaborative *StarCraft 2* matches as part of their assigned small group, to more traditional group assignments where learners created a summary document discussing and analyzing their game-play and how it related to the real world. Please refer to Appendices C, D, and E for the collaborative academic GroupCraft projects and Appendix F for an example of an individual assignment. There were also individual assignments that focus on the iterative nature of digital gaming where learners played

the game and then afterwards reflected on the implications of their performance. Other individual assignments included creative writing, where learners were asked to write a piece of *StarCraft* fan fiction. Learners were encouraged to collaborate using online document and file sharing applications and were also asked to create graphic organizers using Web 2.0 tools such as concept mapping applications to demonstrate their understanding of important concepts by synthesizing text and visual information.

Digital Gaming

Overview

The world is changing and continuing to change. It has been nearly forty years since the iconic two-dimensional game *Pong* debuted and digital games now often feature immersive hyper-realistic environments where groups of players can play together and socialize. Digital games have become extremely popular to the point that some franchises such as the *Resident Evil* survival horror games have even inspired hugely successful Hollywood films. The American digital game industry has become a significant economic force. Americans spent $25.1 billion dollars on digital games, gaming hardware, and gaming accessories and 72% of American households play digital games (Entertainment Software Association, 2011). While the stereotypical portrayal of the typical gamer as being an adolescent male living in the basement seems to persist, in reality, 42% of gamers are female and the average gamer is 37 years old. The Entertainment Software Association's 2011 report also challenges conceptions that digital gamers are only playing violent games. In 2010, game sales figures show 44% of games sold that year were rated "E" for everyone, which is far more than the 24% of games sold that were rated "M" for mature content (Entertainment

Software Association, 2011). Digital gaming's continued popularity and social relevance make DGBL a field full of promise.

Constructivism

Much of the promise educators and researchers see in digital games stems from their tendency to encourage and require players to engage in constructivist processes and experiences. Players often take on the persona of a game character, may actively participate in an interactive storyline, collaborate with other players, or solve complex puzzles and problems. Constructivism is a learning approach that assumes individuals create their own reality based on interpretations of their experiences (Jonassen, 2006). It is a process-oriented approach that examines how learners construct knowledge and also takes into account how they have been influenced by their prior experiences, beliefs, and interpretations. Constructivist educational approaches assume that individuals make meaning of the world and that it does not exist as a separate and independent entity (Duffy & Jonassen, 1992). Individuals do not passively acquire knowledge, but instead actively create and form it and use their cognitive abilities to organize the world they experience (Von Glaserfeld, 1989). To constructivists, all knowledge and meaning is the product of the "activity and situations in which they are produced" (Brown, Collins, & Duguid, 1989). In other words, knowledge and meaning are created through different contexts, situations, and experiences. Many digital games consist of highly immersive and interactive virtual environments where players are free to explore, experience, and create knowledge and understanding.

Although over the years other branches of constructivism with differing perspectives have appeared such as cognitive constructivism, co-constructivism, radical constructivism, and situated constructivism, each share important common elements

(Kanuka & Anderson, 1998). According to Kanuka and Anderson's (1998) analysis of prior research, the constructivist approach considers previous learning as a foundation for new knowledge, sees learning as an active process where communication is crucial, and advocates for learner-centered learning environments (p. 14). Huang (2002) reiterates the learner-centeredness of constructivism and how it "narrows the gap between the school world and real-life society" (p. 34). Lainema and Makkonen (2003) agree and go a step further when they state how constructivist approaches are connected to real-life settings and can offer learners alternate ways to learn (p. 134). The active-learning emphasis of constructivism can help make learning more relevant to learners accustomed to more passive positivist pedagogical approaches.

The complexity and fast-paced nature of games such as *StarCraft 2* have great potential for serving as a dynamic environment which can foster constructivist learning. While playing, players constantly construct meaning from the game environment and their interactions with other players. They must also continually gather, evaluate, and reevaluate information to be successful. Players make decisions and follow strategies that provide real-time feedback. This feedback regarding decisions and actions can help players build their knowledge and experience base. Reflection—both during and after a match—gives players a chance to analyze their performance and decisions to help improve future performance. This reflection process encourages them to navigate complex situations in a wide variety of fluid contexts through critical thinking and analysis.

Experiential Learning

Experiential learning is closely linked to constructivism. Lainema and Makkonen (2003) define it as a "constructivist theory of learning whereby social knowledge is

created and recreated in the personal knowledge of the learner" (p.194). Experiential learning is essentially constructivism applied to the learning process, or the praxis of constructivism and teaching and learning. Experiential learning theory is firmly rooted in the intellectual work of Dewey, Lewin, and Piaget (Kolb, 1984). There are six major characteristics of experiential learning (Kolb 1984; Kolb & Kolb, 2005). First, learning is a process and ideas are not fixed, but are constantly modified via experience. Second, learning is a continuous process rooted in experience, where old ideas are reevaluated and integrated with new ideas. Third, learning involves navigating and resolving conflicts, disagreements, and differences as well as traversing between states of reflection, action, thinking, and feeling. Fourth, experiential learning considers learning as a broad process of adapting to the world or the environment that expands beyond the confines of a classroom. Fifth, learning involves interactions between an individual and their environment. It also refers to the complex relationship between an individual's personal and subjective experience, with their more objective and environmental experience. Sixth, experiential learning considers learning "the process of creating knowledge" (Kolb & Kolb, 2005, p. 194). An experiential perspective of learning considers the learning process as complex, involved, and influenced by environment and experience.

Gentry (1990) presents a view of experiential learning similar to Kolb's definition. Experiential learning involves learners participating in, interacting with, and applying things they have experienced through interaction with their environment and also exposing them to situations and processes that are often highly variable and uncertain. Experiential learning moves beyond focusing solely on an individual's cognitive learning,

but also encompasses individuals' affective and behavioral domains. The experiential learning experience does not grant learners complete free reign over their learning. Rather, the learning experiences must be structured to some degree with learning objectives and the entire process should be monitored and facilitated (Gentry, 1990). These approaches encourage learners to learn for themselves in a carefully planned and executed context. Learners are expected to use their own perspectives, beliefs, experiences, and personal histories to create their own meanings of knowledge and the world around them.

Experiential learning serves as a firm foundation DGBL and can guide the integration of pedagogy with gaming (Kiili, 2005). The *StarCraft 2* course used a learning environment that encourages players to engage in inquiry, exploration, collaboration, teamwork, and experiential learning. As they practiced, they added to and modified their understanding of game concepts, game knowledge, and related real world skills. The iterative nature of *StarCraft 2* meant players had to constantly adapt to new experiences and negotiate numerous conflicts and differences along the way. Playing *StarCraft 2* and practicing for improvement involves the cognitive, behavioral, and affective domains. More specifically, game-play requires reflection, action, thinking, and feeling. Players must have knowledge about the important aspects of the game, reflect upon past performance to inform future practice, and also consider their emotions in a competitive environment. There are also basic skills and competencies such as learning keystrokes and game interface commands that are required for game-play. The *StarCraft 2* course aimed to help structure and facilitate learners' experience in the game environment and to guide them in relating their in-game experiences with

their real-world academic and professional experiences and contexts. In the course, learners were consistently encouraged to synthesize what they learned in the course and in the game world with what they already have learned and known in their academic and professional worlds.

Digital Gaming in Education

Although researchers have championed the potential of using digital games in education, educators still face major challenges in designing and implementing DGBL. Both inside and outside the education field, there is skepticism about using games in education stemming from the misconception that digital gaming is solely entertainment. Because of this, DGBL can often run into significant resistance as “many parents and educators still tend to think of video and computer games as frivolous at best and harmful at worst” (Prenksy, 2003, p. 4). Much of this resistance towards digital games stems from the media’s focus on violent games rated “M” for mature content that revolve around killing and destruction when in reality, in 2011, 73 percent of all games sold were rated "E" for Everyone, "T" for Teen, or "E10+" which means the content is suitable anyone over the age of 10 (Entertainment Software Association, 2011). Digital games have also come under intense criticism for the way they portray women. Researchers have noted that digital games often reduce women’s roles in storylines, portray women as over sexualized, promote unhealthy female body image, and portray women as weaker and subordinate to males (Ogletree & Drake, 2007; Beasley & Standley, 2002; Downs & Smith, 2010; Dietz, 1998). Squire (2003) acknowledges Provenzo’s (1991) criticism of video games as fostering aggressive and violent behavior, encouraging gender stereotyping, and encouraging unhealthy individualist attitudes. However, he also notes so far the research on digital games has found no

relationship between digital games and maladjustment. In his opinion, the worries and concerns about the negative aspects of video games are largely without merit. In fact, the increasing complexity and collaborative aspects of new games actually hold great promise in increasing engagement and interactivity in teaching and learning.

When it comes to using digital games in education, it is important to note they are not the only medium that contains mature and unsuitable content. Other media such as printed literature, music, television, and film also contain countless examples of violent and unsavory content. There are many excellent examples within those media that could be used and are used in education. Digital gaming is no different and to think otherwise would be holding it to a double standard. Perhaps recognition of this fact is one reason why digital games are increasingly being seen as viable educational tools. Despite lingering misgivings in broader society, DGBL is making inroads in mainstream education. Van Eck (2006) notes that with the relatively recent prevalence of mainstream literature on the potential of gaming in education, the argument can be made society in general has become much more open to viewing games as engaging and possibly having a place in learning.

Another possible reason for this greater level of openness towards digital games is their increasing popularity and prevalence. This has also captured the notice of educators and researchers (Squire, 2002; Prensky, 2003; Shaffer et al., 2005) and has helped encourage a proliferation of DGBL research. Digital games have the potential to provide learners with a space to develop, practice, and to engage in critical thinking, problem solving, decision making, management, and collaboration. They can then apply what they learn from these experiences to the real world through learning transfer.

Indeed, one possible benefit of gaming in education is the transfer of learning achieved in games to other contexts (Shaffer, Squire, Halverson, & Gee, 2005; Kirriemuir & McFarlane, 2004). Learning transfer is when learning in one context or situation affects or influences learning or performance in different contexts or situations (Lewis, Lange, & Gillis, 2005; Singley & Anderson, 1989). There is some evidence that it occurs successfully through video and computer games. Sharma, Holmes, Santamaria, Irani, Isbell, and Ram (2007) found that the use of a real-time strategy game did result in learning transfer. Other researchers are a little more cautious, noting how game worlds are often very different from the real world and this difference may result in poor learning transfer (Garris, Ahlers, & Driskell, 2002). This reflects back to Hays' (2005) perspective that the effectiveness of DGBL depends heavily upon the type of game used and the context and way in which it is used.

Advances in gaming technology have enabled the creation of immersive virtual worlds which encourage socialization and collaboration. These worlds represent the engaging and effective environments educators seek for a technologically advanced era (Squire, 2003). Gee (2003) identifies several principles of good learning that are present in well-designed video and computer games. These elements have strong links to constructivism and experiential learning. Games can encourage players to create knowledge and to synthesize and refine that knowledge using new knowledge gained from new experiences. Games offer learners a place for both recreation and meaningful learning. The increasingly interactive and immersive environments of modern games encourage player motivation and promote collaboration (Gee, 2003). While many of

these principles have not yet been empirically examined, they can still help guide the research of games in education.

As noted earlier, well-designed digital games can contain elements of both constructivism and experiential learning. In the digital game world, players can actively interact, experience, and make decisions rather than be limited to passively watching such as with other media like film or text. Gee (2007) notes how game worlds can be places where people can have unique “meaningful new experiences” (p. 16). Prensky (2003) sees games as environments for active experimentation where players can explore to find understanding of complex concepts. Games can play a large role in helping people understand the world around them. They “are a way of knowing the world, a mediation between experience and understanding” (Rieber & Noah, 2008, p. 79). They can bridge the divide between what people know and understand, and what they experience. Games can also provide learners with an entirely new virtual world to experience (Gee, 2005; Prensky, 2003). When interacting with these environments, players must engage in constructivist and experiential processes. They must create and synthesize their own knowledge from what they know about the real world and what they experience in the game world. Each player may also have a different interpretation of reality within the game world as they each have different prior experiences and perspectives. There is not necessarily any one universal game experience. In experiential learning, individuals are constantly navigating and travelling between states of reflection, action, thinking, and feeling (Kolb and Kolb, 2005). With the development of increasingly immersive games, players now often traverse between worlds and not

just internal states. In many modern digital games, players can actually create different realities within the game environment.

Player experiences in game worlds may differ according to genre of game. Technological advances and ubiquitous Internet access have allowed for the increased popularity and proliferation of extremely complex and rich virtual environments that afford players with a high degree of social interaction. Specific genres of games such as massively multiplayer online games (MMOG) are “uniquely engaging environments” (Delwiche, 2006, p. 162). MMOGs with their emphasis on world and social interaction offer players an exponentially greater range and depth of experience than players of other genres of games which do not emphasize social interaction or immersion as heavily. MMOGs and other games also encourage social constructivism. Social constructivism is a branch of constructivism which says individuals construct meaning and knowledge socially and through group interaction (Kanuka & Anderson, 1999). Players in the social MMOG environment often work together to create knowledge or meaning within the virtual worlds they share. In this way, players often function as communities of practice, which are informal groups with shared expertise and interest in specific areas who generate knowledge together (Wenger & Snyder, 2000; Wenger, McDermott, & Snyder, 2002). MMOGs allow and encourage players to interact within complex communities of practice. Learning in the game world tends to be similar to ways individuals learn as members of more conventional real-world communities of practice (Delwiche, 2006).

Experience is not the only trait of experiential learning good games possess. One of the tenets of experiential learning is that learners must often navigate and address

conflict or solve problems. Good games contain at least some level of conflict and difficulty which make them “pleasantly frustrating” to players as they challenge yet also remain do-able (Gee, 2003, p. 2). According to Gee (2003), good games also present situations and problems to players which have solutions upon which they can generalize and build upon for future situations and similar problems. They can also present players with opportunities to observe and experience new information and compare it to their current understanding (Squire, 2002). Games do not solely relate to the cognitive domain, but can also appeal strongly to the affective domain by eliciting strong emotions such as fear, excitement, power, wonder, aggression, and joy in players (Squire, 2002).

Researchers have taken several different approaches to using digital games in teaching and learning. One common approach is to create “serious games” that teach learners as they play through. The main goal of serious games is to educate and train and to leverage “the power of computer games to captivate and engage end-users for a specific purpose, such as to develop new knowledge and skills” (Corti, 2006, p. 1). They represent a good opportunity for developers to make learning opportunities motivating, fun, and educationally worthwhile (Prensky, 2003; Michael & Chen, 2005). When it comes to using serious games in education, Kafai (2006) identifies two main approaches. Instructionist approaches view digital games as vehicles for learning and pedagogy and the resulting games are characterized by embedded lessons. Constructionist approaches focus on giving learners the opportunity to construct their own knowledge as they move through the game design process and “offer an entry point for young gamers into the digital culture not just as consumers but also as producers” (p. 39). One of the benefits of a game design approach is that it is more

inclusive and can appeal to learners who may not initially be gamers. Research shows learners enjoy designing and creating digital games for learning (Kafai, 2006). Kafai (1998) took a constructionist approach that asked students to create their own digital games in the classroom. She found that the process engaged both males and females. Researchers are also using instructionist approaches to DGBL Papastergiou (2009) found that using an educational game in computer education was equally motivating for both males and females and that there was a similar level of learning. Winn and Heeter (2008) designed a serious game and documented their iterative prototyping design process. A study examining the final version of the game found serious games can successfully engage both females and non-gamers.

Other researchers are looking at the potential of using commercial off the shelf games in education. Becker (2006) examines existing pedagogical elements in commercial digital games and connects them to established concepts such as Gagné's Nine Events of Instruction, Reigeluth's Elaboration Theory, Bruner's Psycho-Cultural Approach to Education, Merrill's First Principles of Instruction, Gardner's Theory of Multiple Intelligences, and Kolb's Learning Styles. Begg, Dewhurst, and Macleod (2005) also see games as inherently containing learning principles and concepts. This openness to using games in education is due to a shift in education from traditional didactic models of instruction to approaches which encourage learner-centered instruction and active learning (Garris, Ahlers, & Driskell, 2002).

In their review of the gaming literature, Wilson et al. (2009) note "games can lead to better cognitive, skill-based, and affective outcomes" (p. 259). Garris, Ahlers, and Driskell (2002) also note that one of the inherent strengths of games is the game cycle,

or an iterative process of evaluation, action, and feedback. Games can produce interest, motivation, and enjoyment in players who then participate in sustained, repetitive play or "persistent reengagement" (Garris, Ahlers, & Driskell, 2002, p. 454). The *StarCraft 2* course was built on the premise that learners would engage in some level and form of learning transfer as they applied what they learned in the game world to their own academic and professional contexts.

Digital gaming is a frontier at the forefront of educational research. However, like any frontier, there is a certain level of confusion and chaos that requires more systematic research before the frontier is finally settled. Reviews of the research on gaming research in general have found that much of it is characterized by methodological flaws, a lack of systematic and longitudinal studies, and a wide range of different variables (i.e. different age groups, tasks, and types of games) (Hays, 2005; Mitchell & Savill-Smith, 2004; Kirriemuir & McFarlane, 2004). Hays (2005) studied electronic and non-electronic games and found the effectiveness of games in learning depends on the type of game and the situation in which it is used. He also concludes that there is no evidence in the literature indicating that games are necessarily any better than traditional well-designed instruction. Kirriemuir and McFarlane (2004) note studying games can be an extremely complex endeavor because gaming has implications for many overlapping and related fields such as computer science, psychology, cultural studies, and education. Multiple applicable research fields, great complexity and genres of games, the fast-paced nature of game development, and differing research perspectives all mean that in gaming research, "there are few hard and fast findings in the literature" (Kirriemuir & McFarlane, 2004, p. 2).

In addition to this trend of linking principles of effective learning with digital games, another possible reason for a new openness towards DGBL is the nature of games themselves is becoming more nuanced leading to a greater appeal to a broader audience. The gaming industry seems to have learned from the harsh criticism it has received about violence and gender portrayal and seems to have finally recognized the value and importance of creating games that have a wider appeal. While violent first person shooters such as the *Call of Duty: Modern Warfare* franchise are still extremely popular, other recent digital games have proven that more inclusive approaches can be commercially and critically successful. The massively multiplayer online role playing game (MMORPG) *World of Warcraft* has millions of players who interact in a persistent virtual world where they can either complete quests on their own or collaborate with others to successfully negotiate different challenges. The game play includes an emphasis on crafting in-game items, exploring, and taking part in an involved story narrative. Players can also customize their characters and play either as males or females. *League of Legends* requires a high degree of collaboration and teamwork if players are to succeed. Games in the *Bioshock* and *Mass Effect* series have a moral and ethical tone.

Little Big Planet is an extremely well-received and popular puzzle-based game that also allows players a high degree of character customization and allows them to create items as well as different levels of varying complexity using a level editor. *The Elder Scrolls V: Skyrim* is a game that emphasizes narrative and allows players to freely roam and explore a vast immersive world. It also allows players to play as either male or female characters and to customize them to a high degree ranging from body shape to

eye color. *Portal 1* and its sequel *Portal 2* are puzzle-based games that have also received much critical and commercial success. *Portal 2* allows for cooperative play. *Farmville* is a social media based game played by millions that revolves around the processes of creating and sustaining a farm. *Angry Birds* is also an extremely successful game that focuses on problem solving and also contains puzzle elements. *Candy Crush* helps players practice and refine critical thinking and problem solving skills. Other games focus primarily on creativity. *Minecraft* is a game that allows players to roam freely across huge maps. The main goal of the game is to create tools and build structures to shelter from predators that come at night. There really is no way to "win" the game as in most traditional digital games and the focus is not on winning, but on creating and building.

It is important to note that although *World of Warcraft* and *Skyrim* do contain violence, they do so in a manner consistent with the game's storyline. *World of Warcraft* is known for its cartoonish game world and its depictions of violence tend to be stylized and non-graphic. While *Skyrim* has more realistic graphics, its violence is within context of the adventure narrative and has consequences for players. What all these games have in common is that they are not the stereotypical first person shooters that show graphic violence. It is significant that so many types of games outside the stereotypical violent first person shooter have established a strong presence in the digital gaming landscape and have enjoyed commercial and critical success. The financial potential of these games alone indicates that overly violent and sexualized games are not the only types of games that can be commercially successful. The digital gaming industry has realized that games rated other than "M" for mature can turn a tidy profit. This may

prove to be a huge boon for educators and researchers interested in the potential of DGBL as it provides an increasing number of digital games suitable for use in education and also ensures the relevance of digital games in general.

Online Education: Overview

Technology and education have always had a complicated relationship. The long-running debate between Kozma (1994) and Clark (1983) regarding media, technology, knowledge, teaching, and learning illustrates this well. Dede (2008) further shows this when noting how "historic controversies about technology and pedagogy illustrate an apparently endless search for a universal method of teaching/learning that is best for all types of content, students, and instructional objectives" (p. 59). As such, each new technological advance is seen as a "silver bullet" (Dede, 2008, p. 59) or a panacea for all of education's shortcomings and problems. Rather than fall into this never-ending quest for some elusive pedagogical Shangri-La, researchers and educators must recognize learning is diverse and dynamic. Once this is realized, energy and attention can "shift to developing pedagogical media that provide many alternative ways of teaching, which learners select as they engage in their educational experiences" (p. 59). As researchers and educators continue to study the potential and implications for online learning, they must remain aware of one major caveat as they navigate the growing body of research on the topic. When it comes to making sense of the literature regarding online learning, Moore, Dickson-Deane, and Galyen (2011) note it is important to realize terminology may be a challenge since there are "different expectations and perceptions of learning environment labels: distance learning, e-Learning, and online learning" (p. 129). This finding is especially troubling since it highlights differences in the meanings people in different contexts and geographical

locations assign to foundational terms in the field, which has implications for the "referencing, sharing, and the collaboration of results detailed in varying research studies" (p. 129). Because a full discussion regarding terminology is outside the scope of this research, only a relatively superficial overview of online education is offered here, although future work on standardizing the foundational terms is certainly not only warranted, but necessary.

Harasim (2000) notes how the invention of the Internet was a watershed moment when it comes to education. The networked nature of the Web created a "knowledge economy" (p. 42) which meant there were fundamental shifts in the way knowledge was created, accessed, and used. This progressive shift has continued through the beginning of the 21st century, and there has been a fundamental shift in attitudes and it "has become an integral part of mainstream society" (Harasim, 2000, p. 59). A recent United States Department of Education report has labeled online education as "one of the fastest growing trends in educational uses of technology" (Means, Toyama, Murphy, Bakia, & Jones, 2009, p. xi). Online instruction and learning has become more important in the corporate world (Bonk, 2002) and in higher education (Allen & Seaman, 2008). New technology implementation is one of the driving factors behind its development and expansion (Kim & Bonk, 2006). Kim and Bonk (2006) also note how blended learning has much potential. Online education can also play an effective supportive role to traditional education (Larreamendy-Joerns & Leinhardt, 2006).

As with DGBL research, there is a significant amount of debate and discussion centering on the effectiveness of online education. Tallent-Runnels et al. (2006) reviewed the literature about online teaching and learning and found there is a need for

more systematic and rigorous methodological designs because the field is characterized by inconsistent terminology and a lack of theoretical framework for studies. There are also some persistent misconceptions regarding the quality of online learning which is often seen as inherently inferior and lower quality than more traditional face to face instruction. However, the research tends to go against these misconceptions. Bernard et al's (2004) review of the distance education literature found that distance education and traditional face to face educator are comparable. When it comes specifically to online education, the research generally indicates that online education can be at least as effective as traditional face to face instruction (Swan, 2003). A multitude of studies have shown there are no statistical differences in the learning outcomes when compared to traditional face to face environments (Bernard et al., 2004; Johnson, Aragon, Shaik, & Plama-Rivas, 2000; Carey, 2001; Dutton, Dutton, & Perry, 2001; Arbagh, 2000; Lam, 2009). Others have shown that online education is not only as effective as traditional methods, but can be more effective (Hiltz, Zhang, & Turoff, 2002). Through their meta-analysis of quantitative studies comparing online and traditional learning approaches, Means et al. (2009) found that learners who took all or at least part of a course online performed better than those who experienced only face-to-face instruction. However, they are also quick to point out the online and face-to-face environments differed greatly in aspects such as time on task. There is some evidence online environments may have certain benefits when compared to traditional settings as online education may help disadvantaged students perform more effectively than traditional classroom-based instruction (Lam, 2009). Lam (2009) also found that

"although gender is a significant predictor in traditional classroom courses, its effect disappears in Web-based courses" (p. 323).

However, regardless of its benefits, it is important to keep in mind effective online education shares one important characteristic with traditional methods—solid pedagogy based on theory and practice. To achieve effective online education, it is helpful to consider Cooper's (2001) perspective that it is important to consider the suitability of the subject matter, the instructor or facilitator, and the learner. This advice is very similar to Hay's (2005) perspectives on DGBL and how type of game and the context in which it is used play a large role in the effectiveness of using games in education. Bailey and Card (2009) also recommend some principles of effective online education. According to their findings, online instructors should foster relationships with their students, ensure there is clear and open communication, engage their students, are timely, are organized, are able to troubleshoot technical difficulties, and are flexible. In other words, online instructors must have sound pedagogical skills just like traditional classroom teachers.

StarCraft 2 Course

StarCraft 2 Game Overview

Researchers have classified digital games into genres such as action, real-time strategy and turn-based strategy, sports and racing, first-person shooter, adventure, and role-playing (Laird & van Lent, 2001; Pinelle, Wong, & Stach, 2008), although the delineation between genres has blurred and many current games have elements of multiple genres. *StarCraft 2* is a real-time strategy (RTS) game and was chosen to anchor the DGBL course for three main pragmatic and pedagogical reasons. First, *StarCraft 2* is the second game in the extremely popular *StarCraft* franchise. It has immense name recognition that can potentially draw the most learner interest. Second,

StarCraft 2 is an RTS game, a genre characterized by large environments and the need for both complex decision making skills and resource management skills (Aha, Molineux, & Ponsen, 2005). Third, the complexity of RTS games have the potential to serve as learning environments that can promote and facilitate constructivist, experiential learning, and collaborative pedagogical approaches.

Research in DGBL is growing. However, there is a tendency for researchers to not adequately or fully describe the games studied (Ritzhaupt, Frey, Poling, & Johnson, 2012). In recognition of this and because this research revolves so heavily around using *StarCraft 2* in a DGBL course approach, it is necessary to present some of the basic concepts of this complex RTS game. *StarCraft 2* is an extremely complex and involved game. Foundational understanding of *StarCraft 2* and the RTS genre of games is critical to understanding the theoretical, pedagogical, design, and research implications of the *StarCraft 2* course.

First released in 1998, *StarCraft* has become an extremely popular commercial RTS game. It is a cult classic and is still being played today. An updated sequel, *StarCraft 2,* which this research uses, was released in 2010. *StarCraft 2* retains much similarity to its predecessor, but features enhanced graphics and updated units and capabilities. Despite these differences, both games are solid examples of the RTS genre. In the digital game world, many games come and go, but the *StarCraft* series has demonstrated remarkable staying power as it has remained relevant in popular culture since the late 1990s. *StarCraft 2* is a military science fiction game that has two major game-play components. First, there is a story-driven single-player campaign mode where the player completes chains of related scenarios and where the computer

is an opponent. Second, there is a multiplayer mode where the player competes against other player(s) on a single game map. The player may choose to play against a computer player or against a number of other human opponents. The most popular matches are 1 versus 1 games where a player goes up against a single human opponent. Players may also play cooperatively with or against up to seven other human or computer players. The *StarCraft 2* course and this research focus on the collaborative multiplayer option of the game. The *StarCraft* series' popularity has reached the point where there are professional *StarCraft* gaming leagues in South Korea where professional players are sponsored by major Korean corporations in televised tournaments. The popularity of the game has also resulted in a proliferation of international tournaments and competition. A *StarCraft* culture has also developed where there are also countless gaming resources—including gamer-created videos, websites, and forums—for *StarCraft* players to access, discuss, and disseminate game-related information.

In RTS games such as *StarCraft 2*, the object is for a player to defeat their opponent(s). Game play revolves around creating units and buildings to create military and economic systems on unique game maps. These maps may have different natural barriers, topography, and resource allotments. Players must balance their economies with military expansion and must attack and defend themselves from other players as they seek to do the same. RTS games are defined by several characteristics. They are in real-time and not turn-based, which means there is constant action. Actions and decisions often have immediate consequences. Turn-based games allow players more time to think and make decisions, while the real-time nature of RTS games leads to an

extremely fast-paced game environment. Players must construct a home base consisting of different types of buildings. Each of these buildings produces different units. These buildings may also have prerequisite buildings which must be constructed. Third, players must construct groups of units with different functions and abilities. These units may be classified as defensive, offensive, or resource gatherers and can be upgraded using different technologies which players can “research” at different buildings in their base. Sometimes there are multiple levels of each upgrade. Upgraded units are more powerful than units that have not been upgraded. Some units have special abilities which require the use of “energy” which once depleted must be given time to recharge. At any one time, a player may be in control of dozens or even hundreds of different buildings and units with varying abilities and qualities. The RTS nature of *StarCraft 2* means players must multitask. They must be able manage their existing units, create new units, and attack/defend against their opponent(s) all at the same time. Players must build and maintain an economy in order to sustain their base and their offensive forces. Players must use resource gatherer units to harvest resources which they can then use to build more buildings or units or to purchase abilities/upgrades. All buildings, units, and upgrades cost resources. In *StarCraft 2*, there are two types of resources—vespene gas and minerals. Each unit, building, or upgrade/ability costs gas, minerals, or some combination of both. Players must create units to attack their opponents or to defend against them. The end goal of an RTS game match is to either defeat their opponent(s) or force them to surrender.

As an RTS game, the game mechanics and game play of *StarCraft 2* can be quite complex as players may choose to play as one of three distinct races—the Terran,

Protoss, and Zerg. Set in the 25th century, where the three races are locked in a struggle for galactic dominance, each have unique units, buildings, and abilities and therefore require different play styles. For example, the Protoss are a technologically advanced humanoid alien race that rely on technology. Their units are more costly, but more powerful. Play style tends to be fairly rigid. The Zerg are an insectoid alien race that relies on large numbers of units to overwhelm enemies. Play style tends to be organic and free flowing. The Terrans are humans and a balance between the Zerg and Protoss, possessing the capability to produce units both in quantity and quality. Terran play style tends to be a hybrid of the Zerg and Protoss styles. *StarCraft 2* is similar to traditional chess in that it has moves and countermoves. Depending on which race they choose and what race their opponents choose, players will use different tactics/strategies and counter-tactics/counterstrategies. Players cannot see their opponents because of a "fog of war," or areas of the map that are darkened unless the player has units specifically at those locations. As such, players must constantly gather information about their opponents' strength, location, and strategies to make informed and timely decisions.

StarCraft 2 is an extremely intricate environment that has many overlapping layers of complexity. It is precisely *StarCraft 2's* complexity that made it a suitable and attractive commercial game on which to base an academic course. In order to succeed, players must use and rely on a wide range of skills such as critical thinking, decision making, management, and collaboration. As these 21st century skills are such an integral part of succeeding in the game, *StarCraft 2* presents a prime opportunity for educators to leverage a popular game for more academically structured learner

Table 2-1. Levels of complexity in *StarCraft 2*

Level of Complexity	Explanation
Resources (Vespene Gas or Minerals)	Units, structures, and upgrades cost different amounts of resources. Players must balance resources, and economic/military capabilities.
Races (Terran, Protoss, or Zerg)	Each race has different capabilities, requires different play styles, and possesses race-specific units/abilities.
Map and Topography	Each game map has a unique configuration of resource locations /geographical topography. Topography influences game play (i.e. units holding the high ground have a damage advantage)
Units	Each of the three races has both common and unique units/structures. Units may be melee/ranged, offensive/defensive, fast/slow, air/ground, or are particularly weak/strong against other specific opposing units. Some units have a stealth/cloaking ability and are detectable only by special detector units/structures.
Upgrades	Units can be upgraded to increase defensive/offensive performance or to give units new abilities. Sometimes structure upgrades must be developed before other structural /unit upgrades are available to players.
Strategies and Tactics	As in chess, there are many strategies and counter strategies. Some strategies focus on the macro (big picture) game, while others focus on the micro (small picture) game. Formulaic and standard approaches are often modified according to situation and player preferences.
Build Orders	Chess has standardized opening moves. *StarCraft 2* has build orders. Build orders are the specific sequences in which players produce units/structures. Each build is linked to an overall strategy and enables players to maximize the efficiency of their chosen strategy. Build orders are often player-style specific and heavily influenced by the players chosen race and overall game strategy.
Fog of War	Players can only see parts of the map/opponents only where there are friendly units or structures. This means that players cannot directly see what their opponents are doing for a significant amount of time during a match.

Table 2-1. Continued

Level of Complexity	Explanation
Real Time	The game is played in real-time so adaptive decision making, critical thinking and fine motor skills are crucial for players to succeed.

exploration of these skills. The complexity is precisely what gives it so much potential as a rich learning environment that can encourage constructivist and experiential learning. The table above shows several of the different levels of complexity within *StarCraft 2*. Keep in mind that many of these levels overlap and interrelate with each other. Table 2-1 describes the multiple layers of complexity in *StarCraft 2*.

StarCraft 2 **Course Design Process and Overview**

The *StarCraft 2* course began as an instructional design project for a graduate-level online course development class. From there it was further refined in two independent studies. The researcher approached the University's Honors Program to propose the course be included as an Honors course offering. The Honors Program was chosen specifically for the reason due to the Program's relative openness to innovation; course adoption could be made more easily here than in other parts of the University. After an initial meeting, the Honors Program expressed interest, but requested the course be further refined. Improvements were made and after a second meeting, the course was approved to be offered through the Honors Program as an interdisciplinary studies elective class. The first offering of the course filled up within a day of it being opened for registration, which gives some indication to the popularity of *StarCraft*. Prior to the beginning of the course, due to the heavy student workload, a

design decision was made to reduce the number of credit hours from three to two. The course workload was reduced and a new emphasis was placed on collaborative game play and collaborative academic projects. This decision served the dual purposes of reducing student workload, while also more heavily emphasizing collaboration. At the time of this research, the course had gone through five iterations.

The 21st Century Skills in *StarCraft* course was specifically designed to provide learners with a structured environment in which to learn about and experience collaboration. *StarCraft 2* is used as a mindtool, which Jonassen (2000) defines as critical thinking devices that "represent a constructivist approach for using computers or any other technology, environment, or activity to engage learners in representing, manipulating, and reflecting on what they know" (p. 10). In the *StarCraft 2* course, learners were encouraged to anchor the concepts they are learning to their own experiences and identities. It was an online 8-week honors course offered through the honors program at a major research university in the southeastern United States. The course was interdisciplinary and focused on professional skills useful in any professional field. It took advantage of the fast paced environment of an RTS game to encourage learners to practice important 21st century skills such as critical thinking, problem solving, research literacy, and collaboration in a meaningful and experiential manner. Multiplayer *StarCraft 2* matches require a high level of teamwork and collaboration among group members that goes beyond simply delegating certain tasks and responsibilities. Each player must ensure their actions and decisions are coordinated with their teammates in order to win the match. They must work together to make complex decisions in real-time that determine whether they win or lose.

Academically, each assignment focused on higher order thinking skills such as analysis and reflection and also encouraged learners to constantly link in-game concepts with real world ideas based on their own professional and academic contexts and perspectives.

The course itself was broken down into eight separate weeks in Moodle, an open-source online course management system. Each week included all the required readings, links, assignments, and assignment descriptions. There was a mixture of both individual and group assignments that focused on topics ranging from risk management, critical thinking, and problem solving. Throughout the course, learners were encouraged to link in-game content and concepts with applications and connections to their own real-life academic and professional contexts. There were also two mandatory in-person meetings. The first was an orientation meeting before the course actually began to ensure that all potential learners understand the specifics of the course before the drop/add period of the semester ends. The second was right before the course actually began and served as a final overview and opportunity for learners to ask questions.

Just as careful planning is needed in the design and implementation of games in education, detailed design is required to create effective online courses. The *StarCraft 2* course built on Gros' (2007) guidance regarding the educational use of an RTS game, and Collazos, Guerrero, Pino, Ochoa, and Stahl's (2007) framework for using digital games to teach collaboration. The course also took into consideration what Rovai (2004) and Huang (2002) identify as major principles when designing effective constructivist online courses. These academic principles were applied to the *StarCraft 2* course design. First, courses should be learner-centered. The *StarCraft 2* course was

designed from a constructivist perspective and heavily emphasized experiential learning. Second, there should be careful thought with regards to planning and presenting course content. Adequate guidance and support should be provided to learners. The *StarCraft 2* course was presented in a well-organized modular format and included orientation material to help guide learners as they completed the academic and game-play elements of the course. Third, online courses should foster interpersonal interaction, positive social discourse, and collaboration. The *StarCraft 2* course included forums where learners interacted with each other and the instructor. Learners also interacted virtually in the *StarCraft 2* game environment as well as in face-to-face and virtual meetings. Fourth, learning in online courses should be interactive and strongly emphasize learner reflection. Learners in the *StarCraft 2* course were regularly asked to reflect on their game play, decisions, and performance. They also reflected on connecting the game world with the real world. Fifth, courses should include individual and group activities. The *StarCraft 2* course included individual and group work that had to be completed online, during in-person meetings, or in the game environment. Group interaction and individuals' contributions to the group tasks were monitored throughout the course using learner self-evaluations and group documentation of meetings, group processes, and *StarCraft 2* match performance. Sixth, there should be appropriate assessment of learners. Learners in the *StarCraft 2* course were assessed on the quality and completeness of their assignments, their collaboration performance, and how well they related game ideas to the real world and their own personal contexts. Seventh, there should be an emphasis on developing learners' higher order cognitive abilities such as critical thinking, analysis, and evaluation. The *StarCraft 2* course

emphasized these skills and also learners' proficiencies in problem solving, decision making, and collaboration. While there were some individual assignments, the course recognized the importance for learners to practice working with others so more emphasis was placed on collaborative group projects that link academic and professional skills with in-game concepts. To provide as authentic a collaborative experience as possible, learners were randomly placed into groups of three. They remained in their groups throughout the duration of the course. They were randomly assigned to their groups because in the professional world, they may be asked to work with people who they do not know. In most of the course's collaborative projects, learners played *StarCraft 2* collaboratively with their groups against other random groups online and then documented and reflected on their experiences. Depending on the assignment, learners had to analyze their performance and then link everything they have learned and experienced to the academic and professional worlds.

21st Century Skills

Overview

The *StarCraft 2* course was interdisciplinary and focused on helping learners practice important skills they will need to succeed academically and professionally. Throughout the millennia, humankind has relied on certain skills to survive and to thrive. Humans have long had to work together, be innovative, solve problems, and communicate. Not only did working together and problem solving skills help prehistoric hunters kill giant mammoths to feed their families, but they also aided in building the great pyramids and putting humans on the moon. Innovation fueled the Industrial Revolution and the Age of Enlightenment and creativity sparked the Renaissance. Now in a digital information age, policymakers, professionals, and educators have placed

renewed emphasis on these same skills that humans have used throughout history. They have relabeled them 21st century skills, which refer to a wide range of skills and competencies.

The Partnership for 21st Century Skills is a national organization at the forefront of the renewed focus on critical skills learners and workers need in order to be successful in an increasingly fast-paced and connected world. The Partnership for 21st Century Skills (2013) organizes these skills into a framework consisting of four major groups. Core Subjects and 21st Century Themes include mastery of such subjects as English, math, science, and economics. Learning and Innovation Skills include such skills as creativity and innovation, critical thinking, problem solving, communication, and collaboration. Information, Media and Technology Skills include information, media, and ICT literacies. Life and Career Skills include such skills as flexibility and adaptability. The *StarCraft 2* course aimed to provide learners with the opportunity to actively learn and practice each of these skills in a meaningful, constructivist, experiential, and collaborative environment.

New world and new skills

Towards the end of the 20th century, economists, policymakers, and educators increasingly took note of the pace of global social and economic change. As the 21st century loomed closer, some made predictions that the new millennium would be a drastically different time than preceding eras. Even as early as midway through the century, McLuhan and Fiore (1967) took note of the influence of technology and media and their contributions to making the world a global village characterized by dynamic information flow and creation. A number of people—rather accurately it has turned out—predicted fundamental economic change and a new economic world order for the new

millennium. Johnston and Packer (1987) predicted that the United States would transition from manufacturing economy to a service-oriented economy requiring increasingly skilled workers capable of interacting in redefined professional environments. Reich (1992) noted how increasing global interrelationships and shifting economic situations were causing American industry to move away from high-volume commodity production to high-value information generation and management.

The United States is not the only nation which has had to undergo radical economic change over the past few decades. Tapscott and Williams (2008) note how technological, demographical, and economic change in the 21st century have enabled and empowered people around the world to become increasingly participative in the global economy. Hitt, Keats, and DeMarie (1998) note that business and government policymakers around the world have come to recognize that the technological advances and increased globalization of the digital age have reshaped the business and industry landscape. Developed nations have generally transitioned from regulated and relatively static economies to more dynamic and knowledge-driven economies (Audretsch & Thurik, 2000). Economic changes also effect career and workplace changes. Schein (1996) predicted—largely correctly—that individuals would have more power in career path and development than they had in traditional organization-directed career definitions. Hall (1996) predicted the rise of “protean careers,” where empowered workers are in charge of their own careers and whose roles are dynamic and based on the current environment. He also notes that in knowledge economies, “the new career will be increasingly a continuous learning process” (p. 11). In these knowledge-driven economies, individuals are experiencing new forms of social interaction and must be

competent in new professional skills such as information literacy and networked communication in order to succeed (Ananiadou & Claro, 2009). Essentially, in this new world defined by change, successful companies must harness and attract knowledge and innovation (Tapscott & Williams, 2008). In order to succeed in a "new competitive landscape," (p. 30) Hitt, Keats, and DeMarie (1998) mention how organizations and businesses of the 21st century must embrace flexibility, develop core competences, use new technologies, cooperate, innovate, and invest in training and learning. While they are specifically referring to businesses as a whole, their recommendations are strikingly similar to what the Partnership for 21st Century Skills advocates as important for learners.

While they were conceived decades apart, Hall's (1996) protean individual, McLuhan and Fiore's (1967) citizen of the global village, and the 21st century learner are similar in that they all describe the learner and worker of the new millennium. These individuals live and work in a fast-paced world defined by change and require certain skills to navigate and succeed in an unpredictable world. Casner-Lotto's (2006) survey of over 400 American companies identifies skills valued most by employers. These skills include problem solving, critical thinking, collaboration, innovation, creativity, information technology application, and communication. The United States is not the only nation which is aware of the importance of developing and harnessing these skills. Internationally, these concepts have become increasingly accepted and embraced. Ananiadou and Claro (2009) sent out a questionnaire study to Organisation for Economic Co-operation and Development (OECD) member nations. A total of 17 responded and most recognized and accepted the importance of 21st century skills.

Businesses and governments understand the dynamics of change know that the only way to succeed is to produce and employ workers with new skill sets suited for the new environment. In an increasingly technological and interconnected world, it is imperative for learners to be proficient in 21st century skills such as critical thinking, problem solving, and collaboration.

Because today's world requires such a high degree of social interaction and being able to work together with others, this research focuses on teamwork and collaboration. In an increasingly connected and global world, the ability to effectively and efficiently collaborate and work in teams has become an absolute necessity. Tapscott and Williams (2008) note how society at the beginning of the 21st century is defined by collaboration, innovation, information and technology access and use, peer-to-peer interactions, and participatory culture. They note how "new forms of mass collaboration are changing how goods and services are invented, produced, marketed, and distributed on a global basis" (Tapscott & Williams, 2008, p.10). Advances in collaborative and social media have enabled this economic shift. The lines between consumer and producer have been blurred. In an interconnected world, the English poet John Donne's ideas of human existence ring especially true—that no person is an island. In the past, a consumer may have been relatively isolated due to limits in communication and travel. However, in an era defined by ubiquitous Internet access and social and collaborative media, each individual is now connected to any number of other people on other islands and has the freedom to move around and communicate freely. In addition, technology and new business models allow groups of individuals to design, create, and market new products in new ways. As 21st century society continues

to be characterized by social connections, collaboration and teamwork are just a couple of the many skills that are increasingly important for learners to master if they are to succeed.

Groups and teams

While groups and teams are often used interchangeably, it is important to note there is a difference between them. Both have distinct bodies of research (Paulus & Zee, 2004). Forsyth (2009) defines a group as “two or more individuals who are connected by and within social relationships” (p. 3). Whereas the notion of groups is relatively simple and basic, the concept of teams is more complex. Katzenbach and Smith (1994) make the explicit distinction that teams have a strong emphasis on collaborative performance and joint contribution while small groups may share information and insights, but are not necessarily as focused on performance or common output. Whereas true teams “do real work together,” a group’s focus has a strong element of revolving around the individual, rather than the collective (Katzenbach & Smith, 1994, p. 112). Sundstrom, De Meuse, and Futrell (1990) also note how teams are specific forms of groups when they define work teams as “small groups of interdependent individuals who share responsibility for outcomes for their organizations” (p. 120). For example, a social support group is very different from a sports or military team. For this research the students enrolled in the *StarCraft 2* course were divided into small groups that interacted academically and socially. However, they were also considered a team because they were concerned with performance and the production of collective end products (i.e. winning *StarCraft 2* matches as a team and finishing collective academic projects as a group).

In their discussion, Sundstrom, De Meuse, and Futrell (1990) note one of the elements of teams is they are dynamic in both their characteristics and their approaches to action as they adapt to their shifting environments. In their study, Devine et al. (1999) found that teams are usually driven by consensus, perform multiple tasks, and are peer-oriented. While teams tend to be non-hierarchal, they often have a formal leader. Kozlowski and Ilgen (2006) synthesize a seven element definition of the team from the existing literature on the definition of teams and their characteristics. For them:

> A team can be defined as (a) two or more individuals who (b) socially interact (face-to-face or, increasingly, virtually); (c) possess one or more common goals; (d) are brought together to perform organizationally relevant tasks; (e) exhibit interdependencies with respect to workflow, goals, and outcomes; (f) have different roles and responsibilities; and (g) are together embedded in an encompassing organizational system, with boundaries and linkages to the broader system context and task environment (Kozlowski & Ilgen, 2006, p. 79).

Essentially, a team is a special form of group whose interaction and purpose go beyond simple social interaction and relationships. For example, activities/hobbies groups may simply gather together for the social companionship or because they have shared pastimes or interests. They often have no unified goal that they need to collectively achieve. Amateur and professional sports teams on the other hand may also gather for social reasons, but have the added goal of contributing in an organized and collective manner to a collaborative endeavor where each individual's contribution helps determine the success or failure of the entire team. A military platoon is also a team where individuals engage in distinct social interaction, but also must complete a well-defined mission where they must engage in a high level of teamwork and collaboration.

Cooperation, coordination, collaboration, teamwork, and team cohesion

Reilly (2001) notes “in practice, collaboration is commonly interchanged with terms such as cooperation and coordination” (p. 55). However, each differs from the other in distinct ways so it is important when reading and interpreting this research to have a clear understanding of the terms since each has different implications for teaching and learning. The best way to understand these concepts is to realize they are on a continuum—moving from cooperation to coordination to collaboration—based on the level of organization, formality, and risk of the social interactions (Reilly, 2001). Teamwork, which can be interpreted as collaboration occurring in teams comes next in the continuum and is the most formally organized structured interaction.

The Merriam-Webster Dictionary (2013) defines cooperation as “the association of persons for common benefit.” This definition, while clearly noting a level of social interaction, is rather vague and highlights the absence of formal organization or leadership structure as the individuals are simply associating with each other for a common benefit. Next on the continuum is coordination, which the Merriam-Webster Dictionary (2013) defines as “the harmonious functioning of parts for effective results.” This definition also clearly indicates some level of interaction between different elements or people, but it also seems to indicate a greater level of interdependence since there is an emphasis on the functioning and end result of those interactions. “Harmonious functioning” also implies there is some level of formal organization that is helping guide and drive the process or that there is some loose system that all entities and individuals must adhere to in order to maintain the balance and effectiveness of the coordination process.

Collaboration is more formally organized than either cooperation or coordination and means “to work jointly with others or together especially in an intellectual endeavor” (Merriam-Webster, 2013). This definition specifically states how people are explicitly working together with others towards a common goal. It goes beyond simple “association” or “harmonious functioning.” Gray (1989) defines collaboration as “a process through which parties see different aspects of a problem can constructively explore their differences and search for solutions that go beyond their own limited vision of what is possible” (p. 10). Wood and Gray (1991) modify this original definition and say collaboration “occurs when a group of autonomous stakeholders of a problem domain engage in an interactive process, using shared rules, norms, and structures, to act or decide on issues related to that domain” (p. 146). Collaboration is a process (Rochelle & Teasley, 1995) or can be both a process and an outcome at the same time (Gardner, 2005; Macdonald, 2003), but does not automatically happen in the formation of groups or through interpersonal interaction. Tyre and von Hippel (1997) are clear to point out that just bringing people together and having them interact is not necessarily enough for true collaboration. Rather, the situations surrounding collaborative endeavors and the contexts in which they occur should also be considered. The Partnership for 21st Century Skills (2013) associates collaboration with teams and teamwork as their student outcome statement for collaboration states how learners should be expected to work together in teams, share responsibility, and produce collaborative work.

As the most formally structured and organized form of interaction, teamwork is “work done by several associates with each doing a part but all subordinating personal

prominence to the efficiency of the whole" (Merriam-Webster, 2013). This definition clearly highlights formal structure and organization. It also shows a high level of interdependence even up to the point of subordination to other team members, the team leader, or the task. In collaboration, individuals cede a significant amount of autonomy and instead become part of a collective. Whereas collaboration involves multiple groups, teamwork only involves one and everyone in that group works singularly towards a common goal or purpose. Paris, Salas, and Cannon-Bowers (2001) note teamwork is when team members integrate and utilize specific cognitive, behavioral and affective skills and competencies to achieve goals and objectives and to optimize their performance. It is characterized by attitudes, adaptive behaviors, monitoring, feedback, collective action, communication, and flexibility. Teamwork and its underlying behaviors can help groups enhance their performance and accomplish collective tasks (Rousseau, Aubé, & Savoie, 2006).

Classifying, defining, and understanding the many different levels, forms, and ways human's work with each other can be confusing. When examining how humans work together, clearly defining these terms is more than a petty quibbling over semantics, but rather a matter of utmost importance. Each of these terms and concepts has important similarities and differences. For any research on cooperation, coordination, collaboration, and teamwork to be meaningful and useful, researchers and educators must take great care to avoid using them interchangeably and to only use the appropriate term to refer to and define the appropriate situation(s). Table 2-2 below provides a brief overview of the definitions and characteristics of each term. This research specifically chose to look at collaboration because it is explicitly identified as a

21st century skill. It chose to look at teamwork because the Group Environment Questionnaire—the quantitative research instrument used in this study—was specifically designed to measure team cohesion in a competitive environment which relied on teamwork.

Table 2-2. Definition and characteristics of group and team interaction

	Definition	Characteristics
Cooperation	The association of persons for common benefit (Merriam-Webster, 2013)	Defined by informal relationships that have no formal structure or planning. Emphasizes sharing of information and each group or entity retains full autonomy (Reilly, 2001)
Coordination	The harmonious functioning of parts for effective results (Merriam-Webster, 2013)	Characterized by more formal and structured relationships that also include division of roles. Emphasis is on common tasks and there is increased communication between each group or entity, which retain autonomy, but also take on more risk because of the more involved extent of the relationships (Reilly, 2001, Winer & Ray, 1994)
Collaboration	To work jointly with others or together especially in an intellectual endeavor (Merriam-Webster, 2013)	Requires more robust and durable relationship and also an extensive amount of planning and structure. Previously autonomous groups and entities are incorporated—while still remaining part of their original groups—into a new collaborative structure and there is significant level of risk because everyone invests their own resources to achieve a common goal or purpose (Reilly, 2001)
Teamwork	Work done by several associates with each doing a part but all subordinating personal prominence to the efficiency of the whole (Merriam-Webster, 2013)	Characterized by a highly interdependent dynamics and constant communication between team members Includes team monitoring behaviors to ensure all members are functioning effectively. There is an extreme level of risk since the absolute interdependence of the members behaviors and actions will determine the success or failure of the team in achieving its shared goal or purpose (Jones & George, 1998; Salas, Sims, & Burke, 2005) While in collaboration groups retain some of their autonomy, in teamwork, all members are part of a single group. Requires leadership

It is helpful to consider the similarities and differences between collaboration and teamwork in more detail. There is also an extensive amount of literature for both

collaboration and teamwork. Some researchers such as Thomas, Sexton, and Helmreich (2003) use the terms interchangeably. After reviewing the many definitions and principles of teamwork (Salas, Burke, & Cannon-Bowers, 2001; Jones & George, 1998; Salas, Sims, & Burke, 2005) and collaboration (Gray, 1989; Wood & Gray, 1991; Partnership for 21st Century Skills, 2013), it is clear that the two concepts overlap and share much in common. (Please refer to Table 2-3 below, which shows characteristics of collaboration and teamwork). To avoid becoming embroiled in a semantic debate over the two terms, this research takes the perspective that while any group can collaborate, teamwork specifically refers to a more directed, coordinated, and focused form of collaboration by a team.

Over the years, researchers have developed many theories and definitions of teams and teamwork and there are a multitude of factors that have been connected to the concept including team performance and team effectiveness. These two constructs can be helpful in measuring and determining the level and quality of teamwork engaged in by teams. Salas, Sims, and Burke (2005) note “team performance accounts for the outcomes of the team’s actions regardless of how the team may have accomplished the task” (p. 557).Team effectiveness takes a more holistic perspective in considering not only whether the team performed (e.g., completed the team task) but also how the team interacted (i.e., team processes, teamwork) to achieve the team outcome” (Salas, Sims, & Burke, 2005, p. 557).

Team effectiveness has been addressed and defined differently by researchers, but all definitions tend to have several commonalities. Kozlowski and Ilgen (2006) identify the dynamic qualities of team effectiveness and the importance of relatively

intangible team qualities. They discuss a total of nine factors which influence team effectiveness. Some are cognitive and include factors such as team climate. Other factors are behavioral and center on team competencies. Motivational factors such as team efficacy and team cohesion also play a role in overall team effectiveness.

Table 2-3. Characteristics of collaboration and teamwork

Collaboration	Teamwork
Collaboration is "a process through which parties who see different aspects of a problem can constructively explore their differences and search for solutions that go beyond their own limited vision of what is possible" (Gray, 1989, p. 10).	"With teamwork what one person does is determined by what all others are doing, and the parties must be constantly alert to the ways others are behaving in order to be able to respond appropriately" (Jones & George, 1998, p. 539).
Collaboration "occurs when a group of autonomous stakeholders of a problem domain engage in an interactive process, using shared rules, norms, and structures, to act or decide on issues related to that domain" (Wood & Gray, 1991, p. 146).	Teamwork is characterized by flexible and adaptive behaviors, monitoring of member behavior, interdependence of members, communication, and collective action (Salas, Burke, & Cannon-Bowers, 2001, p. 352).
Collaboration is "creating solutions or strategies through the synergistic interactions of a group of people" (Denning & Yaholkovsky, 2008, p. 10). Learner standards for Collaboration (Partnership for 21st Century Skills, 2013) • Demonstrate ability to work effectively and respectfully with diverse teams • Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal • Assume shared responsibility for collaborative work, and value the individual contributions made by each team member	Salas, Sims, and Burke (2005) have synthesized a definition of stating that "Teamwork is a set of interrelated thoughts, actions, and feelings of each team member that are needed to function as a team and that combine to facilitate coordinated, adaptive performance and task objectives resulting in value-added outcomes" (p. 562).

Similarly, when it comes to defining team effectiveness, Sundstrum, De Meuse and Futrell (1990) “favor a broad definition that accounts for members' satisfaction and the group's future prospects as a work unit” (p. 122). Their definition of team effectiveness also includes cohesion, inter-member coordination, problem solving, establishing roles and norms, and mature communication. Cohen and Bailey (1997) echo this when they state team effectiveness is comprised of three major components. The first component is the team’s performance as measured by quantity and quality of the products it produces. The second component is concerned with members’ attitudes and the third looks at members’ behavior such as if they remain part of the group or if there is turnover. Considering both team performance and team effectiveness is important because a team can still successfully complete a task regardless of whether or not they actually engaged in optimal teamwork (Salas, Sims, & Burke, 2005). A team that collaborates well and engages in a high level of teamwork, yet does not produce a successful output can still be said to exhibit a certain level of team effectiveness. An example of this could be a scientific research team or a *StarCraft 2* team that works well and collaborates at a high level, but still does not succeed with regards to output (i.e. produces significant experiment results or a *StarCraft 2* match victory). If team effectiveness is measured solely by output, then these teams would be considered ineffective teams even though they actually exhibited high levels of teamwork and collaboration. However, when teamwork and collaboration processes are considered in addition to final product, then the teams can still be seen as being effective to a certain degree. They may not be deemed as effective as teams which exhibited high teamwork

and collaboration as well as produced a successful output, but they cannot be written off as total failures. In the same way, a team that severely lacks teamwork and collaboration may be able to produce a suitable outcome, but could still be considered ineffective. It could have been that the lack of teamwork and collaboration led to an individual or small group of individuals within the larger group to simply do all the work. Therefore, when it comes to team effectiveness, it is important to consider process and product as well as context.

As mentioned earlier by Kozlowski and Ilgen (2006) and Sundstrum, De Meuse and Futrell (1990), team cohesion is a factor that contributes to team effectiveness. Team cohesion is important because “cohesive groups perform better than non-cohesive ones and also need less management from above” (Sapsed, Bessant, Partington, Tranfield, and Young, 2002, p. 5). Evans and Dion (1991) found in their meta-analytic study of group cohesion and performance that there is a positive relationship between team cohesion and group performance and that an average cohesive group performed 18 percentile points higher than the average non-cohesive group. Gully, Devine and White (1995) also agree that group cohesion and performance are “generally positively related,” although other factors such as level of analysis and task interdependence influence this relationship (p. 512).

It is interesting to note “cohesive groups also achieve performance benefits when group performance is conceptualized as a behavior instead of an outcome” (Beal et al., 2003, p. 998). When it comes to improving team effectiveness, Guzzo and Dickson (1996) identify three main “points of leverage” that can be used (p. 334). These areas include the design of the group, the context in which the group functions, and group

processes which include rules and cohesiveness. According to Festinger's (1950) seminal definition, cohesion is "the resultant of all the forces acting on the members to remain in the group" (p. 274). These forces include both the prestige of the group as well as the group tasks with which it is involved. Evans and Jarvis (1980) refer to cohesion as how attracted members are to their group. Carron, Brawley, and Widmeyer (1998) explicitly mention the affective nature of group cohesion when they define cohesion as "a dynamic process that is reflected in the tendency for a group to stick together and remain united in the pursuit of its instrumental objectives and/or for the satisfaction of member affective needs" (p. 213). In synthesizing all of these definitions, team cohesion can be understood as how a group feels and thinks about itself and sticks together as it works towards completing its common goals.

Team cohesion is a dynamic multidimensional construct that changes both over the course of time and as individual members change (Carron, Brawley, & Widmeyer, 2002). As discussed earlier, group cohesion has implications for group effectiveness and performance (Sundstrom, De Meuse, & Futrell, 1990). There are a number of established studies which point to a significant relationship between group cohesion and group performance (Evans & Dion, 1991; Cooper, 2001; Gully, Devine, & Whitney, 1995; Beal et al., 2003). However, it should be noted that when it comes to discussing this relationship, there are many ambiguous, conflicting, and inconclusive viewpoints (Mullen & Copper, 1994). For example, Gully, Devine, and Whitney (1995) and Mullen and Copper (1994) do not explicitly define performance, and Beal et al. (2003) acknowledge performance as having both process and product, but choose to focus on aspects of behavioral processes. It should also be realized that some studies do not

support the cohesion and effectiveness relationship (Ancona & Caldwell, 1992). However, while there is wide variation in the quality and nature of the work regarding the relationship of cohesion with performance, there is a general consensus that the two are indeed related (Kozlowski & Ilgen, 2006).

While there are many different aspects of collaboration that could have been studied, there are two main reasons why this research chose to focus on team cohesion. The first reason was because of the significance it plays in group collaboration and teamwork. Collaboration and teamwork are extremely complex social processes. Team cohesion is closely related to the social attitudes, perceptions, and bonds group members form with each other both on a social level and on a task-based level. Therefore, it makes perfect sense to use team cohesion to look at the collaborative processes occurring within the *StarCraft 2* groups. The second reason is because there was already a developed and validated research instrument which measures team cohesion in a context not too dissimilar than the *StarCraft 2* course. Carron, Brawley, and Widmeyer's (2002) Group Environment Questionnaire was designed for competitive sports teams. The *StarCraft 2* game-play in the course is competitive—albeit via online competition—with each group functioning in many ways like a traditional in-person sports team. While there are other well-regarded quantitative instruments that examine different aspects of collaboration and teamwork such as Anderson and West's (1998) Team Climate Inventory, they tend to focus primarily on collaboration of work groups in a professional context and not on collaboration of competitive teams either in traditional sports contexts or in multiplayer online gaming

contexts. It was thought that using an already validated research instrument would be easier than creating a new one from scratch.

CHAPTER 3
METHODOLOGY

Overview

This research is a sequential explanatory mixed methods study which sought to examine the ways in which participation in the *StarCraft 2* course influenced research participants' attitudes, experiences, and perspectives of collaboration and team cohesion. The first phase of the study was quantitative and used a questionnaire that was modified in a previous study and which exhibits some preliminary evidence of validity. The data was statistically analyzed using SPSS software. The second phase of the study involved conducting three individual qualitative interviews. The collected data were analyzed using the constant comparative method.

This chapter first describes the mixed methods research approach and also the research perspective of the study. Second, it describes the research context in detail—including overviews of *StarCraft 2*, the *StarCraft 2* course design process, and the modified Group Environment Questionnaire (GEQ) developed in a previous study. Third, it discusses the study's research design including quantitative methods, qualitative research methods, and sample. This section also discusses procedures that will be taken to address the validity and "trustworthiness" of the study. Table 3-1 provides an overview of this study's research question, data collection, and data analysis. Fourth, it discusses assumptions and biases of the study. Fifth, it briefly discusses limitations and delimitations of the study. Table 3-1 below provides the research question, data collection methods, and data analysis methods.

Table 3-1. Research questions, data collection, and data analysis

Research Question	Data Collection	Data Analysis
RQ: In what ways does participation in an online digital game-based course influence learners' perceptions of collaboration and team cohesion?	Modified questionnaire instrument which exhibits some preliminary evidence of validity (Carron, Brawley, & Widmeyer, 2002)	SPSS, paired samples t-test, Pearson product-moment correlation calculations
	Individual qualitative interviews (Willis, DeMaio, & Harris-Kojetin, 1999), content analysis (Patton, 2002)	Constant comparative method and coding (Patton, 2002; Strauss & Corbin, 1998; Charmaz, 2000)

Research Approach: Mixed Methods

One of the main differences between quantitative and qualitative research is that "quantitative researchers work with a few variables and many cases, whereas qualitative researchers rely on a few cases and many variables" (Creswell, 1998, pp. 15–16). While there are certainly major differences between quantitative and qualitative research methods, there is often a tendency by some researchers to overemphasize these differences to the point where they are seen as divergent and even polar opposites (Howe, 1988). Instead of perpetuating the quantitative-qualitative divide which inevitably leads to perpetual philosophical and epistemological disagreements, Howe (1988) sees both branches of research as "inextricably intertwined" (p. 12) and advocates for a more pragmatic research approach that emphasizes "what works" and which also views quantitative and qualitative methods as compatible. The rigid approach of choosing one quantitative or qualitative cookie cutter approach and attempting to force it to fit a particular study simply does not make sense. When it comes to choosing research methods, Patton (2006) notes, "the gold standard should

be *methodological appropriateness* rather than methodological orthodoxy" (p. i). Methodological appropriateness means that designs should be judged on the extent to which they answer the inquiry question at hand, not whether they adhere to some preordinate standard" (p. i). After all, methods are "tools for the answering of research questions and not vice versa" (Erzberger & Kelle, 2003, p. 482).

Mixed methods research is an increasingly accepted pragmatic approach which combines quantitative and qualitative methods in such a way that the resulting research is stronger than single method quantitative or qualitative approaches (Creswell, 2009; Creswell & Plano Clark, 2007). Mixed methods approaches emphasize practicality and have three major advantages over single method designs in that they can "answer research questions that the other methodologies cannot," provide "better (stronger) inferences," and "provide the opportunity for presenting a greater diversity of divergent views" (Tashakkori & Teddlie, 2003, pp. 14-15). As research in educational technology continues to explore and examine new ways technology is being used in education, the versatility of mixed methods approaches holds great promise.

This study was a sequential explanatory mixed methods design, which is "characterized by the collection and analysis of quantitative data in a first phase of research followed by the collection and analysis of qualitative data in a second phase that builds on the results of the initial quantitative results" (Creswell, 2009, p, 211). Figure 3-1 below provides an overview of the overall project design. This model follows Creswell's (2009) recommendations on mixed method research designs. It shows how quantitative data will be collected in the first phase of the study and qualitative data will be collected in the second phase. The qualitative phase was capitalized to denote this

study placed more emphasis on the qualitative data collection and analysis than on the quantitative phase. During the initial study design, more emphasis was placed on the qualitative phase to acknowledge the fact that results from the quantitative phase would be severely limited due to the extremely small sample size. It was determined the qualitative phase was more likely to provide meaningful and in-depth data than the quantitative statistics.

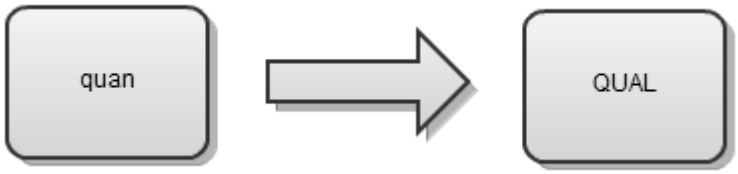

Figure 3-1. Overview of the project design.

Research Perspective

Mixed methods approaches are rooted in pragmatism (Howe, 1988; Patton, 1990; Tashakkori & Teddlie, 1998) and free researchers from being constrained to using a single methodology. Tashakkori and Teddlie (1998) encourage researchers to "Study what interests and is of value to you, study it in the ways that you deem appropriate, and utilize the results in ways that can bring about positive consequences within your value system" (p. 30). These hybrid approaches give researchers the freedom of choice and the ability to mix and match different methods, perspectives, and frameworks that best fit the specific contexts of their study. It is also significant that the pragmatic characteristics of mixed methods approaches also share some similarities with constructivist perspectives of teaching and learning. In mixed methods approaches, researchers are free to create hybrid frameworks to help create new

understanding. In constructivist instructional strategies, learners play an active role in creating their own knowledge and learning.

Indeed, constructivism is a fundamental thread that ties all the elements of this research together. The *StarCraft 2* course design was based on constructivist theory and revolves around encouraging learners to construct their own meaning through experiential learning. DGBL emphasizes constructivist instructional approaches and experiential learning. Social constructivism plays an integral role in the collaborative and teamwork endeavors in the course.

The mixed methods approach of this study allowed for the mixing and matching of different methods, which is helpful when studying new and innovative educational technology approaches such as DGBL courses. DGBL often draws from multiple disciplines and bodies of knowledge so it can be very helpful for researchers to take advantage of the more flexible and multifaceted nature of mixed methods approaches because traditional single-method approaches may not be adequate. Allowing learners to describe their own perceptions and capturing and analyzing this rich data using a multidimensional pragmatic and constructivist research perspective has more potential than simply relying on more close-ended approaches. As technology continues to help facilitate the creation of complex multidimensional learning environments, the multifaceted aspect of mixed methods makes them well-suited for use in studying these new instructional approaches.

Research Design

Sample

The sample for this study came from students who took the Fall 2012 iteration of the *StarCraft 2* course. As the course was only available to students in the University

Honors Program, all students were undergraduate Honors students. It was clearly communicated to potential participants that the course instructor was also the primary investigator, that there were no incentives for participation in the study, and that the data would only be viewed and analyzed once final grades were submitted to the registrar. The course had no restrictions regarding academic majors and there were no course prerequisites other than prior experience with RTS games and *StarCraft 2* in particular. Participants ranged from first-year students to undergraduates in their fourth year. Because the course used a digital game as the primary resource for instruction and learning, each participant in the sample had experience with digital gaming. Furthermore, because the course description clearly stated potential students must already possess basic knowledge and experience with *StarCraft 2*, the sample included beginner-intermediate to advanced skill level *StarCraft 2* players who were also full time university students.

Participants in the *StarCraft 2* course were recruited at the second of two required in-person orientation meetings as outlined in the course description and also via email. As many participants as possible were asked to take part in phase 1 of the study which consisted of a quantitative questionnaire. After the course was completed and phase 1 was complete, participants were then asked and given the opportunity to take part in phase 2, which consisted of individual qualitative interviews. The goal of this two-step process was the ability it provided to zoom in on increasingly specific levels of information and also to help triangulate the data for validity purposes. A total of six individuals elected to participate in the quantitative part of the study and completed both the quantitative pre and post-test surveys. Seven students filled out the pre-test but only

six also completed the post-test. Three individuals—one freshman, one sophomore, and one senior—chose to participate in the individual qualitative interviews. These three participated in both the quantitative and qualitative phases of this research.

Quantitative Methods

Group Environment Questionnaire (GEQ)

Carron, Brawley and Widmeyer's (2002) Group Environment Questionnaire (GEQ) was used in this research study and was chosen after reviewing numerous instruments that measured various aspects of small groups and collaboration. It was chosen based on its very low cost, its clarity, its documented validity and reliability of the scores, and because team cohesion has implications for the collaborative elements of the *StarCraft 2* course. Team cohesion has been identified as an element of team performance (Kozlowski & Ilgen, 2006) and therefore measuring it can provide insight into how effective a group is collaborating.

The GEQ was originally designed for use with in-person competitive sports teams and includes 18-items scored using a 9-point Likert scale, with 1 being "strongly disagree" and 9 being "strongly agree." The decision to modify this particular instrument and use it to study the *StarCraft 2* course was based on two main reasons. First, the course has a strong emphasis on competitive and collaborative game-play. Second, the GEQ measures aspects of group cohesion and one of the objectives of the *StarCraft 2* course is to help learners improve and practice their collaboration and small group skills. Group cohesion likely plays a significant role in each group's interactions within the game and real worlds.

Carron, Brawley and Widmeyer (2002) note the GEQ should be used as a framework and a guide and that researchers studying team cohesion in different

contexts should revise and reword the instrument to fit their purposes. In this research, extensive revisions were completed during an extensive and systematic focus group and cognitive interview procedure to better adapt the instrument to measure team cohesion within the academic, online, and digital game contexts of the *StarCraft 2* course. The conceptual framework for the GEQ assumes "cohesion—a group construct—can be assessed through the perceptions of individual group members" (Carron, Brawley and Widmeyer, 2002, p. vii). The GEQ's conceptual framework as shown in Figure 3-2 identifies four factors which contribute to the overall concept of team cohesion: Individual Attractions to the Group-Task (ATG-T), Individual Attractions to the Group-Social (ATG-S), Group Integration-Task (GI-T), and Group Integration-Social (GI-S). It is important to note that the factors are distinguished by task aspect and by social aspect. The first two factors, ATG-T and ATG-S focus on individual group member's feelings about their personal involvement and acceptance within their group. These questions tend to use the words "I," "my," or "me." The second two factors, GI-T and GI-S, focus on individual group member's feelings and perceptions about the group's closeness and bonding when it comes to the group's task or social interactions. These questions tend to use the words "us," "our," or "we."

It is important to note the GEQ framework assumes team cohesion is multidimensional and dynamic (Carron, Brawley and Widmeyer, 2002). Group interactions and relationships are fluid and change over time. Not all of the four cohesion aspects need be present in the same proportion for a group to be cohesive. Also, while ATG-T, ATG-S, GI-T, and GI-S may help explain team cohesion, these constructs are conceptually different and have moderate relationship to each other.

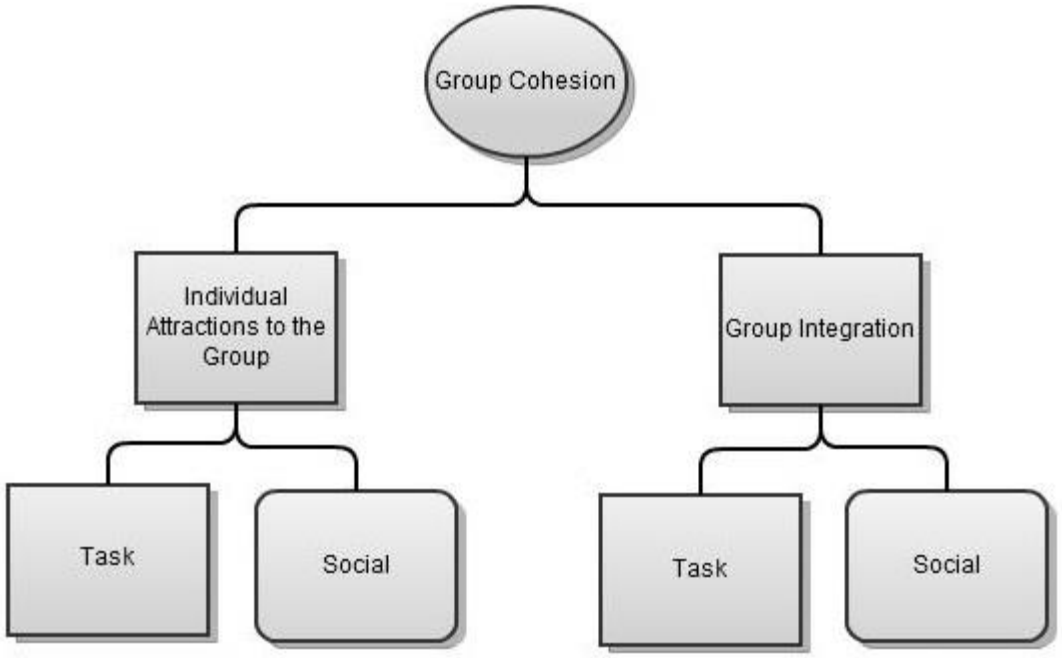

Figure 3-2. Factors that determine group cohesion.

Because of this, the designers of the GEQ suggest scoring and analyzing each of the individual areas separately, rather than simply combining the four total scores to obtain an overall measure of team cohesion. Combining all the four scores would result in a muddy and unclear picture. The overall team cohesion value can provide some insight into the effectiveness of a group, but studying each individual aspect provides a more detailed and meaningful analysis. In some cases, they note it may be appropriate to separately combine the task-oriented factors and to separately combine the social-oriented factors. However, any combining of scores should depend on individual studies' purposes, conceptual frameworks, and characteristics of collected data.

The GEQ is a multidimensional construct that differentiates between team cohesion's social aspects and task aspects. It is important to note that task cohesion has been seen to predict team performance more than social cohesion (Carless & De

Paola, 2000). This makes logical sense in that a group can still successfully complete a task regardless of how close and social the members feel towards each other. A dysfunctional group can still succeed at a task. While this may be a valid point, it is nonetheless in a group's best interest to get along well in both areas. Therefore, it is important to avoid dismissing or underestimating the importance of social cohesion as part of overall team cohesion because it has been established that group social processes and relationships do affect group factors such as group effectiveness and group task performance (Jehn & Shah, 1997; Jehn & Mannix, 2001; De Dreu & Weingart, 2003). While social cohesion may not be as strong a predictor as task cohesion, it is still necessary to consider and acknowledge interpersonal group processes since both dimensions of team cohesion overlap and interact given the very definition of group collaboration.

The GEQ has been found to be valid in many studies over the years (Carron et al., 1985; Brawley et al., 1987; Spink & Carron, 1993; Westre & Weiss, 1991; Li & Harmer, & Acock, 1996). The scores from prior test administrations have also been found to be reliable. With regards to reliability of the instrument's scores, the original GEQ's Crohnbach alpha values are as follows: ATG-T α = .75, ATG-S α = .64, GI-T α = .70, GI-S α = .76. In order to establish convergent construct validity, the modified GEQ's correlation to external variables was calculated. The task cohesion factors and the social cohesion factors were individually correlated with the 10-item Likert-scaled Team Player Inventory (TPI). This scale measures individual's predisposition and attitudes towards working in a group or team environment. The TPI was chosen to help validate the GEQ based on the assumption that an individual's predisposition towards

collaboration and teamwork will positively correlate with attitudes towards both task cohesion and social cohesion in the *StarCraft 2* course. It is logical to assume that most individuals with low predisposition to working in groups will tend to also report less positive experiences when it comes to attitudes towards task and social cohesion. The TPI was analyzed using principal components analysis and it was found that the instrument was valid and that each of the ten items measured the intended construct (Kline, 1999).

Partial validation procedure

The partial scale validation consisted of a focus group and four separate cognitive interviews, each following proper IRB protocols. The focus group participants were recruited via in-person communication and included five members with a wide variety of expert background knowledge and expertise. The group included the following: one tenured educational technology faculty member with extensive experience conducting educational research and focus groups, one tenure-track faculty member with both scale validation and *StarCraft* experience, one educational technology post-doc with experience in scale creation and validation, one educational technology PhD student with experience in both playing *StarCraft* and co-teaching the *StarCraft 2* course, and one volunteer undergraduate research assistant with *StarCraft* experience who also had an integral role in the design, development, and ongoing modification of the *StarCraft 2* course.

In order to maximize the effectiveness of the focus group, the partial validation of the GEQ followed Krueger's (2009) framework for conducting successful focus groups and incorporated many key recommendations such as using open-ended questions and encouraging a permissive environment. The four cognitive interview participants were

undergraduate Honors students recruited via email correspondence. Each of them had taken previous offerings of the course. The partial validation of the GEQ followed Willis, DeMaio, and Harris-Kojetin's (1999) recommendations for conducting cognitive interviews regarding developing and delivering appropriate questions. It used a verbal probing technique since the purpose of the cognitive interviews was to collect specific data to help inform the item modification process. Questions were also thought out before interviews were actually conducted and included both standardized questions as well as flexibility for follow-up questions. Results of the focus group and cognitive interviews led to 11 questions being added to the modified GEQ scale. As the course has both an academic and game-based context and the original GEQ had only a sports team context, these additions consisted of adding questions that specifically related to team cohesion and the academic side of the *StarCraft 2* course.

The partial scale validation also included conducting a pilot test. This was achieved by administering the modified GEQ as pre and post-tests to undergraduate Honors students who were currently taking the *StarCraft 2* course at the time of the study. These students were recruited via in-person correspondence during a required course orientation meeting at the beginning of the semester. A total of 10 students finished both the pre and post-tests. Of these, eight were male and two were female. Academic majors included fields such as physics, astronomy mathematics, biology, and pre-med.

Since this research used a quantitative research instrument to examine a DGBL course, it is important to discuss the results of the partial-validation process of the modified GEQ used in this study. The statistical analysis in the previous partial

validation study of the GEQ was comprised of four main parts. The first part of the statistical analysis examined the correlation of the task-cohesion elements of the modified GEQ with the TPI and on the correlation of the social-cohesion elements of the modified GEQ with the TPI. Carron, Brawley and Widmeyer's (2002) advice to examine the task and social aspects of team cohesion separately was followed since the two areas are both a part of team cohesion, but have been shown to not be highly related to each other. The task cohesion aspects of the GEQ were combined and then correlated with the TPI. The social cohesion aspects of the GEQ were summed and then also correlated with the TPI. A Pearson product-moment correlation coefficient was calculated to assess the relationship between the task cohesion aspects of the GEQ and the TPI and also the relationship between the social cohesion aspects of the GEQ and the TPI. Both aspects had a significant positive correlation with the TPI. There was a significant positive correlation between the overall social cohesion aspect of the GEQ and the TPI, $r = .753$, $n = 10$, $p = .012$. There was also a significant positive correlation between the task cohesion aspect of the GEQ and the TPI, $r = .816$, $n = 10$, $p = .004$.

The second part of this research's statistical analysis focused on the modified GEQ's reliability. Although the sample size (N=10) was extremely small, the reliability of the scores of the modified GEQ was still calculated. While the results were not generalizable, they still can help provide some insight into the effectiveness of the modified GEQ. With regards to reliability, the original GEQ's Crohnbach alpha values are as follows: ATG-T $\alpha = .75$, ATG-S $\alpha = .64$, GI-T $\alpha = .70$, GI-S $\alpha = .76$. The modified GEQ pilot test analysis resulted in significantly higher Crohnbach alpha values in three

of the four areas as shown by the following: ATG-T α = .85, ATG-S α = .85, GI-T α = .90, GI-S α = .67.

The third part of this research's statistical analysis focused on the correlation each of the four team cohesion factors has with each other. A Pearson product-moment correlation coefficient was calculated to assess the relationship between each of the four aspects of team cohesion. Please refer to Table 1 for all of the correlations. The social cohesion aspects were highly correlated with each other. There was a significant positive correlation between ATG-S and GI-S, r = .805, n = 10, p = .005. The task cohesion aspects were also highly correlated with each other. There was a signification correlation between ATG-T and GI-T, r = .795, n = 10, p = .006. On the other hand, the analysis also showed that in some instances the social cohesion aspects were not significantly correlated with each other. There was not a significant correlation between ATG-T and GI-S, r = .571, n = 10, p = .085. There was also not a significant difference between GI-T and GI-S, r = .259, n = 10, p = .470. However, there were two instances where the social aspects did have significant positive correlations with the task aspects of team cohesion. There was a significant positive correlation between ATG-S and ATG-T, r = .910, n = 10, p = .000. There was also a significant positive correlation between ATG-S and GI-T, r = .720, n = 10, p = .019.

The fourth part of the partial scale validation research's statistical analysis focused on using the modified GEQ to measure the effect the *StarCraft 2* course had on team cohesion of the students enrolled in the course. Paired samples t-tests for each of the four factors of the GEQ were conducted. The pre-test scores (M = 48.00, SD = 10.29) and post-test scores (M = 46.20, SD = 10.10) did not differ significantly with

regards to levels of attractions to group based on social interaction (ATG-S), t(9) = .896, p = .394. The pre-test scores (M = 48.60, SD = 9.19) and post-test scores (M = 52.10, SD = 3.81) did not differ significantly with regards to levels of attractions to group based on task (ATG-T), t(9) = -1.81, p = .104. The pre-test scores (M = 68.70, SD = 11.87) and post-test scores (M = 71.20, SD = 8.59) did not differ significantly with regards to levels of group integration based on task (GI-T), t(9) = -0.867, p = .409. The pre-test scores (M = 14.30, SD = 3.43) and post-test scores (M = 13.10, SD = 3.67) did not differ significantly with regards to levels of group integration based on social interaction (GI-S), t(9) = 1.18, p = .269.

The preliminary results from the focus group and cognitive interview procedures of this study pointed to the modified GEQ exhibiting some preliminary evidence of validity with respect to content. The significant positive correlation between the task and social aspects of the instrument and the TPI indicated that it also exhibits some preliminary evidence of validity with respect to external variables. Also, the high Crohnbach alpha values of each factor making up team cohesion—while certainly not generalizable due to the study's small sample size—nevertheless show there is potential for using the modified GEQ to examine team cohesion in academic DGBL courses.

Modified GEQ administration and data collection

The first phase of this research consisted of collecting quantitative data using a questionnaire that measures learner perceptions of team cohesion. It used a 28-item modified version of Carron, Brawley and Widmeyer's (2002) Group Environment Questionnaire (GEQ) that was developed in a previous study. Please refer to Appendix J for the items of the modified GEQ. While the previous study was not a full validation

study and not generalizable due to an extremely small sample size, it did find some very preliminary evidence of validity for the GEQ regarding validity with respect to external variables (found by correlating the GEQ with another survey) and with respect to content (found by conducting an expert panel/focus group and cognitive interviews).

When it came to questionnaire administration, in week 4 of the *StarCraft 2* course, participants were asked to complete the GEQ pretest which also included a short survey section to collect important demographic and descriptive data. Week 4 was chosen because it was the midway point of the course and by this time, the groups would have had enough time to become more familiar with their group mates. Since this research examined the research participants' small group interactions, it was important to give each of them enough time to actually interact with their groups so they could accurately answer the quantitative questionnaire items. In week 8 of the course, participants were asked to complete the GEQ posttest. Emails were sent to participants to remind them to fill out the questionnaires. In both instances, the GEQ was administered via Moodle, the online course management system used for the course. Because the principle investigator of this research was also the course instructor, data was not accessed or analyzed until after the *StarCraft 2* course had officially ended and final grades were submitted to the registrar. This was clearly communicated to participants via the IRB consent forms.

Questionnaire data analysis

The data was analyzed using SPSS statistical software. Paired samples t-tests for each of the four factors of the GEQ were conducted to measure learner perceptions of team cohesion. To examine learner characteristics and success in the course, Pearson product-moment correlation coefficients were calculated to determine what

characteristics—if any—were correlated with each of the four factors of team cohesion as measured by the modified GEQ. The results were further analyzed in relation to the qualitative data that were also collected.

Qualitative Methods

Individual interview procedure and data collection

During the qualitative phase of the research, Patton's (2002) guidance on collecting qualitative data via qualitative interviews was followed. Patton (2002) notes different interview approaches can be combined based on the situation. This research combined the more rigid and standardized planned questions of the standardized open-interview approach with the more flexible topic and subject area of the interview guide approach. The standardized open-interview approach helped ensure all participants were asked the exact same questions while the interview guide approach allowed for a degree of conversational flexibility during each individual interview. Patton (2002) notes the two interview approaches have specific strengths. The standardized open-ended interview approach has many benefits including the fact that the exact interview protocol is available for readers, the interviews are highly focused and thereby time efficient, data analysis is made easier by the data being already grouped and standardized, and comparisons of participants' responses can be compared more readily. The interview guide approach is beneficial because it relies on the careful planning and targeting of questions to make the most efficient use of the limited time of an interview and also ensures that the data collection is relatively systematic for each participant. This research combines the two interview approaches to take advantage of the respective strengths of each approach. This hybrid approach offers a certain level of flexibility that

the standardized open-ended interview approach lacks and a higher level of standardization that the interview guide alone does not necessarily have.

The 18-question interview protocol used in this research followed Krueger's (2009) guidelines of interview question creation and included an opening question, introductory questions, transition questions, key questions, and ending questions. Please refer to Appendix K for the interview protocol. While they were originally designed for focus group interviews—which are a special form of qualitative interviews—the structure and organization of the questions is still informative and useful for individual interviews. Questions included in the interview protocol included many types that Patton (2002) identifies such as experience and behavior questions, opinion and values questions, feeling questions, and background/demographic questions. Please see Appendix K for the interview protocol.

Interview data analysis

The qualitative focus group data were transcribed and then analyzed using the constant comparative method (CCM). CCM was chosen as the data analysis method for this research because of the relative ease in which it can be applied, its flexibility in allowing for creativity, and its suitability for analyzing and studying social phenomena. Boeije (2002) notes "comparisons go hand-in-hand with interpretation and it is our opinion that purposeful comparison makes the valuable task of interpreting social phenomena a much easier proposition" (p. 409). CCM was also chosen for its organic creation of codes, categories, and themes, which aligns well with the constructivist perspective of this *StarCraft 2* research.

Strauss and Corbin (1998) state "analysis is the interplay between researchers and data" (p. 13), that "it is both science and art" (p. 13) and that it is a creative

endeavor. Patton (2002) echoes this in saying that analysis “transforms data into findings” (p. 432) but that there is no universal approach or recipe. Rather, while guidance and direction can be gleaned from established methods, “the final destination remains unique for each inquirer, known only when—and if—arrived at” (Patton, 2002, p. 432). To make accurate sense of qualitative data, it must be analyzed in a consistent and systematic manner. Patton (2002) notes developing “some manageable classification or coding scheme is the first step of analysis” (p. 463). Coding and categorizing data helps highlight themes and patterns in the data (Ryan & Bernard, 2000; Patton, 2002). Strauss and Corbin (1998) identify five important concepts regarding coding. First, coding is concerned with building theory and not only testing it. Second, coding is an analytic tool that can be used to sift through large quantities of raw data. Third, coding helps researchers consider alternative meanings for phenomena. Fourth, coding is both systematic and creative at the same time. In many ways it is a systematically creative process. Fifth, coding helps “identify, develop, and relate the concepts that are the building blocks of theory” (p. 13).

The individual interview data in this research was coded according to the constant comparative method (CCM) of grounded theory which allows for comparisons to be made in five major domains (Charmaz, 2000). First, the CCM approach to coding allows comparisons of different people including their views, perspectives, and accounts. Second, it allows comparison of data from the same person with data they provided at a different point of time. Third, it allows comparison of incident with incident. Fourth, it allows comparison of data with different categories. Fifth, it allows comparison

of a category with other categories. In this research, by coding the collected data using CCM, patterns will become evident and theories and themes can be formed.

Boeije (2002) notes while CCM is popular—and often written about—there is a lack of literature which systematically and specifically details how to effectively conduct it. Often researchers will extensively document data collection, but remain vague on their CCM data analysis methods. Recognizing this as a major challenge to systematic CCM research, Boeije (2002) presents a practical and systematic step by step guide of how to apply the CCM method. The guide consists of five steps including: comparison within a single interview, comparison between interviews within the same group, comparison of interviews from different groups, comparison in pairs at the level of the couple, and comparing couples (Boeije, 2002). Since this research only consisted of three participants in one group, only steps one and two were applicable.

After the transcripts were completed, they were sent to the participants for member checking. Once this was complete Boeije's (2002) first step regarding CCM data analysis was started by open coding a single interview to establish categories and codes. These codes were then when further compared and analyzed with each other to determine if new information about a code or category was being uncovered or if old information was simply being repeated. The main aim of this first step of internal comparison was to establish the most appropriate codes and to "formulate the core message of the interview" (Boeije, 2002, p. 395). During this first stage, Boeije (2002) recommends asking the following questions about the data: "Which codes are used to label the categories in this particular interview? What characteristics do fragments with the same code have in common? What is the core message of this interviewee? Is the

storyline consistent? Are there any expressions that are contradictory? How are all the fragments related?" (p. 395). These questions were taken into consideration during the data analysis and the data were color coded in a separate table containing data from each individual interview according to theme/category.

Once the initial categories and codes were established, data analysis moved onto Boeije's (2002) second step of CCM data analysis. During this step, multiple interviews coded in the same way as step one are compared. Codes between the multiple interviews are analyzed, verified, combined, or added. In this step, codes often form patterns or natural groupings. The main aim of this second step is to conceptualize the subject and to discover the patterns formed by codes and the combinations of codes. During this second stage, Boeije (2002) recommends asking the following questions about the data: "Is interviewee A talking about the same category as B? What do both interviews tell us about the category? What are the similarities and differences between interviews A, B, C . . . ? What are the criteria underlying this comparison? What combinations of codes/concepts occur? What interpretations exist for this?" (p. 398). In this research, the color coded data fragments from each of the three individual interviews were analyzed, compared, and contrasted. The codes and categories were also modified and combined as necessary. The color coded data from each interview was cut and pasted into a master chart that included data from all three individual interviews under the appropriate categories/themes. Relevant supporting quotations were also noted for use in the discussion of the qualitative interview results.

Study Validity

Yin (2009) stresses the importance of having multiple sources of evidence when it comes to conducting research and analyzing data. The mixed methods research

design of this study included a quantitative questionnaire, and qualitative interviews. These sources of data contribute to a "development of converging lines of inquiry," which is a process of "triangulation and corroboration" (Yin, 2009, p. 115) that helps address the validity of a qualitative study.

Quantitative validity

Content validity is "evidence that the content of a test corresponds to the content of the construct it was designed to cover" (Field, 2009, p. 783). While the modified GEQ has not gone undergone a full validation study, the questionnaire does exhibit some preliminary evidence of validity including validity with respect to external variables and content validity.

Qualitative trustworthiness

When it comes to evaluating the quality of qualitative constructivist research, Lincoln and Guba (1985) propose that the traditional concepts of validity, reliability, and objectivity criteria are inadequate and that the concept of "trustworthiness" should be used instead. In their framework, credibility replaces internal validity, transferability replaces external validity, dependability replaces reliability, and confirmability replaces objectivity. The term trustworthiness refers to how researchers can convince their audience that their research and findings are worthwhile and worthy of attention. There are several ways researchers can address "trustworthiness" in their studies including triangulation, peer debriefing, and member checking. Other researchers such as Patton (2002) still consider validity and reliability as applicable to qualitative research. This *StarCraft 2* research followed Patton's (2002) guide to ensure reliability and "trustworthiness" by ensuring the data were correct via member checking during the qualitative interviews. The data were also member checked via email after the

interviews had been transcribed and emailed to the research participants. This research also had solid codes that underwent a systematic coding process and which did not shift after the finalized version had been developed. The validity of the qualitative data collected in this study was addressed by triangulating with the quantitative data and also by member checking. The study also made sure to collect rich, thick description and clarified researcher bias and subjectivity to ensure the highest level of validity and "trustworthiness" as possible.

Subjectivity Statement

Freely admitting and documenting researcher bias and subjectivity is important to research design. It is important to acknowledge the lenses and perspectives of this work examining the *StarCraft 2* course. That being said, I am a gamer and an advocate for using technology in teaching and learning. Digital game-based learning is an emerging instructional approach gaining increasing traction in mainstream education. Online education has also been maturing since the late 1990s to the point today where many educational institutions at all levels are offering online courses and degrees. I have been researching online education and DGBL over the past five years and have both taught and taken numerous online courses. This extensive experience with online education and DGBL has undoubtedly helped shape my advocacy for online learning and the harnessing of digital games in education.

My becoming an online and DGBL learning advocate can be traced to two major factors. The first factor was a lifelong love of digital games beginning with *Tetris* and *Pac Man* that soon gave way to SimCity and *Super Mario Bros.* as technologies improved. Playing the real-time-strategy (RTS) game *WarCraft 2* proved to be a watershed moment and led to a love of *StarCraft 1* and turn-based strategy games such

as the *Civilization* series. As digital gaming became more social and immersive, my interests in the medium continued with games such *World of Warcraft*, *Call of Duty*, *MindCraft*, and *StarCraft 2*. However, it was the *StarCraft* series and RTS genre in general that held a special place in my heart and had the most effect on my views and perspectives. The second factor which helped shape my online and DGBL advocacy was that I was an English education and Communications double major as an undergraduate, which led to a prolonged interest in education as well as recognition of the fast-paced nature of technology.

Undergraduate training in education and communications, two years of public school teaching experience, four years teaching at the college level, and a lifelong love of digital games have profoundly shaped my perspectives as an educator and I fully recognize the potential of technology. These factors inspired and facilitated the *StarCraft 2* course design, its implementation over multiple iterations, and the subsequent research of its effects on learners. This advocacy is a double-edged sword. On one hand it helped me create an innovative DGBL course which was offered for two years at a major research university. On the other, however, there is always the danger I may become too invested in DGBL and online learning's merits and become too much of a "cheerleader" and not enough of a pragmatic researcher. While some may be accused of viewing the world through rose-tinted glasses, I tend to see things from gamer-tinted glasses. I am bringing a passion for online and DGBL and a strong belief that they are viable ways to help empower learners to the table. However, it should always be remembered that I am also bringing a personal bias by being a staunch

advocate for these methods which will always influence my research perspective and the way I approach and design online and DGBL research.

Limitations of the Study

This research has several limitations.

1. The sample for the quantitative phase of the study was not truly random and the size was very small so results need to be interpreted accordingly and are not generalizable.

2. The sample contained only male participants. This was due to self-selection in registering for the course. One possible reason for the gender disparity is that more males play digital games in general and more males play RTS games like *StarCraft 1* and *StarCraft 2*. In this study, the researcher had no control over course enrollments.

3. The quantitative instrument used in this research did not undergo a full validation and reliability study. The instrument itself has been drastically modified. The original was designed for use in in-person sports teams, but for this research it was applied to an academic online DGBL course. Essentially, the *StarCraft 2* course has both a competitive game context, as well as an academic collaboration context, something that the original GEQ was not designed to address. The contexts, while having similarities also have many drastic differences. The extremely high level of modification is certainly a limitation.

4. The researcher is also the course instructor. This could potentially lead to bias in the data collection and analysis. In this study, there was no way around this. The *StarCraft 2* course is so specialized and content specific that no one else in the department had the expertise or the time to teach it.

Delimitations of the Study

This research has several delimitations that must be kept in mind.

1. The *StarCraft 2* course was designed specifically for Honors Program students. These students tend to be highly self-motivated, intelligent, and responsible and are a subset of the general undergraduate population. The results of this research cannot be generalized beyond the Honors Program context.

2. The course was designed around *StarCraft 2*, which is a very specific title in a very specific genre of digital game. Therefore, the course and the medium would only appeal to a very small part of the overall Honors Program population.

3. The course was offered online due to instructor time constraints. Students not used to taking online courses or those who disliked taking them would not want to enroll in the course.

4. The course content and research design heavily focused on collaboration and teamwork skills. This was because the researcher identified working with others was an extremely important skill for today's students to master if they are to succeed in the academic and professional worlds.

5. The course content and research followed constructivist and experiential learning perspectives which means other educational epistemologies and methods were not examined in depth.

The delimitations of this *StarCraft 2* course research were due to practical reasons. The formal course adoption process at the University was known to be extremely time-consuming and there was concern a course as innovative as the *StarCraft 2* course would be summarily dismissed and not considered. The Honors Program at the University had a reputation for innovative instruction, so it was deemed a better idea to approach them to gauge their receptiveness to the idea and if they were willing adopt the course on a more limited basis. The course was designed to be offered online because the Honors Program did not have many online offerings in their catalogue and the *StarCraft 2* course was conceived as a way to help address this. The focus on collaboration, teamwork, and team cohesion was because working with others was a skill identified by the course designer and researcher (who were informed by the literature) to be extremely important for students to master in order to succeed in the academic and professional worlds. The course and this research adopted constructivist and experiential learning perspectives because of the experiential nature of playing digital games, which encourages learners to constantly engage in the process of constructing meaning and understanding.

CHAPTER 4
RESULTS

Overview

This research used a mixed-methods approach to examine the following research question.

RQ: In what ways does participation in an online digital game-based course influence learners' perceptions of collaboration and team cohesion?

This chapter begins by presenting the quantitative and qualitative data. It then discusses how participation in the *StarCraft 2* course influenced learners' perceptions of collaboration and team cohesion based on the thematic framework that emerged. The quantitative data is embedded within this thematic framework and the results showed there was interplay between the quantitative and qualitative data. The thematic framework consisted of four main themes including: digital gaming and *StarCraft* experience, background and perspectives of collaboration, group functioning, and lessons learned. Finally, the chapter provides a summary of the results.

Quantitative Results

Quantitative research participants completed pre and post-test administrations of the modified GEQ which measured four different related constructs of team cohesion as noted in Table 4-1 below.

Participants responded to items using a 9-point Likert scale, with 1 representing "strongly disagree" and 9 representing "strongly agree." There were 15 items that were reverse-coded. The quantitative data was statistically analyzed using SPSS. Specifically, three statistical procedures were performed. First, a paired sample t-test was conducted for the modified GEQ pretest and posttest. Second, Pearson product-

moment correlation coefficients were also calculated to determine the correlations each of the four team cohesion factors of the GEQ had with learner characteristics such as digital game-play experience, *StarCraft 1*/*StarCraft 2* experience, GPA, and year in school. Third, a Pearson product-moment correlation coefficient was calculated to determine the correlation each of the four team cohesion factors had with each other as and to determine the validity of the modified GEQ.

Table 4-1. Constructs of team cohesion in the GEQ

Construct	Definition
Individual Attractions to the Group-Social (ATG-S)	Individual team member's feelings about his or her personal acceptance and social interactions with the group.
Individual Attractions to the Group-Task (ATG-T)	Individual team member's feelings about his or her personal involvement with the group's task, productivity, and goals and objectives.
Group Integration-Task (GI-T)	Individual team member's feelings about the similarity, closeness, and bonding within the team as a whole around the group's task.
Group Integration-Social (GI-S)	Individual team member's feelings about the similarity, closeness, and bonding within the team as a whole around the group as a social unit.

The quantitative part of this mixed-methods research had an extremely small sample of 6 participants, which is a serious research limitation. Three of the participants also participated in the individual qualitative interviews. The sample consisted of all male undergraduates and had an average of 11 years of digital game experience, 6.17 years of RTS game experience, and 4.17 years combined experience with *StarCraft 1* and *StarCraft 2*. Of the six participants, three were in their first year, two were in their second year, and one was in his fourth year. For this research, year in school was

assigned a numerical value (e.g. “1” for a first year student or “2” for a 2nd year student, etc.). When it came to academic majors, there were two computer science majors, one business management major, one chemical engineering major, one physics/mathematics major, and one nursing major.

Statistical analysis focused on using the modified GEQ to measure changes in research participants’ attitudes and perceptions of team cohesion as a result of participating in the *StarCraft 2* course. Paired samples t-tests for each of the four factors of the GEQ were conducted. Please refer to Table 4-2 below for t-test results. The pre-test scores (M = 49.33, SD = 6.44) and post-test scores (M = 54.17, SD = 7.57) did differ significantly with regards to individual attraction to group based on social interaction (ATG-S), t(5) = .-4.49, p = .006. The pre-test scores (M = 55.33, SD = 9.05) and post-test scores (M = 49.50, SD = 7.06) did not differ significantly with regards to individual attraction to group based on task (ATG-T), t(5) = -1.84, p = .126. The pre-test scores (M = 76.83, SD = 10.40) and post-test scores (M = 82.00, SD = 7.56) did not differ significantly with regards to group integration based on task (GI-T), t(5) = -1.64, p = .163. The pre-test scores (M = 15.17, SD = 2.32) and post-test scores (M = 14.17, SD = 2.93) did not differ significantly with regards to group integration based on social interaction (GI-S), t(9) = .577, p = .589.

Table 4-2. Compiled statistics for the modified GEQ

	Mean	N	Std. Deviation	t	df	p
GEQ PreATG-S	49.33	6	6.44	-4.49	5	.006
GEQ PostATG-S	54.17	6	7.57			
GEQ PreATG-T	55.33	6	9.05	1.84	5	.126
GEQ PostATG-T	49.50	6	7.06			
GEQ PreGI-T	76.83	6	10.40	-1.64	5	.163
GEQ PostGI-T	82.00	6	7.56			
GEQ PreGI-S	15.17	6	2.32	.577	5	.589
GEQ PostGI-S	14.17	6	2.93			

Analysis also included calculating the Pearson product-moment correlation coefficients for each of the team cohesion factors of the modified GEQ and learner characteristics such as digital gaming experience, GPA, and year in school. As with the paired samples t-test results, great care must be taken when interpreting the quantitative data since the sample size was so small. Please refer to Table 4-3 below for all the correlations. Group integration to the task (GI-T) had a significant correlation with *StarCraft 1/StarCraft 2* experience, $r = -.946$, $n = 6$, $p = .004$. There was also a significant correlation between RTS game experience and *StarCraft 1*/ *StarCraft 2* experience, $r = .836$, $n = 6$, $p = .038$. There was a significant negative correlation between individual attraction to group task (ATG-T) and year in school, $r = -.908$, $p = .012$. There was also a significant correlation between *StarCraft 1/StarCraft 2* experience and year in school, $r = .906$, $n = 6$, $p = .013$.

To partially address the validity of the data recorded by the modified-GEQ, this research's statistical analysis also focused on the correlation each of the four team cohesion factors had with each other. A Pearson product-moment correlation coefficient was calculated using the modified GEQ posttest to assess the relationship between each of the four aspects of team cohesion. Please refer to Table 4-4 below for documentation of all the correlations. The social cohesion aspects were not significantly correlated with each other. There was no significant correlation between ATG-S and GI-S, $r = .411$, $n = 6$, $p = .382$. The task cohesion aspects were also not found to be correlated with each other. There was no significant correlation between ATG-T and GI-T, $r = .528$, $n = 6$, $p = .282$.

Table 4-3. Correlations and descriptive statistics and factors of team cohesion

		GEQPost ATGS	GEQPost ATGT	GEQPost GIT	GEQPost GIS	Digital GameXP	RTSXP	SCXP	Year	GPA HS	GPA College
GEQPostATGS	Pearson Correlation	1	.320	.363	.441	.332	.238	-.218	-.132	-.437	-.083
	Sig. (2-tailed)		.537	.479	.382	.520	.650	.679	.804	.386	.876
GEQPostATGT	Pearson Correlation		1	.528	.779	.150	-.428	-.700	-.908*	.170	.784
	Sig. (2-tailed)			.282	.068	.776	.397	.121	.012	.747	.065
GEQPostGIT	Pearson Correlation			1	-.036	-.510	-.738	-.946**	-.746	-.400	.275
	Sig. (2-tailed)				.946	.301	.094	.004	.088	.433	.598
GEQPostGIS	Pearson Correlation				1	.649	.174	-.132	-.458	.311	.572
	Sig. (2-tailed)					.163	.742	.803	.361	.549	.235
DigitalGameXP	Pearson Correlation					1	.433	.400	.143	.592	.180
	Sig. (2-tailed)						.390	.432	.786	.216	.733
RTSXP	Pearson Correlation						1	.836*	.759	-.191	-.529
	Sig. (2-tailed)							.038	.080	.717	.281
SCXP	Pearson Correlation							1	.906*	.128	-.473
	Sig. (2-tailed)								.013	.810	.343
Year	Pearson Correlation								1	-.152	-.757
	Sig. (2-tailed)									.773	.082
GPAHighSchool	Pearson Correlation									1	.453
	Sig. (2-tailed)										.367
GPACollege	Pearson Correlation										1
	Sig. (2-tailed)										

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

There was no significant correlation between ATG-T and GI-S, r = .779, n = 6, p = .068. There was also no significant correlation between GI-T and GI-S, r = -0.36, n = 6, p = .946. There was no significant correlation found between ATG-S and ATG-T, r = .320, n = 6, p = .537. Finally, There was also no correlation found between ATG-S and GI-T, r = .363, n = 6, p = .479.

Table 4-4. Correlations between the four separate aspects of team cohesion

		GEQ PreATG-S	GEQ PreATG-T	GEQ PreGI-T	GEQ PreGI-S
GEQ PreATG-S	Pearson Correlation	1	.320	.363	.411
	Sig. (2-tailed)		.537	.479	.382
GEQ PreATG-T	Pearson Correlation		1	.528	.779
	Sig. (2-tailed)			.282	.068
GEQ PreGI-T	Pearson Correlation			1	-0.36
	Sig. (2-tailed)				.946
GEQ PreGI-S	Pearson Correlation				1
	Sig. (2-tailed)				

As the Pearson product-moment correlations clearly indicated, the 4 individual factors of the modified GEQ were not found to be statistically significant. Ideally, the two social aspects of team cohesion should have been correlated with each other and the two task aspects of team cohesion should have been correlated to each other. It is important to note this since it means there are serious quantitative concerns with the instrument used in this study. Since both the task-based constructs and the social-based constructs are not significantly correlated with each other even though they should be, this brings up serious issues of internal consistency and validity. This severe limitation

must always be considered when taking into consideration the conclusions, interpretations, and discussions of the quantitative data of this study.

Although the sample size (N = 6) was extremely small, the reliability of the scores of the modified GEQ was still calculated. While the results were not generalizable, they still can help provide some insight into the effectiveness of the modified GEQ. With regards to reliability, the original GEQ's Crohnbach alpha values are as follows: ATG-T α = .75, ATG-S α = .64, GI-T α = .70, GI-S α = .76. The modified GEQ pilot test analysis resulted in mixed Crohnbach alpha values compared to the original values as shown by the following: ATG-T α = .28, ATG-S α = .63, GI-T α = .84, GI-S α = .09. As seen from the statistics, the modified GEQ for this research had values close to the original regarding ATG-S and GI-T, but the values were not close for ATG-T or GI-S. This is probably because of the extremely small sample size or the large number of reverse worded items which accounted for approximately half of the instrument, and means the instrument shows no signs of being reliable during the administration in this research.

Data analysis revealed only a statistically significant positive effect with regards to the ATG-S aspect of team cohesion. Analysis revealed that research participants' attitudes and perceptions towards the social aspects of collaboration and team cohesion were most changed by participation in the *StarCraft 2* course. However, it can still be helpful to examine items from the other aspects of team cohesion and to note the increases and decreases in mean scores between the pretest and the posttest broken down by team cohesion construct and individual item. Table 4-5 below for the means and standard deviations of all items for both the pretest and posttest administrations of the modified GEQ.

Table 4-5. Means and standard deviations of the pretest and posttest modified GEQ

ATG-S		Pretest		Posttest	
		M	SD	M	SD
Item 1	Overall, I do not enjoy engaging in the game-related social interactions (e.g. Skype/Facebook conversations, planning sessions, collaborative game play) of this group.*	2.00	1.09	1.67	0.82
Item 2	Overall, I do not enjoy engaging in the academic social interactions (e.g. group projects, planning meetings, Skype/Facebook conversations) of this group.*	2.33	1.75	1.67	0.82
Item 4	I am not open to continuing to play collaboratively with my group after the course ends.*	3.33	1.63	3.17	1.94
Item 7	I have made some good friends in this group.	5.83	1.94	6.50	1.64
Item 8	I am open to staying in contact with members of my group after the course ends.	6.83	1.83	7.17	1.60
Item 11	I prefer to play collaboratively with my group members rather than collaboratively with people not in my group.	4.83	2.86	6.00	2.83
Item 12	I enjoy working with my current group members in this course more than working with other groups.	5.50	2.81	5.83	2.14
Item 15	During this semester, this group is a meaningful social group to me.	4.17	1.83	5.17	1.72
ATG-T					
Item 3	Overall, I do not do my best at being personally involved and committed during group game play.*	1.50	0.55	4.00	3.52
Item 5	I am unhappy with my group's desire to win games.*	1.17	0.41	1.83	1.17
Item 6	I am personally invested in helping my group win games.	7.33	2.25	6.17	3.31
Item 9	This group does not give me enough opportunities to improve my personal game-play skills.*	2.67	2.42	2.33	1.03
Item 10	This group does not give me enough opportunities to improve my collaborative skills.*	1.67	1.21	2.83	2.14
Item 13	Overall, I do not like the work style (e.g. communication, planning, time management) of this group.*	2.83	2.23	3.00	1.55
Item 14	Overall, I do not like the play style (e.g. communication, competitiveness, strategies) of this group.*	2.17	0.98	2.00	0.89
GI-T					
Item 16	Our group is united in trying to achieve its goals for game play.	7.50	1.05	7.67	1.51
Item 17	Our group is united in trying to reach its goals for academic performance.	7.83	1.17	8.33	0.82
Item 19	We all take responsibility for losing any game.	7.33	2.34	8.00	1.67
Item 20	We all take responsibility for any performance that is below expectations on submitted group work.	7.50	1.97	8.00	1.67
Item 22	Our group members have conflicting expectations for the group's game play performance.*	3.50	1.64	1.33	0.52

Table 4-5. Continued

ATG-S		Pretest		Posttest	
		M	SD	M	SD
Item 23	Our group members have conflicting expectations for the group's academic performance.*	1.83	0.98	1.17	0.41
Item 25	If members of our group have problems during game play, other members are willing and wanting to help.	8.00	0.89	8.17	1.17
Item 26	If members of our group have problems during academic projects, other members are willing and wanting to help.	7.67	1.75	8.33	0.82
Item 27	Members of our group do not communicate openly about each member's responsibilities regarding game play.*	3.00	2.61	2.17	1.17
Item 28	Members of our group do not communicate openly about each member's responsibilities regarding academic projects.*	2.67	2.73	1.83	1.33
GI-S					
Item 18	Members of our group would rather play collaboratively with non-group members than play together as a group.*	3.50	1.76	3.67	1.86
Item 21	Our group members rarely socialize together outside of the course.*	7.33	1.21	8.00	1.26
Item 24	Our group is open to spending time together inside or outside of the game after the course is over.	6.00	0.89	5.83	1.72

*Items must be reverse scored

These items, while not yielding any significant statistical results, nevertheless can help shed light on some of the ways participation in the *StarCraft 2* course affected research participants with regards to their attitudes and perceptions towards collaboration and team cohesion. Please refer to

The data analysis revealed a statistically significant positive effect only with regards to the social aspect of team cohesion (ATG-S). Examination of the research participant's responses to individual items measuring all four team cohesion constructs—even if the differences in means were not significant—can still help provide a more comprehensive glimpse at the collaboration and team cohesion dynamics within the research participants' groups during the *StarCraft 2* course. Looking at the actual items

can help provide a more nuanced perspective of the research participants' attitudes and perceptions of collaboration and team cohesion that is not visible when only looking at the overall results of the t-tests and Pearson product-moment correlation calculations.

When it came to research participants' individual social attraction to group (ATG-S), Item 1 asked participants to agree or disagree with the following statement: "Overall, I do not enjoy engaging in the game-related social interactions (e.g. Skype/Facebook conversations, planning sessions, or collaborative game play) of this group." There was a decrease in the means between the pretest (M = 2.00, SD = 1.09) and the posttest (M = 1.67, SD = 0.82). Since this item was reverse-coded, the decrease in means actually meant that participants reported an increase in their enjoyment in engaging in the social interactions with their group. Item 7 asked participants to agree or disagree with the following statement: "I have made some good friends in this group." There was an increase in the means between the pretest (M = 5.83, SD = 1.94) and the posttest (M = 6.50, SD = 1.64). Item 8 asked participants to agree or disagree with the following statement: "I am open to staying in contact with members of my group after the course ends." There was an increase in the means between the pretest (M = 6.83, SD = 1.83) and the posttest (M = 7.17, SD = 1.60). Item 15 asked participants to agree or disagree with the following statement: "During this semester, this group is a meaningful social group to me." There was a positive increase in the means between the pretest (M = 4.17, SD = 1.83) and the posttest (M = 5.17, SD = 1.72).

When it came to research participants' individual task-based attraction to group (ATG-T), Item 3 asked participants to agree or disagree with the following statement: "Overall, I do not do my best at being personally involved and committed during game play." There was an increase in the means between the pretest (M = 1.50, SD = 0.55)

and the posttest (M = 4.00, SD = 3.52). Since this item was reverse-coded, the increase in means actually meant that participants reported a decrease in their personal involvement related to the task with their group. Item 5 asked participants to agree or disagree with the following statement: “I am unhappy with my group’s desire to win games.” There was an increase in the means between the pretest (M = 1.17, SD = 0.41) and the posttest (M = 1.83, SD = 1.17). Since this item was reverse-coded, the increase in means actually meant that participants reported a decrease in their personal happiness related to the game-related task undertaken by their group. Item 13 asked participants to agree or disagree with the following statement: “Overall, I do not like the work style (e.g. communication, planning, time management) of this group.” There was an increase in the means between the pretest (M = 2.83, SD = 2.23) and the posttest (M = 3.00, SD = 1.55). Since this item was reverse-coded, the increase in means actually meant that participants reported a decrease in their personal happiness related to the academics-related tasks undertaken by their group. However, it is important to note in this item that there was a difference in the research participants’ perspectives of the game-related tasks and academics-related tasks. Item 14 asked participants to agree or disagree with the following statement: “Overall, I do not like the work style (e.g. communication, competiveness, strategies) of this group.” There was a decrease in the means between the pretest (M = 2.17, SD = 0.98) and the posttest (M = 2.00, SD = 0.89). Since this item was reverse-coded, the decrease in means actually meant that participants reported an increase in their personal happiness related to the game-related tasks undertaken by their group.

When it came to research participants’ perceptions of their group integration based on task (GI-T), Item 17 asked participants to agree or disagree with the following

statement: “Our group is united in trying to reach its goals for academic performance.” There was an increase in the means between the pretest (M = 7.83, SD = 1.17) and the posttest (M = 8.33, SD = 0.82). Item 22 asked participants to agree or disagree with the following statement: “Our group members have conflicting expectations for the group’s game play performance.” There was a decrease in the means between the pretest (M = 3.50, SD = 1.64) and the posttest (M = 1.33, SD = 0.52). Since this item was reverse-coded, the decrease in means actually meant that participants felt they had fewer conflicting expectations related to game-play tasks at the end of the course compared to the beginning. Item 23 asked participants to agree or disagree with the following statement: “Our group members have conflicting expectations for the group’s academic performance.” There was a decrease in the means between the pretest (M = 1.83, SD = 0.98) and the posttest (M = 1.17, SD = 0.41). Since this item was reverse-coded, the decrease in means actually meant that participants felt they had fewer conflicting expectations related to academics-related tasks at the end of the course compared to the beginning.

When it came to research participants’ perceptions of their group integration based on social interaction (GI-S), Item 21 asked participants to agree or disagree with the following statement: “Our group members rarely socialize together outside of the course.” There was an increase in the means between the pretest (M = 7.33, SD = 1.21) and the posttest (M = 8.00, SD = 1.26). Since this item was reverse-coded, the increase in means actually meant that participants reported a decrease in their socializing outside of the *StarCraft 2* course. Item 24 asked participants to agree or disagree with the following statement: “Our group is open to spending time together inside or outside of the

game after the course is over." There was a decrease in the means between the pretest (M = 6.00, SD = 0.89) and the posttest (M = 5.83, SD = 1.72).

Qualitative Results

Qualitative data analysis revealed four main themes and 18 related subthemes which helped describe the research participants' collaborative experiences in the *StarCraft 2* course, their perceptions of working with others, and their attitudes towards team cohesion. These four main themes formed a thematic framework. As shown in Figure 4-1 below, the quantitative data was embedded within this framework and there was interplay between the quantitative and qualitative data with regards to digital gaming and StarCraft experience and Background and perspectives of collaboration.

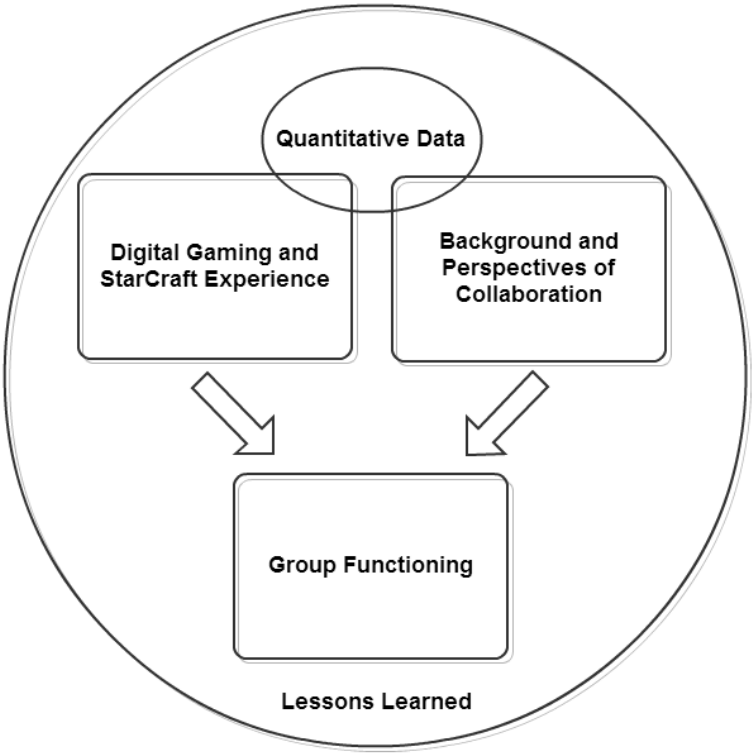

Figure 4-1. Thematic framework and interplay between quantitative and qualitative data.

Analysis also showed that the three qualitative research participants had extensive experience playing digital games and generally had high GPAs both in high

school and in college. Alex was a first-year computer science major with an approximate high school GPA of 3.72 and a hopeful approximate college GPA of 4.0. (This participant was in his first semester of his first year at the time of the *StarCraft 2* course so he did not have any final grades on his transcripts.) This participant had played digital games for approximately 13 years, real-time strategy (RTS) games for 7 years, and *StarCraft 2* for 1 year. Ben was a second-year chemical engineering major with an approximate high school GPA of 4.0 and an approximate college GPA of 4.0. This participant had played digital games for approximately 11 years, RTS games for 9-10 years, and *StarCraft 1* and *StarCraft 2* for a combined 9-10 years. Caleb was a fourth-year computer science major with an approximate high school GPA of 4.0 and an approximate college GPA of 3.0. This participant had played digital games for approximately 15 years, RTS games for 15 years, and *StarCraft 1* and *StarCraft 2* for a combined 8-9 years.

The figure mentioned earlier in Figure 4-1 shows the four major themes which emerged from the data and which helped explain research participants' perceptions of and attitudes towards collaboration and team cohesion. It is important to note in the thematic framework how three of the main themes closely influenced each other while the fourth more generally explained the research participants' experiences of and attitudes towards collaboration in the course. "Digital Gaming and *StarCraft* Experience" focused on the participants' digital gaming and *StarCraft* experience. "Background and Perspectives of Collaboration" focused on the participants' prior attitudes and experiences with collaboration. Together, these two themes seemed to explain the forces and factors defined by a third theme, "Group Functioning," which focused on how participants' groups actually functioned and communicated during the *StarCraft 2* course. The interaction and relationship between these three themes was explained and

interpreted by a fourth theme called “Lessons Learned,” which describes what the qualitative research participants felt they learned overall from the course and their collaborative *StarCraft 2* game play. From the four major themes, 18 related subthemes emerged from the data. Table 4-6 below shows all four major themes and their 18 related subthemes.

Table 4-6. Main qualitative themes and subthemes.

Main Theme	Sub Themes
Digital Gaming and *StarCraft* Experience	Digital gaming experience *StarCraft* experience and skill level Gaming and the real world Digital games as exploratory environments
Background and Perspectives of Collaboration	Digital gaming and collaboration Personal preferences of teamwork/collaboration Experience/exposure to collaboration/teamwork Definition and characteristics of teamwork/collaboration Perceived benefits of collaboration
Group Functioning	Group dynamics Group communication processes Leadership Team/group role Task/responsibility delegation Group frustration
Lessons Learned	Learning collaboratively vs. learning alone Learning to collaborate and communicate

As this was a mixed-methods research study, the research question was answered using both quantitative and qualitative data. Table 4-7 on the next page below shows the sources of quantitative and qualitative data.

Integration of the Quantitative and Qualitative Data

Overall, participation in the *StarCraft 2* course did influence learners' perceptions of collaboration and team cohesion. There was interplay between the quantitative and qualitative data within the thematic framework.

Table 4-7. Research question and data sources

Research Questions	Data Source
RQ: In what ways does participation in an online digital game-based course influence learners' perceptions of collaboration and team cohesion?	Quantitative 1. Paired samples T-test results 2. Discussion of means and SD of non-significant items to inform understanding of the qualitative data Qualitative Themes and Subthemes 1. Lessons Learned a. Learning collaboratively vs. learning alone b. Learning to collaborate and communicate 2. Group Functioning a. Group dynamics b. Group communication processes c. Leadership d. Team/group role e. Task/responsibility delegation f. Group frustration 3. Digital Gaming and *StarCraft* Experience a. Digital gaming experience b. *StarCraft* experience and skill level c. Gaming and the real world d. Digital games as exploratory environments 4. Personal Background/Perspectives of Collaboration a. Digital gaming and collaboration b. Personal preferences of teamwork/collaboration c. Experience/exposure to collaboration/teamwork d. Definition and characteristics of teamwork/collaboration e. Perceived benefits of collaboration f. Perceived benefits of collaboration

Please refer to Figure 4-1 earlier in the chapter for a visual representation of the thematic framework. Quantitative data analysis revealed some preliminary evidence that participation in the *StarCraft 2* course did have a statistically significant influence on the quantitative research participants' attitudes and perceptions towards social aspects of collaboration and team cohesion. Results of the paired samples t-tests showed that the pre-test scores (M = 49.33, SD = 6.44) and post-test scores (M = 54.17, SD = 7.57) differed significantly with regards to individual attraction to group based on social interaction (ATG-S), t(5) = .-4.49, p = .006. The qualitative data supported and elaborated and on these findings to provide a more detailed account of the collaborative processes and interactions occurring during the course and during the collaborative group game-play. Specifically, qualitative data analysis revealed four main themes and 18 related subthemes—shown earlier above in Table 4-7—that helped explain the quantitative and qualitative research participants' experiences and perspectives.

Both the quantitative and qualitative data indicated that participation in an online digital game-based course influenced the research participants' perceptions of collaboration and team cohesion. The quantitative analysis showed preliminary evidence of a statistically significant positive change in participants' personal perceptions and attitudes towards their social attraction to their group. The qualitative data reflected this focus on the social aspect but also provided more information on the research participants' perceptions of the task-based aspects of collaboration and team cohesion which were not indicated as significant in the quantitative data. While the usefulness of the quantitative data was limited due to the small sample size, the qualitative emphasis of this mixed-methods research meant that the qualitative interviews partially made up for this by providing a second source of rich data. The themes and subthemes which

emerged from the qualitative interviews proved to be extremely helpful in helping inform understanding of many of the complex interrelated social processes and team cohesion dynamics present in the qualitative research participants' groups. While the quantitative data provided a vague outline of the collaborative processes that were occurring in these groups, the qualitative data helped provide a more complete picture of the collaboration and team cohesion in the *StarCraft 2* course. The three qualitative research participants were given the pseudonyms Alex, Ben, and Caleb.

Digital Gaming and *StarCraft* Experience

This was the first of the four major themes that emerged from the qualitative data. Alex, Ben, and Caleb's digital gaming and *StarCraft* experience was one of two major factors that influenced how they and their groups functioned and communicated during the *StarCraft 2* course. Please refer to Figure 4-1 presented earlier in the chapter for a visual representation of the relationship between the four major themes. Participants with more experience playing *StarCraft 1* and *StarCraft 2*—and RTS games in general—tended to take on or were placed in leadership and mentorship roles in their groups while those with less experience were more comfortable following advice and seeking guidance. Alex, Ben, and Caleb noted how mastery and experience in RTS games and *StarCraft 1* and *StarCraft 2* specifically seemed to automatically mean the more experienced players became leaders of their groups. Alex specifically noted this from the perspective of a less experienced player and Caleb noted it from the perspective of a more experienced player who was made leader because of his prior gaming history. This dynamic played a significant role in how the small groups functioned. This main theme had four subthemes: "Digital Gaming Experience," "*StarCraft* Experience and Skill Level," "Gaming and the Real World," and "Digital Games as Exploratory Environments."

Digital gaming experience

Extensive digital gaming experience was a characteristic that the participants shared. While all three participants had extensive digital gaming experience, there was a significant level of variation in the types and genres of games they played. Alex reported playing on a PC as well as on a wide range of gaming systems such as Nintendo GameCube, N64, Wii, PS3, and Xbox 360. Alex also remembered playing educational games in school and reported a special affinity for games in the real-time strategy (RTS) genre, multiplayer online battle arena (MOBA) genre, and the massively multiplayer online role-playing game (MMORPG) genre. He admitted to liking the fun and enjoyable aspects of digital games. While he had limited *StarCraft 2* experience, his past experience with other RTS games helped make the learning curve less steep. Some of the digital game titles this participant specifically reported playing in addition to *StarCraft 2* included *League of Legends*, *Rise of Nations*, *Age of Empires*, and *Age of Mythology*. Ben reported liking role-playing games, strategy games, and indie games, but only a couple of RTS games. He stated digital games were his primary form of entertainment and—similar to Alex—also noted he got great satisfaction from playing. Some of the digital game titles this participant specifically reported playing in addition to *StarCraft 2* included *StarCraft 1*, *Endless Space,* and *Age of Empires*. Caleb identified themselves as being a primarily PC gamer who tended to focus on role-playing games as well as RTS games. He did report some limited experience with console-based role-playing games. Unlike the other two participants, who seemed to focus more on the casual and enjoyment aspects of digital games, Caleb played RTS games on a more competitive level. Some of the digital game titles this participant specifically reported playing in

addition to *StarCraft 2* included *StarCraft 1, Mass Effect*, *Dragon Age*, *Final Fantasy*, *WarCraft 1*, and *WarCraft 3*.

Prior experience with real-time (RTS) strategy games was especially important for the less experienced *StarCraft 2* players. Quantitative data analysis showed there was a significant correlation between RTS game experience and *StarCraft 1*/ *StarCraft 2* experience, $r = .836$, $n = 6$, $p = .038$. One way to see this is that the qualitative data supported the assertion that prior RTS game experience helped provide guidance and a frame of reference for playing *StarCraft 2*. Alex and Ben mentioned they had played the RTS game *Age of Empires* in the past and Caleb had played the RTS game *WarCraft 3* competitively. Prior digital game-play experience and familiarity with the real-time strategy (RTS) game genre in particular helped one participant who was inexperienced with *StarCraft 2* master the unfamiliar game.

> [RTS experience] definitely sped up my process of learning in the game because I mean, from RTS to RTS most of it's the same. You can drag to select multiple units and you right click to send them somewhere. But a lot of the finer things, like control click and stuff like that, that's what I had to get used to. But I mean, mostly my prior experience with RTS made the learning curve a lot easier (Alex, personal communication, December 3, 2012).

For Alex, recognition of his own inexperience with *StarCraft 2* even though he had a significant amount of digital game-play experience and had played RTS games before caused him to take a more passive role in his group during the course.

> You guys are way better than I am. So you guys basically just tell me what to do and I'll follow that. And that kind of became my role in the *StarCraft* group to a little bit of a greater extent. That helped me assume, "Ok, they know more than I do, so I should follow them while trying to learn how to form my own strategy and plan. I know I'm not ready to assume that sort of leader position (Alex, personal communication, December 3, 2012).

Like Alex, Caleb also noted he lacked experience with *StarCraft 2*, but was very familiar with the RTS genre. Similar to Alex, this familiarity with the RTS genre in general also influenced Caleb's role in his small group during the course—although he ended up taking a much different group role when compared to Alex.

> For real-time strategy games I say I would be very experienced. I've played *WarCraft 3* competitively for a couple of years, but for *StarCraft* I've never really put as much time into it so I'm kind of new to the game. But I'm very familiar with the mechanics of the real-time strategy genre (Caleb, personal communication, December 17, 2012).

Although he had limited *StarCraft 2* experience, Caleb was still regarded as an expert in the game by his group because of his extensive prior experience playing other RTS games competitively. Partially due to the other members of his group being even more inexperienced with *StarCraft 2* and RTS games in general, this perception of being an expert led to Caleb being placed in a leadership role in his group. Alex and Caleb's responses showed how their prior digital game and RTS experience did influence each individual's attitudes and experiences towards collaboration in the *StarCraft 2* course—albeit in two very different ways. Prior digital game experience—RTS experience in particular—obviously helped provide some degree of scaffolding for the quantitative and qualitative research participants as they learned in the course.

StarCraft experience and skill level

Quantitative data analysis showed preliminary evidence that *StarCraft 1*/*StarCraft 2* experience and skill level had a significant negative correlation with the Group Integration to the Task (GI-T) aspect of team cohesion, $r = -.946$, $n = 6$, $p = .004$. This negative correlation provided evidence there was wide variation in *StarCraft 1*/*StarCraft 2* skill level amongst the quantitative research participants which influenced how well they perceived their collaborative groups were integrated according to the task. (Note GI-T

describes how individuals feel about how well their groups are integrated according to task, while GI-S describes how individuals feel well their groups are integrated according to social interaction.) The differences in skill level could have meant that more experienced players felt frustrated with their less experienced group mates because they always had to provide guidance and support. Conversely, the less experienced players tended to like working with their more experienced group mates because they were the ones receiving a significant amount of support and guidance. The more experienced players tended to feel that their group was not well integrated based on the task while the less experienced players tended to feel the opposite because of the support they were receiving. From their perspective everything was going well because they did not know any better, while the more experienced players were able to see the weaknesses in the group's performance of the task. These opposite perspectives could certainly have caused the negative correlation between *StarCraft 1*/*StarCraft 2* experience and Group Integration to the Task (GI-T).

Interviews with the qualitative research participants supported this. All three participants had significant digital gaming experience. While all had prior experience with RTS games, they differed greatly in their familiarity with *StarCraft 2.* This had implications for their perceptions of and experiences with collaboration/teamwork and group functioning. Alex was aware of how *StarCraft 1*/*StarCraft 2* skill level could affect group collaboration and collaborative group game-play. "Yeah, especially with our specific group dynamic. I think it would have been different if we had all been at the same skill level" (Alex, personal communication, December 3, 2012). Alex stated he had only limited experience with *StarCraft 2* and that he was first exposed to it at a friend's house. During the random assignment of groups in the course, Alex was paired with one

player who was closer to the same skill level and another one with significantly more experience with the game. He was very aware of his inexperience and made efforts to improve his skills so as to not bring his team down during matches. He reported being nervous at first, but became more comfortable after finding out he was not the only relatively inexperienced player on the team. Alex noted that the disparity in *StarCraft 2* skill level resulted in the more experienced player of the three assuming a leadership and teacher role in the group. Ben reported he played through the single-player mode of *StarCraft 1* and participated in multiplayer matches when he had time. However, he had less experience with *StarCraft 2* since it was first released right when he started college. This participant said his experience with both *StarCraft 1* and *StarCraft 2* helped him be able to focus more on the teamwork and collaboration aspects of the *StarCraft 2* course since he did not have to spend a lot of time learning how to play the game. Caleb had extensive experience with *StarCraft 1,* but had less experience with *StarCraft 2*. Whereas Alex was the least experienced member of the group and had to rely on others for guidance, Caleb was the most experienced in his group. He had extensive experience with RTS games and some experience with *StarCraft 2*. The group relied on Caleb's leadership and help in learning and executing strategies and tactics since that member had a clearer understanding of the game. Caleb noted the leadership role he took on in during the digital game-play also extended to the academic part of the course and he found himself taking charge of coordinating assignments.

Gaming and the real world

One of the advantages of a mixed-methods study is that the qualitative data collected can provide a richer and more complete picture than if only quantitative data was used alone. Two of the three qualitative research participants specifically noted the

relationship between digital gaming and the real world. Alex was especially interested in the *StarCraft 2* course because of his own digital gaming experience as well as digital gaming's implications for real life.

> I've experienced that cross-over knowledge you gain from playing the video game and applying that in real-world situations normally, like on a small scale, so I was intrigued in finding out how this could apply on a larger scale, like in actual, micro/macro management and resource management and all that (Alex, personal communication, December 3, 2012).

Alex said he was certainly able to recognize the importance of the *StarCraft 2's* micro/macro management skills and relate them to real-world contexts. Like Alex, Ben also clearly saw a connection between digital gaming, *StarCraft 2*, learning, the application of learning, and the real world.

> I think it emphasizes the thought process exceptionally beyond any other form of recreation beyond reading or something. It allows for application of learning and learning simultaneously and it, I think given the right choice of game, it's very provocative to your, development—your intellectual development (Ben, personal communication, December 10, 2012).

Digital games as exploratory environments

All three participants saw digital games as spaces and opportunities where they could explore and experiment and this affected how they approached and viewed the collaborative game-play component of the *StarCraft 2* course. They saw how the exploratory nature of *StarCraft 2* encouraged experimentation and provided a safe environment for failure as they engaged in the collaborative game-play of the course. Alex highlighted the exploratory and iterative nature of digital games and *StarCraft 2* in particular since they allow players to learn from past mistakes and apply those lessons to future game-play.

> There were moments when there was a little bit of frustration among group members, oh, "why didn't you put the supply depots up or something like that." But, most of the time it was" just ok, shake it off, we'll play, we'll do better next game" (Alex, personal communication, December 3, 2012).

Ben also noted the iterative property of digital games and saw them as safe places to fail and make mistakes because the consequences do not extend to the real world.

> I enjoy problem solving challenges, especially when failure isn't, consequential and you're allowed to experiment. I like experimenting because I always make silly mistakes and then I'm able to correct them over time. I'm mistake prone, so video games are very…I like them for that reason, you can experiment with thoughts and experiment with ideas and if you mess something up, just do it again, and do it again and do it again until you have perfected the thing. The lack of consequences allows for free thinking (Ben, personal communication, December 10, 2012).

Caleb did not specifically mention digital games as spaces for experimentation, but nevertheless hinted at some of the exploratory freedom these environments can provide and the experimental approaches they can foster. For him, the exploratory environment of *StarCraft 2* allowed his group to work on different strategies together and to try them out.

> Towards the end we were communicating and timing, our schedules to achieve the goal academically and in the game where we're working together and timing our strategies around each other as opposed to "I'll do this and you do that and we'll just see if it works (Caleb, personal communication, December 17, 2012).

Background and Perspectives of Collaboration

Participants' background and perspectives of collaboration was the second of two major themes that helped explain and also influenced how participants' groups actually worked and functioned during the *StarCraft 2* course. All three qualitative research participants came into the course with prior experience working in groups at the high school and college level. These previous collaborative experiences helped shape their personal perspectives about working with others even before they enrolled in the course and continued to do so throughout the time they were taking it. This main theme had six subthemes: "Digital Gaming and Collaboration," "Personal Preferences of Teamwork and Teamwork/Collaboration," "Experience/exposure to Collaboration/Teamwork," "Definition

and Characteristics of Teamwork/Collaboration," and "Perceived Benefits of Collaboration."

Digital gaming and collaboration

While only Alex specifically linked digital gaming in general with collaboration, it still proved to be a notable subtheme. He noted the difference between working together with others in a traditional professional context and working together with fellow players in a digital game environment. The urgency and fast-paced nature of the *StarCraft 2* environment actually acted as a catalyst that accelerated collaboration.

> It sort of sped up the collaborative process, because most of the time, when you work with a group in a professional environment, you have a long term goal, like, ok, "you have one week to assemble all these papers and blah blah blah blah blah. But here you have 20 minutes to win. Go." And it's that fast-paced instant collaboration that's like, "ok we have to work together, and we have to get to know each other or else we're going to lose" (Alex, personal communication, December 3, 2012).

It is clear this participant felt that both the digital game environment and the process of playing the game influenced how players worked together and collaborated. He felt the ever-present risk of losing and the fast-paced nature of many digital games—where groups must solve problems and reach goals in a limited amount of time and in a pressured environment—both helped contribute to a collective feeling of needing to work together. Speaking to the urgent necessity of working together in complex digital games, Alex pointed out, "I think gaming just has that kind of effect where all the short term goals force you to work as a team" (Alex, personal communication, December 3, 2012).

Personal preferences of teamwork/collaboration

All three participants expressed personal preferences about teamwork and collaboration. Alex stated he was very open to collaboration, enjoyed communicating with others, and liked working towards a common goal even if all group members weren't

equally capable of the task. If this was ever the case, he was also willing to help those members and work with them. Ben stated he used to dislike teamwork and collaboration up until his senior year in high school. However, since starting college, he has had the opportunity to work collaboratively during a summer internship. This experience and the *StarCraft 2* course showed him "collaboration's actually exceptionally useful and very good when, with people who are as motivated to accomplish what you want to accomplish" (Ben, personal communication, December 10, 2012). Like Alex, Caleb also stressed he really liked working with others and saw some distinct benefits of collaboration.

> I do like having a team to work with since if you're feeling down or if you're getting distracted a lot they can help you keep focused and you can do the same to them. And if you're stuck on a problem you can kind of bounce ideas off each other to help resolve the problems, since a group of people will always have more ideas than an individual (Caleb, personal communication, December 17, 2012).

Alex also said his affinity towards working with others helped nurture and facilitate the overall collaboration and teamwork dynamic in his own small group. This preference for group work also helped him have a positive experience working with his assigned group in the *StarCraft 2* course.

Experience/exposure to collaboration/teamwork

In addition to participants' individual preferences on working with others, their prior experiences/exposure to collaboration/teamwork also influenced their overall perspectives, attitudes, and experiences in the *StarCraft 2* course. The quantitative data analysis indicated preliminary evidence there was a significant negative correlation between individual attraction to group task (ATG-T) and year in school, $r = -.908$, $p = .012$. These quantitative findings indicated that similar to the *StarCraft* experience gap

between the quantitative research participants, there was also a college-level collaboration experience gap. The quantitative research participants with more college experience measured by year in school felt less personal attraction towards their group based on the task while the participants with less college experience felt more personal attraction towards their group based on the task. This negative correlation may be because the quantitative research participants with less college experience only had relatively negative high school experiences to draw upon while the participants with more college experience could remember more favorable college-level experiences during their undergraduate coursework. The more experienced and older college students with strong college—level collaborative skills may have felt a level of frustration towards group mates with lesser college collaboration experience and fewer college-level collaboration skills. Conversely, the less experienced and younger college students—students with less developed college-level collaborative skills—may have felt that working in a college-level collaborative environment with more responsible group mates was a hugely positive change from dealing with the irresponsible high school groups to which they were accustomed.

The qualitative data supports this view and showed that the three qualitative research participants varied with regards to college-level collaboration experience. Alex was a first year, first semester student and reported a significant amount of collaboration experience in the school setting and in the digital gaming setting, but not much at the college level. He mentioned how working with his group in the *StarCraft 2* course was similar in some ways to his experience in his chemistry lab where he was assigned to work with two other students. Alex noted while the introductory foundational courses of his computer science program were centered on individual work, the *StarCraft 2* course

was “kind of like, being thrust into this class where it’s like, ‘ok, well, you’ve either played *StarCraft* on your own or you haven’t but you’re going to collaborate now’” (Alex, personal communication, December 3, 2012). Being a first year, first semester student meant that Alex had the least amount of college-level collaboration of the three qualitative research participants.

Ben also had prior experience with collaboration and teamwork. He had some limited experience working in groups as part of other college courses and also gained collaboration experience during a summer internship. Ben recalled some negative experiences with collaboration in high school where unmotivated group members failed to complete their assigned work which left the participant to complete all the work alone. However, Alex also noted his collaboration experiences in college have generally been more positive since group members have been more willing to do quality work. This led to a more positive collaborative experience in the *StarCraft 2* course. The course also helped him determine and evaluate his leadership skills. Similar to Alex, Caleb tended not to enjoy working in groups in high school because there seemed to always be difficulties getting group members to complete their assigned tasks. In contrast to high school, this participant’s experience in college has been much more positive. Like Alex, he also recognized the benefit of working with others.

> I do like having a team to work with since if you’re feeling down or if you’re getting distracted a lot they can help you keep you focused and you can do the same to them. And if you’re stuck on a problem you can kind of bounce ideas off each other to help resolve the problems, since a group of people will always have more ideas than an individual (Caleb, personal communication, December 17, 2012).

Caleb said that he had a very positive collaborative experience in the *StarCraft 2* course and that he now looks forward to working collaboratively with others.

Definition and characteristics of collaboration/teamwork

Each of the participants identified different characteristics of collaboration and teamwork and how these all related to their experiences with digital games, *StarCraft 2*, and the *StarCraft 2* course. Alex stated the first thing that came to mind when he thought about collaboration was a soccer team or a traditional group project context where there was delegation of tasks and responsibilities. For him, regardless of whether it is in an athletic, academic, or professional environment, working with others requires communication and feedback between members. Alex also noted a difference between collaboration and teamwork, with teamwork requiring a greater sense of cohesion between members.

> Well obviously collaboration and teamwork are closely related because they both deal with the group but I think the key difference is that when you're talking about teamwork, there's no "me" in team, or there's no "I" in team. I feel that there has to be a sense of cohesiveness within the group beyond just communicating goals to one another, but an actual support system where if they decide to take an opposite direction, there's at least a system of constructive criticism…where it's like, oh man, you did that really poorly, but this is how you could do it better next time. It's basically the same thing as collaboration, a bunch of individuals working towards a common goal, but there's that feedback between group members (Alex, personal communication, December 3, 2012).

Alex stressed there is a difference between working together with others in an RTS environment and traditional collaboration in an academic or professional small group environment since there is usually a period of time in which the work and tasks can be completed. However, in *StarCraft 2*, because of the quick-paced nature of matches, players are forced to collaborate effectively in a much shorter amount of time or risk losing. Because of this, working together in a RTS environment requires especially effective real-time communication.

Ben stated teamwork and collaboration are useful because each is "a collective thought process" that allows for troubleshooting because "like before the thing is even created you can, uh, bounce ideas off each other and that prevents problems from occurring beforehand and uh, it allows for more foresight" (Ben, personal communication, December 10, 2012). Taking the *StarCraft 2* course helped Ben realize the synergy required in working with others and caused him to refine his understanding and definition of teamwork.

> I guess I saw teamwork previously as simply a delegation of responsibility to prevent any one person from having to do this massive thing. But, through the course, the synergistic effect came out a lot more and I began to see that there is an additional benefit simply beyond dividing the work and that is to get a product that is greater than if you were to do it alone. It's like if you as one person simply had all their ability and one mindset, you would still make less of a product than, the ability divided up amongst different mindsets...this is the synergistic effect (Ben, personal communication, December 10, 2012).

The course also helped Ben better understand teamwork and collaboration and appreciate their benefits.

Similar to Ben, Caleb also said his definitions of teamwork and collaboration had changed. Before the course, he tended to see only the similarities between collaboration and teamwork, but has since realized there are some important differences. Caleb was able to identify the shift in meanings and how these applied to his own small group interactions in the *StarCraft 2* course.

> I think, collaboration is less loose, less organized so it's a more loose group of people than teamwork. Teamwork I think is when the group is a lot more organized or they work together a lot. I think, for my group and the class, at first it was kind of like collaboration where we all had the same goal but we weren't really working together to achieve it. But towards the end we were communicating and timing, our schedules to achieve the goal academically and in the game where we're working together and timing our strategies around each other as opposed to "I'll do this and you do that and we'll just see if it works" (Caleb, personal communication, December 17, 2012).

Perceived benefits of collaboration

The perceived benefits of collaboration are one subtheme all three participants mentioned as they reflected on their *StarCraft 2* course experience. Alex saw collaboration as a way for people to have a "support system" and to be part of a "system of constructive criticism" (Alex, personal communication, December 3, 2012). Ben also saw the upside of working with others through teamwork and collaboration when he mentioned how working with others brought out a "synergistic effect" that makes an effective group essentially greater than the sum of all its individual parts. He also mentioned how collaboration provides the opportunity for members to "bounce ideas off each other," how it serves as a space for "in vitro trouble shooting," and how it is a "collective thought process." Alex also felt that collaboratively working with others "allows us to do something great" and that it is "the other half of the human experience" (Ben, personal communication, December 10, 2012). Caleb echoes the other two participants and appreciates the support of fellow members of the group or team.

> If you're feeling down or if you're, getting distracted a lot they can help keep you focused and you can do the same to them. And if you're stuck on a problem you can kind of bounce ideas off each other to help resolve the problems since a group of people will always have more ideas than an individual (Caleb, personal communication, December 17, 2012).

Caleb was the oldest and most experienced in his group and he noted the benefits of collaboration in terms of self-reflection when he said,

> The collaborative element helped me. I guess since most of the people in my group were kind of younger students than me, it kind of helped me see where I was back then as opposed and compared to where I am now (Caleb, personal communication, December 17, 2012).

Group Functioning

Alex, Ben, and Caleb's digital gaming/*StarCraft* experience and their background/perspectives on collaboration influenced how their small groups actually

worked together during the *StarCraft 2* course. The research participants' experience in both areas played an integral part in how each small group functioned, since working and playing together throughout the semester forced members to constantly negotiate and renegotiate their understanding about the game and about working effectively with others. Understanding how their small group worked together and actually experiencing a complex collaborative environment helped shape the three participants' overall perception and attitudes towards collaboration in the *StarCraft 2* course. This main theme had six subthemes: "Group Dynamics," "Group Communication Processes," "Leadership," "Team/Group Role," "Task/Responsibility Delegation," and "Group Frustration."

Group dynamics

Group members' experience and attitudes towards teamwork and collaboration were not the only factors which influenced how well their collaborative *StarCraft 2* group worked together. Group dynamics and how the members related and communicated with each other were extremely important as the groups worked towards their in-game and academic goals. Each of the three qualitative research participants came from different small groups so each had a unique perspective on the teamwork and collaboration he experienced during the course and during collaborative game-play. For Alex, being randomly assigned a group and forced to work with strangers was actually easier than working with friends or people he knew. He mentioned overall his group was close and that he were friendly towards each other. Interestingly, the digital game environment seemed to have acted as a catalyst in this participant's group.

> During the course at the beginning I barely knew what they looked like. I only had seen their face or profile pictures, so it was kind of weird but once we were all together and in that group environment, we started to like crack

> a joke every once in a while and the awkwardness started to fade away. I mean, when you're playing a game I feel like all of that awkward, "oh I don't know this person very well" vibe sort of goes away in favor of the game. And then the interesting thing about your partners being right next to you is that sort of continues outside of the game. So I think, playing the game actually helped us get over that. We got used to each other's personalities really quickly and then we were just able to communicate fine after that (Alex, personal communication, December 3, 2012).

Another factor that helped this participant feel more comfortable with his group was discovering one of his fellow members was also not very experienced with *StarCraft 2*. He was very nervous at first and feared his relative lack of game experience would adversely affect the group. However, having a fellow inexperienced player and being able to follow the guidance of a more experienced player was comforting. Playing a few *StarCraft 2* matches together, knowing each other's *StarCraft 2* experience level, and cracking jokes all helped this group gel and warm up to each other. Alex recalled that his group dynamic was a little disjointed since the group tended to play the required collaborative *StarCraft 2* matches during one part of the week and then not communicate any more until they had to work on the academic group project assignment. While reflecting on his perceptions and experiences in the *StarCraft 2* course, Alex identified some of the factors that can influence working in a group including individual members' personalities, game-play styles, and communication styles. This participant's experience showed him that having one more experienced player thrust into a leadership role guiding two lesser experienced players could also impact a group's dynamic and also place significant pressure on the mentor.

Ben also noted how the digital game environment had an effect on the group dynamic, which tended to not be very personal, but did have "a very professional

dynamic" (Ben, personal communication, December 10, 2012). Motivation and attitudes played a significant role on group dynamics in this group.

> Well like I mentioned before, they were, as motivated as I was not only to get a good grade but to learn what we were there to learn and try out what you had assigned to try out so such that we can learn that. And, I liked how the attitudes made me want to work with them…which is good. And it was actually quite fun to work with people like that and it gives me hope for my eventual career. And the fact that it was a video game made it that much more fun to do with people and I think that was a good framework for making it interesting (Ben, personal communication, December 10, 2012).

Regardless of how well the group worked together, Ben admitted he did not see the group staying together beyond the end of the course.

Caleb said his group took some time to gel, but towards the end of the *StarCraft 2* course the group navigated the game-play and academic aspects of the course together much more easily. It was not until the fourth or fifth week of the eight-week course that the group really came together well. When asked how his group experienced teamwork and collaboration during the semester, Caleb stated:

> It happened but it took a little bit of time to happen. At first, we were kind of all doing our own thing, and, but towards the end as we met up more often and, played more games together. There was a lot more communication going on and we were able to collaborate better instead of being just three individual players who just happened to be on the same team (Caleb, personal communication, December 17, 2012).

Reflecting back on his perspectives and experiences, Caleb noted his group's dynamic certainly evolved over the course of the semester, moving from a looser collaborative dynamic at the beginning of the course to a closer, more tightknit teamwork dynamic at the end.

> I think at first we were just kind of, a lot of individuals kind of being forced together in a group. We didn't really have a very strong group dynamic at first and then kind of grew stronger as the course went on as we worked with each other more and learned each other's quirks and how we each like to do work. We got closer as a group. Towards the end I think we were kind

> of approaching a team aspect where we were more organized and had a lot more communication, but it took, us a while to get to that aspect (Caleb, personal communication, December 17, 2012).

Throughout the course, Caleb said his group "had a very open environment so anyone could just speak whatever he thought of." Being the oldest and most experienced player in his group also meant he experienced a strong leadership aspect during his collaboration in the course.

Group communication processes

The specific ways how each *StarCraft* 2 group communicated and worked together also influenced the group's dynamics and its overall perspectives and experiences of collaboration. Alex acknowledged the importance for groups to communicate and provide helpful feedback to one another. However, he also said his group was at times disjointed because they never exchanged phone numbers or Skype information, but instead relied solely on Facebook group chat. They would also play all their required collaborative *StarCraft 2* matches in person. When it came to the academic portion of the course, they would wait until a few days before the deadline before beginning to work on the group project (GroupCraft).

> We'd say, "Well, I'll do this part and you'll do this part, and I'll do this part." And then we'd go home and we wouldn't get anything done. And then it would be a couple days before the deadline and I'd be," hey guys, has anyone worked on their parts of the GroupCraft report that's due in a couple days?" And they're like, "no, no we haven't." So we'd end up rushing throughout the weekend sending messages back and forth and that's when communication was really nice, but other than that it kind of like, playing the game and then just a dead zone for a few days then we'd get back and get the project, get the papers done (Alex, personal communication, December 3, 2012).

Ben's group communicated primarily online via Skype due to group member's extremely busy schedules.

> It was just easiest to say, “Ok just be at your residence at this time” and that’s it. You didn’t have to worry about venue or timing. You could just hear that time and it was easier, plus it was online so…that made it easy (Ben, personal communication, December 10, 2012).

Similar to Ben whose group had to deal with members’ busy schedules, Caleb’s group also found it hard to meet together. However, as the course progressed and the group began to gel, their communication processes also changed. They primarily used email, Skype, and text messaging to communicate.

> At first it was very hard to get everyone together. We usually waited till the last day or second to last day before we could finally meet up due to time pressure, but toward the end we were able to meet up throughout the week and just kind of plan things around each other’s’ schedules so that we could meet up earlier and get our work done as opposed to waiting till the last minute (Caleb, personal communication, December 17, 2012).

Caleb’s group also primarily worked together online and his entire group met only once in person during the semester. While they began primarily with email communication, they switched more to Skype and text messaging as the course progressed. Since Caleb took on a leadership role and personally preferred a high degree of communication, he took it upon himself to take the lead in organizing the group’s communication processes. He noted that when communicating with his group, he had to take into account that one member was really only responsive to email while the other was really only responsive to text messages.

Leadership

Because the small groups were randomly assigned in the *StarCraft 2* course and the class had a wide range of individuals with varying *StarCraft 2* experience, each group tended to have players of different experience and skill level. Because novices and experienced players were forced to work together, it was not surprising that leadership proved to be a significant subtheme during the data analysis. Blizzard Entertainment’s

StarCraft 2's online multiplayer option is extremely popular and competitive. Players can log on to Blizzard Entertainment's Battle.net site where they can play a range of Blizzard titles—including *StarCraft 2*—against other players online. Based on their performance and win-loss records, players are ranked on a seven-level ranking system (bronze, silver, gold, platinum, diamond, master, or grandmaster). Alex noted that one of his teammates had been diamond ranked at one time and was therefore a much more advanced player than either of the other two group members. Because of this, the group automatically placed this individual in a leadership role where he mentored the less experienced players. This Alexlso mentioned how during matches the less experienced players would defer to the leader/mentor. There was one instance where the two more inexperienced players had been eliminated from the match, but the group leader was able to still win the match against their three opponents. This highlighted the range of skill within the small groups.

Ben had a different and more personal perspective on leadership. He focused primarily on how the *StarCraft 2* course had helped him learn, develop, and evaluate his own leadership skills. For him, the course was a focusing lens where he could observe and analyze those skills. Ben felt the course was helpful because "it helped me identify what I was doing right and wrong and I could see the differences between now and before" (Ben, personal communication, December 10, 2012).

As mentioned earlier, Caleb was placed in a leadership and mentorship role in the group because he was the most experienced *StarCraft 2* player. The other members of the group especially looked up to him for guidance on *StarCraft 2* strategy and concepts. This leadership role in the digital game environment also extended to the real-world academic contexts with Caleb coordinating the group project.

> I guess since I was the oldest person in the group, they kind of looked up to me at the start and I was kind of put into a leadership role from my group members since they were both younger students and from that I kind of just took over the organizing and getting everything set up from there. I kind of took on a leadership role where I guess I would get us together (Caleb, personal communication, December 17, 2012).

Team/group role

Research participants' digital gaming and *StarCraft* experience and leadership position had an effect on the roles they played in their assigned groups throughout the *StarCraft 2* course. Alex and Caleb specifically mentioned how differences of group members' familiarity and experience with *StarCraft* meant that the more experienced players tended to take on the role of mentor or teacher, while the less experienced players tended to take on the role of mentees or students.

Task/responsibility delegation

The *StarCraft* 2 course's game-play and academic focus meant that delegation of tasks and responsibilities was extremely important for each small group. Not only did all the groups have to delegate tasks in the traditional academic group projects, but they also had to determine roles and responsibilities for each group member during the collaborative *StarCraft* 2 matches. According to both Alex and Ben, the delegation of work and responsibility for the academic group projects was democratic. Alex's group took both members' strengths and interests into consideration during responsibility delegation.

> Definitely with some of the papers they had a lot of sections, like, "write this part which is 2-3 paragraphs" and "write this one," and "make a chart of this blah blah blah." Just being able to divide that not necessarily like at random, but instead according to "who would be better at doing this." I like playing with all the websites and all of the graphic designs stuff, so it got when we were asked to make a chart I would take care of that, whereas _____ and _____ would work on the more verbal answers. It was like being able to divide out assignments not just based on who gets

> who gets how many, but who is better at doing what (Alex, personal communication, December 3, 2012).

This delegation also extended to the digital game play environment where the group leader would assign different strategies and attacks for the members to use and execute. Like Alex's group, Ben's group also took members' interests and skill set into consideration. He specifically discussed how to proceed if these interests overlapped.

> For the most part we kind of told each other what we wanted to do and if it didn't overlap, then we would just go ahead and do it. If it overlapped a bit we would figure out who would be best for what role. Since I knew more about the game mechanics, usually I would do the section that was based very heavily on the game mechanics. And then they would do something more group focused so we would figure out who would do what after the game depending on our personal preferences if there was some overlap about who we thought would be better at what topic (Ben, personal communication, December 10, 2012).

Group frustration

Because of both the varied *StarCraft 2* experience level and course participants' busy college schedules; it was not surprising that there was some group frustration. Alex specifically highlighted some of this frustration that his group experienced.

> There were moments when there was like a little bit of frustration among group members, oh, "why didn't you put the supply depots up or something like that." But, most of the time was" just ok, shake it off, we'll play, well do better next game." Something like that. It was all friendly (Alex, personal communication, December 3, 2012).

When it came to the academic side of the course and with communication in general, Caleb's group also faced some trouble and frustration.

> At the beginning there were some, I guess there were some negative experiences as far as communication and getting everyone on the same page, but after we got that all worked out it was a very positive experience. It was fun to meet the new people and work with them on the project (Caleb, personal communication, December 17, 2012).

Lessons Learned

All three participants were able to synthesize new understanding of teamwork and collaboration after taking the *StarCraft 2* course by reflecting on their own digital gaming and *StarCraft 2* experiences, their previous collaborative experience, and how their small group functioned during the semester. Since the course had already ended at the time of the interview data collection, participants were able to provide a more holistic account of their perspectives and attitudes towards collaboration during the *StarCraft* 2 course. This main theme had 2 subthemes: “Learning Collaboratively vs. Learning Alone,” and “Learning to Collaborate and Communicate.”

Learning collaboratively vs. learning alone

While all three participants in general seemed to have found the *StarCraft 2* course both meaningful and useful, it was Alex who especially noted that the learning process he experienced working collaboratively with others was different from the learning processes he engaged in individually. He clearly saw the benefits of collaborative learning, even going so far as to say it is a superior way to learn.

> It was very interesting because learning a skill in a group dynamic is much different than learning a skill on your own. I’m trying to decide whether it’s quicker or whether it’s more efficient or not and I’m leaning towards learning a skill in a group would be more efficient (Alex, personal communication, December 3, 2012).

Learning to collaborate and communicate

In general, according Alex, Ben, and Caleb, the StarCraft 2 course had a positive influence on their attitudes and perceptions towards working together with others. They also learned how to better collaborate and communicate. Alex specifically noted how he learned and practiced his scheduling skills when he said, “and also I mean, it just like getting that experience of collaborating with people that you don’t know very well. I

mean, that's always a great skill to have" (Alex, personal communication, December 3, 2012). Ben learned that collaboration with likeminded and motivated individuals with the right attitudes can be a positive experience. The course has made him more excited and optimistic about future collaboration and opportunities to work together with others.

> In my previous experience, it was just the lack of motivation and maybe ability. I don't know, mostly motivation, and here, in this course the, severe presence of motivation was actually very shocking in a good way. It makes me more optimistic about it (Ben, personal communication, December 10, 2012).

Both Ben and Caleb stated they were more optimistic about collaboration. Caleb said that he now looked "forward to working in groups even more than before" (Caleb, personal communication, December 17, 2012).

Caleb had the most to say about lessons he learned from his perceptions and experiences collaboratively working with others in the *StarCraft 2* course. Being older and more experienced, Caleb learned how to sympathize, empathize, and work together with younger group members because he knew where those younger members were coming from. He also stated how he had a positive prior collaborative experience in another class and this course has reinforced those positive perceptions about working together with others, so much so that he actually are looking forward to future collaborative work. Alex noted he learned how to work with group members with different communication styles and how to take charge of a group project.

> I think that I still enjoy it very much and I think it's still a very positive experience that you can learn a lot out of. But I think you would have to look over some of the, I guess, downsides at the beginning especially with communication and maybe getting all the group members to work together, say you had different personalities or work styles, but after that I think it can still be a very positive experience (Caleb, personal communication, December 17, 2012).

Results Summary

The quantitative and qualitative data analyzed in this research helped provide a clearer understanding of the collaborative processes and team cohesion dynamics present in the *StarCraft 2* course. The research question examined the ways participation in an online digital game-based course influenced learners' perceptions of collaboration and team cohesion. There were five main findings. First, data analysis revealed preliminary evidence that participation in the *StarCraft 2* course did lead to a statistically significant positive change in participants' personal perceptions and attitudes towards their social attraction to their group (ATG-S). Second, there was a statistically significant negative correlation between the quantitative research participants' perceptions of how close their group was regarding task (GI-T) and research participants' *StarCraft 1*/*StarCraft 2* experience. Third, there was a statistically significant negative correlation between participants' personal perceptions of how close their group was according to their task (ATG-T) and their year in school. Fourth, qualitative data analysis showed there were four main themes and 18 related subthemes that helped explain and interpret research participants' experiences, attitudes, and perceptions of collaboration and team cohesion. Fifth, closer examination of the modified GEQ items generally supported that the *StarCraft 2* course positively influenced research participants' attitudes and perceptions towards the social aspects of collaboration and team cohesion, but that it was important when considering the task-based aspects of team cohesion to remember that in DGBL environments there are game-based tasks and academics-based tasks. In general, both the quantitative and qualitative results indicated that participation in the *StarCraft 2* course tended to influence the research participants' perspectives of the social aspects of team cohesion and the task-based aspects. The

qualitative data went a step further and showed how the qualitative research participants' perspectives of the task-based aspects of collaboration and team cohesion were also influenced by participation in the *StarCraft 2* course.

CHAPTER 5
DISCUSSION

Overview

This research examined how participation in an innovative online DGBL course using the RTS game *StarCraft 2* influenced learners' perceptions of collaboration and teamwork as expressed and measured by learners' perceptions of team cohesion. Collaboration and the ability to work effectively with others are vital skills learners will need to succeed in today's highly interconnected technological world. Modern digital games can be highly complex and require significant levels of collaboration between players. These highly fluid and dynamic environments encourage experiential learning and have potential for pedagogy (Gee, 2003; Shaffer, Squire, Halverson, & Gee, 2005; Kirriemuir & McFarlane, 2004). Seeking to build upon the innate experiential nature of digital games, the *StarCraft 2* course was carefully designed based on constructivist and experiential learning principles (Jonassen, 2006; Duffy & Jonassen, 1992; Von Glaserfeld, 1989; Kolb & Kolb, 2005) since constructivist instructional approaches can be an effective way to merge digital games with pedagogy (Kiili, 2005). The *StarCraft 2* course builds upon prior work by Gros (2007), who also studied the educational use of an RTS game, and Collazos, Guerrero, Pino, Ochoa, and Stahl (2007) who developed a framework model for using digital games to teach collaboration. As the *StarCraft 2* course was designed as an online course, the educational material and activities were developed according to Cooper's (2001) recommendations about effective online learning and also followed some of Gros' (2007) recommendations for the educational use of RTS games.

This chapter discusses each of the major themes which came up during the qualitative data analysis and how the quantitative results fit into this thematic framework. Please refer to Figure 5-1 for a visual representation of this framework and the interplay between the qualitative and quantitative data. (Note: this is the same diagram as first mentioned in Chapter 4 reproduced here for convenience.)

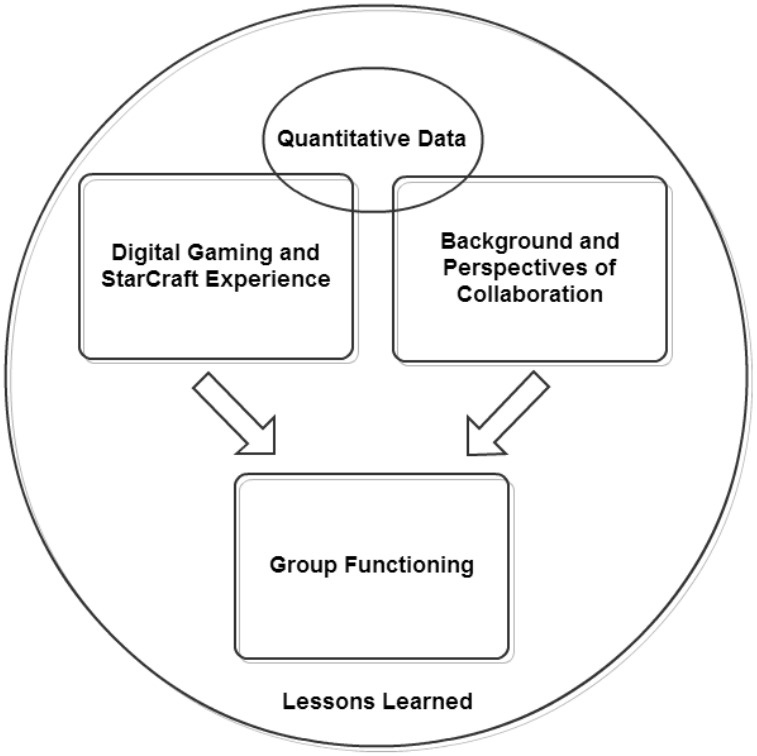

Figure 5-1. Thematic framework and interplay between quantitative and qualitative data.

This chapter also discusses the results, recommendations, implications, caveats, and conclusions of this research. Overall, the data from this mixed-methods research indicated the *StarCraft 2* course did influence the study participants' collaborative perspectives and experiences. The quantitative results from the six participants who took part in the quantitative part of the study indicated a statistically significant increase in their feelings of social attraction to their group (ATG-S) after taking the course. Also, a

few factors from the participants' backgrounds proved to be significantly correlated with each other and with several of the modified GEQ constructs of team cohesion. Examination of the differences in the mean scores of specific items between the pretest and posttest also helped provide a fuller picture of how collaboration was actually occurring in the course. However, it is absolutely critical that it be remembered that the modified GEQ administered in this research had severe limitations regarding internal consistency, validity, reliability of the scores, and results should be interpreted accordingly. The qualitative results from the three interview participants also indicated the *StarCraft 2* course had an effect on their perceptions and attitudes towards collaboration and how they experienced working with others. Qualitative data analysis revealed four interrelated themes relating to the participants' collaboration experiences and perspectives. Please refer to Figure 5-1 for a visual representation of the themes that emerged from the qualitative data analysis. Each of the three participants noted their digital gaming/*StarCraft 2* experience and their background/perspectives of collaboration influenced how their groups functioned and interacted. The quantitative data is interwoven within the themes of digital gaming and *StarCraft* experience and background and perspectives of collaboration. Each of the three qualitative research participants synthesized new learning and perspectives regarding collaboration by considering their prior experience working with others, their digital game experience, their experience with *StarCraft 2*, and their actual collaborative experiences in the *StarCraft 2* course.

Discussion

With regards to the first research hypothesis of this study, the quantitative results showed that enrollment and participation in the *StarCraft 2* DGBL course did increase learners' perceptions of collaboration with regards to one of the four aspects of team

cohesion—their personal social attraction to their groups ATG-S). The null hypothesis for regarding this one aspect was rejected at the .006 level of significance with regards to the personal social attraction to group (ATG-S) team cohesion aspect of the modified GEQ. The null hypothesis regarding the other three aspects failed to be rejected at the 0.05 level of significance. For the second research hypothesis, the results did not show a positive correlation between *StarCraft 2* course learners' characteristics and their perceptions of collaboration and team cohesion. Rather, two negative correlations were found. Participants' *StarCraft 1*/*StarCraft 2* experience had a negative correlation with their perceptions of how close their group was regarding task (GI-T). Because of this, the null hypothesis could not be rejected at the 0.05 level of significance. However, there was a statistically significant negative correlation at the 0.01 level of significance. Participants' year in school also had a negative correlation with their personal perceptions of how close their group was according to their task (ATG-T). Because of this, the null hypothesis could not be rejected at the 0.05 level of significance. However, there was a statistically significant negative correlation at the 0.05 level of significance. These results, when interpreted together more holistically with the qualitative data help paint a fuller picture of the effects the *StarCraft 2* course had on learners.

The mixed-methods approach helped synthesize a richer and more complete understanding of the effects of the *StarCraft 2* course. Each of the four themes and related quantitative data which emerged from this research has important implications for researchers and educators seeking to design, implement, and examine DGBL courses. This research examined how the *StarCraft 2* course affected participants' attitudes and perceptions towards collaboration and working with others. Participating in and studying collaborative groups can be an extremely complex task since so many different factors

contribute to group success. Kerr and Tindale (2004) succinctly capture this sentiment when they say “there is general agreement that groups are certainly more complex than most of our theories and methods would suggest. The difficulty has and continues to be, ‘how can this complexity best be analyzed and understood?’” (p. 642). This research addresses this question by using mixed methods in an attempt to explore the complexities of collaboration, teamwork, and team cohesion within the *StarCraft 2* course. It also looked at leadership within the small groups, a theme not initially considered at the onset of the study. (The importance of group leadership only became evident during the qualitative interviews and data analysis.) The qualitative data analysis pointed to a number of important factors related to each theme with implications for the design, implementation, and study of DGBL courses. This section specifically discusses each of the major emergent themes, how the quantitative data fit with the qualitative findings, and how what was learned is related to the literature.

Digital Gaming and StarCraft Experience

Each of the three qualitative research participants noted digital gaming and *StarCraft 2* experience was an important factor in determining and establishing the social processes and leadership structure of their individual groups. These findings regarding leadership were unexpected and only came to light during the qualitative data analysis. During the planning for this research, it was assumed that digital gaming and *StarCraft* experience was going to be an important factor when it came to the research participants’ attitudes, perceptions, and experiences of collaboration in the *StarCraft 2* course. However, at that time it was not known in what ways or to what extent this experience was important. Subsequent qualitative data analysis clearly pointed to digital gaming and *StarCraft* experience having implications for the leadership decisions in their

groups. Indeed, a *StarCraft* skill gap tended to play an integral role in how the three research participants collaborated, functioned, and delegated leadership. The participants' focus on leadership is noteworthy because all three noted it was an important part of their collaboration experience and group integration during the *StarCraft 2* course.

Past research has shown leadership plays an integral role in group performance and effectiveness (Burke et al., 2006). Of the three participants in the qualitative part of this research, one took on a leadership role in his group, one was not the leader but still explored leadership concepts within his group, and one took on the role of follower in his group. All three participants said that in their groups, experienced group members who were more comfortable with the game tended to take on or be placed into leadership roles. Lesser skilled participants tended to defer to more experienced peers based solely on game experience without considering any other leadership qualities. This dynamic caused or influenced by the *StarCraft* skill gap may be attributed to the social identity theory of leadership.

While there are many leadership theories, the data collected and analyzed in this study points to the social identity theory of leadership being especially helpful because of its emphasis on social dynamics. This theory also makes sense in this research's context because digital gaming is often a highly social process. The social identity theory of leadership states leadership is a group process and a complex interplay of factors at both the individual level and at the group level including social identity, self-categorization, self-esteem, and social attraction (Hogg, 2001; Hogg & Knippenberg, 2003). This theory also says leadership tends to fall on individuals who possess more of the prototypical traits of good leadership. Because of this, individuals possessing more

prototypical leadership qualities appear to have more influence and “leader prototypicality is positively related to leader effectiveness” (Hogg, 2001; Hogg & Knippenberg, 2003). As part of society, group members have been conditioned and socialized to follow deeply rooted social norms, expectations, stereotypes, and processes, which cause them to “cognitively and behaviorally conform to the prototype” and to “agree and comply with the leader’s ideas and suggestions” (Hogg, 2001, p. 184). There was evidence this occurred in the three qualitative research participants’ small groups in the *StarCraft 2* course where the more experienced players were considered prototypical players/leaders and where the less experienced players automatically deferred to these prototypical players/leaders. The participants’ groups tended to value greater game experience as a desirable prototypical leadership quality. Data from all three individual interviews indicated that in each of the three participants’ groups, there seemed to be the assumption that the better *StarCraft 2* player would automatically make the better leader. This occurrence may have been caused by inadequate guidance for course learners regarding leadership and leadership delegation, which brings to mind Colbeck, Campbell, and Bjorklund’s (2000) findings that “when a student assumed leadership without faculty guidance, selection was often connected to students' perceptions of which team member had the most technical knowledge relevant to the particular project” (p. 72). It may also be due to the “halo effect” (Nisbett & Wilson, 1977) where individuals base their evaluations and opinions of others’ specific skills based on their overall impression of them. In the *StarCraft 2* course, participants had a high opinion of participants with greater *StarCraft 2* experience and considered these individuals to be the best leader candidates based on this evaluation.

Digital game and *StarCraft 2* experience influenced not only leadership dynamics, but also hinted at some of the other complex social relationships present in collaborative groups which have implications for group performance and effectiveness. One participant expressly stated how he felt he was the least experienced player in his group and therefore worked especially hard so the group would not fail. This indicates what is known as the Kohler effect, which is "when less-capable members of groups working at conjunctive tasks (i.e., where the poorest performance defines the group score) increase their effort" (Kerr & Tindale, p. 629) was present in at least one of the *StarCraft 2* groups. A collaborative *StarCraft 2* match as played in the *StarCraft 2* course—with a group of three people playing against another group of three people—is in many ways a conjunctive task, where not only does the group's success hinge on each member's performance, but is also on the performance of the group's weakest member. This person is known as the group's proverbial "weakest link" and overall success is contingent on their skills and knowledge base. In collaborative *StarCraft 2* matches, often the weakest and least experienced player in a match is attacked first. If this person's other two group mates are unable to provide adequate assistance, that player is often eliminated, thereby completely changing the dynamics of the match. Elimination of a player turns a 3 versus 3 match into a 3 versus 2 match, which severely limits the chances of success for the group of two. Therefore, the better the least skilled player in a group plays, the better the chances are of the group succeeding. In this research, the research participant who reported being the least skilled in his group worked extra hard to improve his skill. He recognized he was the "weakest link" and expended extra effort and motivation to improve his performance so as not to let his group down. Had this individual not expended the extra effort to improve and instead simply let his group carry

the slack, it would have been an example of social loafing, which is “the tendency for individuals to expend less effort when working collectively than when working individually” (Karau & Williams, 1993, p. 681).

Digital game and *StarCraft* experience also affected how the quantitative research participants felt about their groups regarding their group’s integration based on task (GI-T). While the prediction that the *StarCraft 2* course learners’ characteristics would positively correlate to their perceptions of collaboration and team cohesion was not proven by the data collected in this research, there were a couple of statistically negative correlations that proved to be extremely helpful in understanding the collaboration and social dynamics in the small groups. The negative correlation between *StarCraft* skill and GI-T sheds light on how the *StarCraft* skill level gap within the research participants’ groups shaped the group dynamics, group processes, and leadership delegation. In general, more experienced group members tended to be less satisfied with their group’s level of integration according to the task than less experienced group members. This could have stemmed from the more experienced members feeling frustrated with their lesser skilled group mates and the less experienced members appreciating the help and guidance from their mentors. In hindsight, more guidance in the course should have been specifically provided regarding both leadership and mentor-mentee relationships. This could have been valuable for all of the course participants and could have helped strengthen the small group bonds.

While none of the qualitative research participants mentioned personality during their interviews, in hindsight it would have also been an excellent construct to examine since many researchers (Stogdill, 1948; Hogan, Curphy, & Hogan, 1994; Zaccaro, Foti, & Kenny, 1991) have considered it to be a major factor when it comes to leadership and

leadership delegation. Although not explicitly explored in this research—and certainly an area for future inquiry—personality could have played some part in how leaders were delegated in those participants' groups. Hogan and Kaiser (2005) go a step farther when they say "personality predicts leadership" and "who we are is how we lead" (p. 169). Judge, Bono, Illies, and Gerhardt (2002) identified "extraversion," "openness to experience," and "conscientiousness" as the personality traits most important and influential with leadership. Personality is not the only factor which influences and affects leadership. Zaccaro (2007) notes how leadership traits go beyond an individual's personality and extend to their values, problem solving skills, and cognitive abilities. There is "a substantial and growing empirical research base" (p. 14) indicating that traits such as these are precursors to leadership effectiveness. The oversight in this research of not examining personality and leadership is even more regretful because one of the assignments in the *StarCraft 2* course was for learners to take a shortened Internet version of the Meyers-Briggs personality type indicators and also a short leadership styles survey. Please refer to Appendix G for the assignment. Including discussion about these during the qualitative interviews could have provided an even richer picture of the three qualitative research participants' perceptions, attitudes, and experiences of collaboration as well as leadership in the course.

One other important observation regarding the leadership findings of this research is the qualitative research participants never formally defined the term "leadership" and since this research did not initially intend to examine that construct, the interview protocol did not ask for their precise definition, explanation, or experiences. The qualitative data seemed to show the research participants had extremely traditional and rigid perspectives on what leadership exactly meant and entailed, with it primarily being seen

simply as a role or position. This is not surprising given that the research participants were undergraduates and probably relatively inexperienced when it came leadership and its complex dynamics. However, leadership is highly complex and Scribner, Sawyer, Watson, and Myers (2007) caution researchers and educators should not only "look at leadership as a phenomenon exclusively associated with specific roles, positions, or behavioral traits" but rather "a complex social phenomenon manifested in many ways, and in many contexts" (p. 96).

Since it is a social construct, leadership could have been examined in this research in a similar manner to how collaboration was examined. Exploring the social aspects of leadership and collaboration and the interplay between the two could have provided an even richer picture into the experiences the research participants experienced in the *StarCraft 2* course. If leadership had been identified as an area of inquiry during the initial design of this research, more probing questions could have been included that could have more closely examined the leadership dynamics in the *StarCraft 2* small groups. Based on this research's results, the social identity theory of leadership—with its prototypical leader figure—seemed to best fit the data the qualitative research participants provided. Had leadership been formally included in the interview protocol, further probing may have provided more data identifying other leadership theories that could have helped explain the leadership frameworks in the *StarCraft 2* course. Relational leadership theory could have also helped explain the leadership dynamics since it considers both leader attributes and traits and "views leadership as a *process of social construction*" (Uhl-Bien, 2006, p. 654). Having more specific data regarding the research participants' leadership experience, perspectives, and how the leadership dynamics specifically played out in their groups could have helped shed light

on which leadership theory or theories could best explain what occurred in the collaborative groups. More than one theory may explain leadership in a given context. Kark and Van Dijk (2007) combined and integrated multiple leadership theories to help explain and understand leadership dynamics. They combined self-regulatory focus theory and self-concept based leadership theories to explain how leadership is the complex interplay between leaders' and followers' self-construct and also leaders' influence on their followers stemming from different traits and motivations. The collection of more in-depth leadership data would definitely have helped add to the rather limited and one-dimensional perspective on leadership this research has provided.

Digital gaming and *StarCraft 2* experience was an especially important factor for the qualitative research participants in the *StarCraft 2* course. Not only did this experience provide familiarity with the course material, but it also had a direct impact on the leadership and social organization of the participants' small groups. There was evidence within the three qualitative research participants' groups a significant *StarCraft* skill level gap existed. This gap played a role in helping form some of the collaboration dynamics present in the *StarCraft 2* course groups such as the Kohler effect. It influenced how research participants at different ends of the skill level spectrum perceived their groups with regards to team cohesion and also helped determine the leadership decisions of these groups. In turn, these leadership decisions and structures played an integral role in how each group actually functioned and collaborated. Since leadership was such an important theme in this research, it is unfortunate the relationship between personality and leadership was overlooked during the planning of this research and that leadership was not initially identified as an integral factor affecting collaboration, teamwork, and team cohesion. Had the leadership factor initially been a

research focus, it could have been incorporated into the qualitative interview protocol and therefore more thoroughly explored and interpreted using multiple perspectives of leadership theory. Research participants could have been asked about their personal experiences and definitions of leadership similar to the way they were asked about their definitions of collaboration and prior experience. Examining digital game experience, leadership, and personality all together would have provided a fuller look at collaboration, teamwork, and team cohesion in the *StarCraft 2* course.

Background and Perspectives of Collaboration

Digital game and *StarCraft* experience as well as leadership were not the only factors which influenced the group dynamics and functioning in the *StarCraft 2* course. The three qualitative research participants' prior background and perspectives of collaboration also influenced their attitudes towards collaboration. Data analysis revealed they had very different collaborative experiences in college than in high school. The three participants reported having generally negative collaborative experiences prior to starting college and mostly positive experiences so far at the college level. It is noteworthy even though some participants reported negative high school collaborative experiences they continued to recognize the positive benefits and potential of collaboration. All three participants noted their definitions and understanding of teamwork and collaboration were broadened after taking the course and that they valued the social interaction and affective support they experienced in their groups. The participants also reported increased skill and experience in working and interacting with others, both in the academic environment and in the *StarCraft 2* game environment. They reported a generally positive collaborative experience in the *StarCraft 2* course, with two

participants expressly stating how they now looked forward to future collaborative projects after the experiences they had in the course.

Prior experience and exposure to collaboration has been identified as a factor in the success of collaborative projects. Cummings and Kiesler (2008) found individuals who had collaborated in the past with each other had stronger collaborative bonds while working together on current projects. This prior collaborative experience also reduced the "negative impact of distance and disciplinary backgrounds" (p. 1). When it comes to prior collaboration experience in general, Bruneel, D'Este, and Salter (2010) note it can play a major role in helping reduce and mitigate barriers to current and future collaboration. In their study of undergraduate engineering students, Colbeck, Campbell, and Bjorklund (2000) found students' prior collaborative experiences—both negative and positive—helped provide them practical insight into effective collaboration such as how to set goals, develop leadership skills, and divide tasks. Prior collaborative experience also had an effect on group leadership as learners with more group "in-class or out-of-class group experiences were more likely to assume leadership and more likely to attempt to motivate all members to participate actively" (Colbeck, Campbell, & Bjorklund , 2000, p. 78). Such learners also tended to describe their group experiences in terms of interdependence and how tasks and responsibilities were delegated amongst group members. Huxham (2003) explains the complex interactions inherent to collaboration using themes such as membership structures, leadership, common aims, power, and trust. The qualitative research participants experienced dynamics related to each of these themes and also learned to set goals, develop leadership skills, and divide tasks like Colbeck, Campbell, and Bjorklund (2000) found in their study of undergraduates. This research is noteworthy because it has provided some documented evidence the

three participants were able to learn the same skills in a DGBL course environment as those reportedly learned in a traditional face-to-face college course environment.

Similar to the *StarCraft* skill gap observed earlier, there also seemed to be a college-level collaboration experience gap. The hypothesis that predicted the *StarCraft 2* course learners' characteristics would positively correlate to their perceptions of collaboration and team cohesion was not proven by the collected data. Rather, there was a statistically significant negative correlation where the quantitative research participants who had more college experience as measured by year in school felt less personal attraction to their groups based on task than the participants with less college experience. This could have been because those with more college-level collaboration experience felt some level of frustration with group mates with less experience. Those with less college level experience could have really enjoyed their *StarCraft 2* group because the more responsible nature of working with peers at the college level was so different than past negative experiences they had in high school. As with the *StarCraft* skill gap, in hindsight the course should have provided more guidance and frameworks about how to ensure small groups collaborate fairly, smoothly, and effectively.

This research discovered firsthand how important it is to consider learners' prior collaborative experiences when assigning learners to small groups. Colbeck, Campbell, and Bjorklund (2000) suggest educators and researchers should take the extent and context of learners' prior collaborative experiences into consideration when creating small groups since those who have worked more with others in small group settings are more likely to have developed expertise in managing conflict and solving problems that will benefit the entire group. They also note educators should provide a high level of guidance when it comes to collaboration to maximize group effectiveness and streamline

their collaborative processes. Unfortunately, at least one of the three qualitative research participants felt there was a lack of such guidance in the *StarCraft 2* course. He felt the *StarCraft 2* course did not include enough scaffolding to guide him and his group as they started working together and that learners were simply thrown together and expected to collaborate. This was part of the course design, which aimed to create a real-world collaborative experience. Members were randomly assigned to groups using an online random group generator tool with no attention paid to individual characteristics in an effort to simulate real-life professional situations where learners would have no say in the group they were assigned to work or collaborate with and where guidance is often sparse or nonexistent. Heterogeneous groups do have their benefits and past research has shown working with others who have different learning styles and are of different gender/race can be beneficial (Hunkeler & Sharp, 1997). However, after analyzing the interview data, there was evidence from two of the three participants that in the *StarCraft 2* course, this high degree of randomness actually hindered the small group experience since the course duration was so short and such a large proportion of time and effort was spent simply getting to know each other and figuring out the basics of group collaboration.

A more effective way to have addressed the *StarCraft 2* course group assignments could have been to follow Colbeck, Campbell, and Bjorklund's (2000) advice to use a more "planned" random approach to assigning learners to groups. They suggest assigning learners to groups based on different criteria such as prior group experience. There would still some element of randomness and working with strangers, but the groups would also likely have a firmer foundation to build upon. Shih et al. (2010) studied collaboration in a digital game environment and recommend educators

remember individual learning styles, learning motivations, and learning strategies can influence collaboration in DGBL contexts. Other criteria could include factors such as digital game experience or personality types. When it came to the *StarCraft 2* course specifically, considering collaborative experience, digital game experience, and *StarCraft* experience when forming the small groups could possibly have positively affected how the groups delegated leadership and also how learners' felt overall about their experiences. A more "planned" random assignment of groups may have been able to provide the course participants with a smoother, yet at the same time authentic collaborative experience.

Background and perspectives of collaboration played an important role in how the *StarCraft 2* course groups worked together. The research participants were able to learn from past experiences—both negative and positive—to set goals, develop leadership skills, and divide tasks. The results also revealed two main areas of improvement regarding the collaborative aspect of the course design and implementation. First, due to the *StarCraft* skill gap which became evident during the data analysis, the completely random group assignment was not the most effective grouping strategy for the course. This skill gap—in regards to both *StarCraft* and college-level collaboration—influenced the leadership structure of the groups and how they collaborated. This could have been addressed by more carefully considering learner characteristics such as digital gaming experience and prior collaboration experience. Second, there may not have been enough scaffolding and resources to help guide novice collaborators. Providing more material and guidance in how to collaborate with others and how to delegate leadership could have helped give the *StarCraft 2* course groups a firmer foundation as they started working and playing together. Since the duration of the course was so brief, more

scaffolding could have saved groups time and effort and could have helped streamline their collaborative processes. However, it is important to keep in mind that regardless of the level of support and scaffolding regarding group collaboration and leadership, some learners would still be dissatisfied since not all learners enjoy group collaboration. Despite the course's oversight regarding supporting the collaboration and leadership decisions of the groups, the qualitative research participants still generally enjoyed their collaborative experiences and felt the course was a meaningful experience which taught them how to collaborate. It is noteworthy one of the elements they enjoyed most was the social interaction which occurred in their groups and the affective support they received from their group mates.

Group Functioning

Qualitative data analysis revealed social interactions and group dynamics had an important influence on how groups actually functioned. Additionally, the three qualitative research participants reported communication, logistics, scheduling, and group members' personalities played a major role in their academic-based and game-based group interactions. They found the social interactions in their groups extremely meaningful for the learning processes they experienced during the course. This emphasis on the social aspect of collaboration is noteworthy. During their interviews, each of the three participants reported experiencing a sense of camaraderie and common purpose as they played collaborative matches and worked together on group projects. They experienced increased team cohesion and positive experiences in the affective domain. Humans are social creatures and depending on the genre and specific game, modern digital gaming can be an extremely social and emotional activity.

Researchers and educators interested in DGBL should focus not only on the content and processes of using games in education, but also on the affective domain since feelings, emotions, and social processes play a significant role in digital gaming (Garris, Ahlers, and Driskell, 2002; Squire, 2002; Wilson et al., 2009). The experiential and immersive nature of many digital games means players can experience a wide range of feelings including but not limited to competition, captivation, control, completion, challenge, discovery, exploration, fantasy, fellowship, sympathy, thrill, and relaxation (Korhonen, Montola, & Arrasvuori, 2009) as they interact with the game and/or with other players in highly complex and detailed virtual environments. This emotional connection means they have a vested interest in what they do and what occurs. The DGBL environment combines the motivational and enjoyment factors of digital games with academic and professional learning. Well-designed and effectively implemented DGBL approaches have the potential to encourage learners to care not only about the game-play, but also about learning. The enjoyment experienced by learners in DGBL environments can help them become more emotionally invested in the knowledge-building processes of academic learning.

While DGBL environments can certainly offer many innovative and immersive ways to learn, there is one important characteristic which need to be considered. DGBL can include many affective dynamics not necessarily present in traditional classroom settings. Researchers and educators should be prepared to use this to their advantage in promoting learning as well as prepared to handle situations where emotions can get out of hand (i.e. when learners become too competitive or belligerent, or when they begin belittling fellow players). The *StarCraft 2* course syllabus in this research specifically accounted for the competitive aspect of the game and included a players' code of

conduct for learners. Proactive measures such as this can go a long way in mitigating and avoiding many potential difficult group problems. Please refer to Appendix A for the Fall 2012 *StarCraft 2* course syllabus and Appendix B for the course description.

In this research, when it came to the communications and logistical side of their groups' collaboration, all three qualitative research participants used communications technology to communicate and coordinate. This research aligns with the findings of others who have also studied online collaboration and computer-mediated communication (CMC). Stacey (2007) studied graduate-level learners in an MBA course who collaborated together via CMC and identified some of the many ways they worked together collaboratively. Learners tended to engage in the social construction of knowledge, give and receive feedback, share diverse perspectives, share resources/ideas/advice, and provide socio-affective support for their group mates. The three qualitative research participants' groups used CMC for all of these tasks. Stacey (2007) also highlights the importance of a group's social and affective dynamics and noted the social relationships learners formed online helped develop trust and emotional support that in turn helped facilitate communication and learning. The three qualitative research participants in the *StarCraft 2* course reported similar experiences and used tools such as Skype and Facebook group chat to communicate. One participant noted how their group used humor and the fun of playing *StarCraft 2* to strengthen social bonds. Another interview participant also recalled how his group became socially closer as they played and worked together more. All three participants reported their groups were places where they could find support—socially, academically, and digital game-wise.

The use of modern CMC technologies does not ensure a group's success and effectiveness. All three qualitative research participants noted how practical communication strategies not only contributed to their groups' success, but sometimes also to the challenges. Two of the three participants specifically mentioned how their groups tended to struggle with communication and coordination early in the course even though they had access to technologies such as Skype, Facebook, email, and text messaging. One participant reported how his group did not exchange phone numbers or texts and this led to some scheduling and deadline issues. Another participant noted how his group mates had a difficult time working together until they all received the appropriate contact information from each other. After they had the information, their collaboration became more effective. This participant also related how as group leader, he learned to communicate with his group mates on their preferred medium of communication—one group member preferred texts while the other preferred emails. These struggles with working together were not surprising and echo Baltes et al. (2002) who found groups using CMC are not necessarily significantly any better than groups working in a solely face-to-face environment. The two *StarCraft 2* course participants' reported experiences demonstrate that CMC and online technologies alone are insufficient when it comes to achieving collaborative group success. Rather, these technologies must be used along with other small group processes such as establishing workflows, setting up communication/scheduling frameworks, and focusing on the socio-affective dynamics of the group. Researchers and educators must remember collaborative DGBL courses—and any online courses in general—should have adequate resources and frameworks in place to help guide learners as they decide how to communicate as a group. Providing a list and description of different CMC and cloud-

based Web 2.0 productivity tools could help improve communication and small group collaboration effectiveness. While the groups in the *StarCraft 2* course also met occasionally in person, these tools would have still proven to be useful for online collaboration on the academic group projects.

Group functioning was an integral factor which influenced how the research participants—both quantitative and qualitative—experienced and felt about working with others. Communication while collaborating is crucial and all three qualitative research participants used modern communication technologies to coordinate their academic project-related tasks and their collaborative *StarCraft 2* game-play. The participants learned that merely having access to these tools was not sufficient to working effectively. Rather, they had to actually use these tools appropriately and also be flexible regarding different group members' preferences. Most importantly, the research participants learned collaboration and effective communication within small groups revolves around getting to know their group mates, being flexible, and being willing to experiment to find which communication processes work best in facilitating smooth group functioning.

Lessons Learned

Overall, the three qualitative research participants reported learning a significant amount about collaboration, teamwork, and leadership as they progressed through the *StarCraft 2* course. The participants' digital game/*StarCraft 2* experience, collaboration experience, and how their group actually functioned all influenced what lessons they felt they had learned and their perspectives about collaboration. Qualitative data analysis indicated the three participants generally had increased positive attitudes and perspectives towards collaboration and also noted the course helped reinforce their views of its value and potential.

Each of the three participants reported having generally positive experiences working with their groups and stressed one of the most important lessons they learned from both the in-person and online collaboration processes was that collaboration is essentially about managing human relationships, maintaining effective communication, and learning how to work with others despite their differences. This parallels Stacey's (2007) findings in that social relationships are crucially important when it comes to online collaboration. Overall, the three qualitative participants expressed that through the *StarCraft 2* course, they were able to synthesize new attitudes and understanding towards collaboration from their prior collaborative experiences and that they had improved their skill in setting goals, being leaders, and delegating responsibilities. This is similar to what Colbeck, Campbell, and Bjorklund (2000) found in their research of collaboration in a traditional face-to-face college course. The lessons the three qualitative research participants reported learning show how the *StarCraft 2* course was in many ways an effective environment for groups to experientially learn about and practice complex and dynamic collaborative processes.

Key Implications

This *StarCraft 2* course research has five key implications not only for the future design, development, implementation, and study of DGBL approaches, but also for the educational potential of digital games in general. The first implication is that the genre of game used in DGBL approaches matters a great deal when it comes to equitable and socially responsible educational practice. The second implication is that the experiential nature of digital games and DGBL approaches both have potential in teaching collaboration skills in a meaningful way. The third implication is that DGBL approaches which focus on the social and collaborative nature of digital games have the potential to

teach learners effective leadership skills by giving them an opportunity to actually lead and manage. The fourth implication is that researching DGBL approaches is challenging due to the often highly fluid, complex, and immersive nature of modern digital games and that DGBL-specific research instruments should be developed and used. The fifth implication is that DGBL learning approaches can be applicable to a wide range of professional fields for a wide variety of different purposes.

DGBL and the Need for Socially Responsible Educational Practice

In retrospect, the *StarCraft 2* course is an enigma that simultaneously exceeded expectations in some areas, yet also fell short in others. On one hand, it is a carefully designed DGBL course that was not only conceived and designed, but was actually implemented for two years at a major research institution—during which it attracted significant national and international media attention. It exceeded all design, implementation, and popularity expectations and brought together research from many different fields to inform, guide, and facilitate innovative technology integration into education. The *StarCraft 2* course proved it was possible at a major educational institution to teach and sustain a DGBL course that used a popular commercial off the shelf game. However, like all research, there were limitations. A closer examination reveals that while the course was indeed carefully designed according to theory and practice, when considered from a sociocultural and equity perspective it fell short of expectations in that it only served an extremely limited demographic. It was available only to Honors students and appealed to a much smaller subset of those learners—predominantly male—who enjoyed playing real-time strategy games. The enigmatic nature of the *StarCraft 2* course highlights the need for researchers and educators to

carefully consider the genre of games used in their DGBL approaches as well as their intended learner demographic.

Unfortunately, in this research, there was not enough consideration of the implications of using a real-time strategy game to build a DGBL course. From the onset of the course inception and development, the course was specifically designed for the University's Honors Program because of the need to manage the course's scope, the fact the researcher had finite resources and time, and because it was seen as the best way to get the course approved. The Honors Program had a strong history of accepting innovative instructional methods and offering innovative courses. Getting an innovative course accepted and offered at a major research institution can be a challenging and involved task and every effort was made to design the *StarCraft 2* course in a way that maximized its potential for adoption. In the case of this research, *StarCraft 2* was chosen based heavily on the popularity of the game and the fact that the University of California, Berkeley had offered a *StarCraft* course the previous year which aimed to help learners become better players. Having a prestigious university already having offered a course using *StarCraft* was seen as helping provide support for the course's adoption at the institution where this research was conducted. At the time, *StarCraft 2* seemed like an extremely suitable game to build a DGBL course around due to its complexity and suitability in teaching important 21st century skills such as collaboration, problem solving, and critical thinking. The intent was to go beyond the Berkeley course—which inspired this research—and actually focus on the academic and professional skills the game could help develop and teach. While much thought had been given to the design and content of the course, not nearly enough consideration had been given to the sociocultural and equity factors inherent to a DGBL course---especially one which used a

game with a predominately male player base. The decision to use a real-time strategy game practically guaranteed the exclusion of female learners as this genre predominately is played by males. During the course development, these factors became increasingly evident and modifications were made to the course, the course description, and the course material/assignments to appeal to a wider range of learners (i.e. more collaborative game play and collaborative projects.) However, this was a case of too little too late and over the two years the course was offered, these changes turned out to be inconsequential in recruiting a more gender-balanced course enrollment as the real-time strategy genre ensured a continued predominantly male enrollment. While this was foreseen during the course design, it was not until after the course was being offered that the gender disparity in the course enrollments became fully evident. Once implemented, it was not feasible to move the course out of the Honors Program or to change the game that was used. From a sociocultural and equity perspective, several factors of the *StarCraft 2* course helped contribute to this. The course's design, subject matter, and appeal to an elite group of overwhelmingly male learners meant that the course essentially provided an already privileged learner demographic with yet another resource, while the general student population was unable to participate or experience any of the benefits of its innovative approach. Ironically, however, without the immense name recognition of the game and the fact that the University of California, Berkeley had previously offered a course based on *StarCraft*, the *StarCraft 2* course detailed in this research would probably never had come to fruition.

In many ways, the *StarCraft 2* course represents a danger which every educational technologist and DGBL researcher faces. The educational technology field is driven by interest in using innovative technological approaches in education. Practical

research and resource constraints often mean these innovative approaches may be implemented only where the innovative technologies can be afforded and where they can be more easily implemented. This can often result in situations where the rich get richer and the poor get poorer. More affluent educational institutions and school districts can afford to provide innovative approaches for their learners—who already may tend to be academically higher achieving—while the less affluent and lower achieving institutions and districts may miss out. In many ways the *StarCraft 2* course enriched the already wealthy while neglecting the poor. It was offered and available only to Honors students, who already tended to have access to a wide range of support and resources. It also only catered to real-time strategy game players, who are predominantly males and by their gender tend to be more privileged in society. In serving what basically what amounted to a male elite, the course reinforced societal hegemony even though it was never its intent.

The implications of this research are clear. Educators must not only consider the *hows* and *whats* of education, but they must also keep in mind the *whos*. In the movie, *Star Trek II: The Wrath of Khan*, the Vulcan character Spock took an apt perspective that is applicable to the sociocultural implications of this research when he said, “The needs of the many outweigh the needs of the few” (Sallin & Meyer, 1982). Although Spock is a fictional character, his words still have great weight for educators in our own very real world. In the case of this *StarCraft 2* research, the needs of the few outweighed the needs of the many. In a fair and democratic society, educators should do their best in helping all learners succeed while not focusing entirely on one subset. While there will certainly be technologically innovative approaches where it will not be possible to cater to every learner or to provide them with access, the *StarCraft 2* course’s extremely narrow

target demographic should serve as a warning to researchers and educators of potential concerns when it comes to equity in designing, developing, and implementing DGBL approaches and courses. Much caution and careful thought should be considered during future work in incorporating digital games into education so as to appeal to and most effectively impact the greatest number of learners as possible. In retrospect, a broader seminar-based DGBL approach that incorporated a variety of digital games would have probably attracted and served a much more diverse range of learners than the singular focused *StarCraft 2* course. This research has shown that systematic and pedagogically-sound design is not sufficient in creating effective, fair, and equitable DGBL approaches. Careful consideration of the type and genre of game as well as audience is paramount if a wider demographic of learner is to have the opportunity to experience and benefit from innovative DGBL educational approaches. Despite its weaknesses, this research has nevertheless proven DGBL is gaining increasing traction and acceptance in education. It has shown it is possible for DGBL to be implemented in more involved contexts outside of more isolated uses in single classroom lessons or after-school activities. For all its strengths and weaknesses, this research has helped advance the DGBL field by carefully documenting the design, development, and implementation of an innovative digital game-based instructional approach.

DGBL and Teaching Collaboration

Despite its shortcomings, this *StarCraft 2* research still has much to offer as it can help inform best practices regarding DGBL. It demonstrates the potential popular, complex games can have in engaging and teaching learners important real-world skills. It also highlights some of the important social and equity factors researchers and educators must consider when developing and implementing DGBL instruction. When

learners play digital games, they are engaging in often complex processes and interactions with each other and with the game in those virtual environments. When they play digital games with others, these processes and interactions often become even more complex because another process—collaboration—is introduced into the environment. Zagal. Rick, and Hsi (2006) note games—traditional board games and digital games—"have a unique potential to engage people in collaborative activities" (p. 37). Whitton (2009) believes DGBL has potential in higher education because it can aid "the development and application of high-level transferable skills—such as analysis, critical evaluation, autonomy, and team working–situated within specific areas" (p. 45) which are all skills the *StarCraft 2* course focuses on. This research was specifically informed by and also builds upon Collazos, Guerrero, Pino, Ochoa, and Stahl's (2007) three-phase model developed for teaching collaboration using digital games.

It is important to remember collaboration can be seen as both a product and a process. When playing collaborative digital games, learners must navigate two processes to reach an end product or goal in the game—the actual process of playing the games and also the process of collaborating with others while playing. Essentially, they must use one process to facilitate another process. Being able to effectively function in such a complex environment is an invaluable skill for learners to be able to take to the real world, where they will be expected to engage in many complex and often collaborative environments as professionals. DGBL provides an enjoyable and immersive way for learners to engage in complex processes. In the *StarCraft 2* course, learners engaged in the collaboration process not only in the digital game environment, but also in the more traditional academic group project environment. They were forced to navigate two worlds and to become fluent in each. The *StarCraft 2* course essentially

encouraged learners to be bilingual and to be able to navigate seamlessly between the worlds. The digital game environment provided learners with an opportunity to experience and practice actual collaboration in a meaningful real-time context.

DGBL and Teaching Leadership

The *StarCraft 2* course also holds promise with regards to teaching leadership skills. While this research did not initially focus on examining leadership in the context of the *StarCraft 2* course, it nonetheless proved to be a significant factor in participants' experiences with group dynamics and functioning during the semester. Leadership also influenced and informed their experiences, attitudes, and perceptions about working with others in collaborative contexts. DGBL courses have great potential in helping teach learners how to collaborate because digital games can represent learning spaces where learners can negotiate and renegotiate what they know and understand about social roles and what it takes to lead. Many modern multiplayer digital games require a significant level of collaboration and also force players to work together to successfully accomplish goals and tasks. As such, they also can become excellent environments in which to study leadership in action.

Social identity theory (Hogg, 2001) may be a useful lens researchers can use to better understand leadership, teamwork, and collaboration in digital game environments. The theory also has implications for any group collaborating virtually since interactions will undoubtedly rely on different communications technologies and groups may be tempted to automatically delegate the member perceived as having the most technological skill as leader without consideration of other leadership qualities. More fully understanding leadership dynamics and qualities can help educators and researchers

create more effective DGBL approaches that teach learners important leadership, teamwork, and collaboration skills.

Need for DGBL-Specific Quantitative Instruments

Both human learning processes and digital game-playing processes can often be highly complex. As technology evolves and an increasing number of people play digital games, the delineation between the real world and the digital game world will continue to blur. The increasing relevance of these worlds to more people makes the research of these spaces not only interesting, but necessary. While modifying existing instruments designed to study traditional learning environments and group contexts seems logical when researching DGBL, there are several factors that may mean these instruments may require extensive modification and adaptation. For example, digital game environments also include other factors in the affective domain not necessarily considered in traditional professional or academic contexts such as feelings of enjoyment, competition, camaraderie, and pride. Since DGBL merges the academic context with a gaming context, traditional research instruments designed only to examine the academic context may prove to be unsuitable for use in a digital-game environment. This research was designed based on the assumption that modifying and adapting the GEQ was the best course of action since creating a new instrument would have required time and resources not available. The partial validation process for the modified GEQ conducted during a previous pilot test modified the instrument to such an extent that it was essentially an entirely new instrument. This drastic modification was necessary because the *StarCraft 2* course had an academic context and the original GEQ was not designed with academics in mind.

This research clearly illustrates the predicament facing researchers and educators interested in quantitatively examining the effectiveness of DGBL. Existing research instruments could be modified to address a DGBL context and undergo a validation process. However, as with the example of the modified-GEQ in this research, there is always the risk of the existing instrument not aligning closely enough with the DGBL context resulting in the need for extensive modification. On the other hand, while it may take a significant amount of time and effort, new DGBL-specific instruments could be created that take the unique academic and game-play factors inherent to DGBL into consideration. These new instruments could potentially be extremely valuable and insightful because of their ability to examine the complex dynamic nature of digital gaming environments and their related embedded social interactions. Either of these choices would require a significant amount of time, resources, and patience, but this research suggests the latter may be the most viable way forward. After all, if so much time and effort must go into modifying an existing instrument, it makes sense to simply apply that effort into creating a DGBL specific instrument capable of examining the DGBL environment and the processes which occur in it. Creating a robust and popular DGBL course using a suitable popular digital game that could be offered over multiple semesters and years could be a first step. Then the instrument could be developed, pilot-tested, and validated using students from the multiple iterations of the course. The *StarCraft 2* course is an example of such a course that could be used as the foundation for future research in developing a DGBL-specific quantitative instrument that can measure DGBL's effectiveness. It should be remembered that a DGBL course must be popular enough to be offered for multiple iterations. This means the course should have academic value and the digital game used should be popular and have name

recognition. Both of these factors can go a long way in satisfying university administration as well as learners.

Applicable to a Wide Range of Professional Fields

As noted earlier, digital gaming is becoming increasingly intertwined with modern society. Individuals from all walks of life, backgrounds, professions, and educational and levels are playing a wide range of different games in different genres. The experiential learning dynamics that can be promoted and facilitated by digital games have great potential in teaching valuable skills such critical thinking, problem solving, collaboration, leadership, and analysis skills. All of these skills are directly applicable to a wide range of professional fields. The findings of this research regarding collaboration, teamwork, team cohesion, group dynamics, and leadership are applicable to a wide range of professional fields including education, business, government, social science, and military/law enforcement. The content of the *StarCraft 2* course which included skills such as critical thinking, problem solving, decision making, resource management, risk management can also be helpful to these wide range of professional fields. The course demonstrates how learners can be exposed to all these important concepts using a collaborative and innovative DGBL approach. In this increasingly networked world, individuals must be able to work together effectively with others. Due in large part to technological advances, the compartmentalized and individual nature of past periods of human existence have been replaced by a high level of interconnectivity and interdependence.

Today, almost all professional fields will require individuals to interact and collaborate with others at some level and also to utilize many different skills. This research can help researchers and educators better understand how innovative educational approaches like DGBL can be developed, designed, implemented and

studied. For the business and government fields, the complex real-time nature of DGBL can help provide hands-on training for individuals who need to have strong critical thinking and problem solving skills. DGBL approaches like the *StarCraft 2* course can provide environments where business and government professionals can learn about resource management, time management, organization, optimization, microeconomics, and macroeconomics. Digital games are often highly social and the group dynamics and functioning seen in the *StarCraft 2* course demonstrate how complex human and collaborative group interaction can be. The rich social fabric of collaborative groups in this research and in collaborative digital gaming in general can certainly inform and help guide social scientists interested in exploring online collaboration and group dynamics in virtual digital game environments. As some of the participants in this research noted, DGBL environments can provide safe places for experimentation and practice. Those in the military/law enforcement professions may find these immersive and often collaborative contexts to be valuable in helping individuals sharpen their risk management, adaptive decision making, and leadership skills. Learning and mastering these skills—which in the real world are often the difference between life and death—in a meaningful yet safe digital game environment can help military personnel or law enforcement officials when they are actually faced with these choices to act appropriately and accordingly.

Recommendations

This research presents four major recommendations based on the results of this study as well as on prior research. The first recommendation is to ensure that the DGBL approach or course is robust and fair. Researchers and educators should ensure any DGBL courses they develop is well-designed where the digital game-play is clearly linked

to academic objectives, procedures, and outcomes and are inclusive, fair, equitable, and take sociocultural factors into consideration. The second recommendation is to support learner collaboration. If the DGBL course incorporates collaborative learning and small groups, researchers and educators must carefully consider just how to assign learners to groups and what scaffolding/resources to provide as they collaborate together. The third recommendation is to draw upon theory from many different fields to inform the course design and instruction. When designing collaborative DGBL, researchers and educators should consider drawing upon multiple leadership and collaboration theories. Leadership and collaboration are closely intertwined and as this research has shown, it is impossible to examine one without the other. The fourth recommendation is to create DGBL-specific quantitative research instruments to study what occurs when learners play digital games and interact in DGBL environments. DGBL environments are highly complex and since they blend the academic and digital gaming worlds together, research of these environments requires instruments specifically designed to capture both.

Ensure DGBL Robustness

DGBL is much more than simply taking a digital game and haphazardly incorporating it into a lesson and then expecting the process to be effective and to run smoothly. Researchers and educators should ensure that the DGBL courses they design and the approaches they choose are carefully planned and are grounded in theory and practice. The *StarCraft 2* course followed best practices as much as possible and this section details how this was achieved for this research. DGBL is increasingly being accepted and studied by researchers and educators (Van Eck, 2006; Squire, 2002; Prensky, 2003; Shaffer et al., 2005). Well-designed digital games can help facilitate meaningful learning, motivation, and collaboration (Gee, 2003) and players may transfer

learning from the digital game world and apply it to other real-world contexts (Shaffer, Squire, Halverson, & Gee, 2005; Kirriemuir & McFarlane, 2004). While this perspective of the potential for DGBL approaches may be prevalent among the proponents of using digital games in education, such innovative instructional methods tend to face more scrutiny and skepticism from areas of the educational field that adhere more strictly to more traditional pedagogy. Recognizing this, during the planning and development stage of the *StarCraft 2* course, careful emphasis was placed on creating a well-designed and pedagogically sound course that taught learners meaningful real-world skills. The *StarCraft 2* course was developed on the premise that when based on solid theory and pedagogy, well-designed DGBL courses using commercial off-the-shelf games can have great potential as effective learning environments (Gros, 2007; Yang, 2012). The course design took the perspective that the effectiveness of using digital games in education is related to the context and manner in which they are used (Hays, 2005).The course was carefully developed to blend educational theory, digital gaming, and online education to teach crucial 21st century skills essential for learners to succeed in the real world such as collaboration, critical thinking, and problem solving. The course was developed according to constructivist and experiential learning principles (Jonassen, 2006; Duffy & Jonassen, 1992; Von Glaserfeld, 1989; Kolb & Kolb, 2005) because of their ability to encourage learners to connect what they learn with the real-world (Huang, 2002; Lainema & Makkonen, 2003). Constructivist pedagogy can represent a feasible way to integrate digital games with teaching and learning (Kiili, 2005).

One of the skills focused on most was collaboration, which is highly valued by employers and increasingly important in a fast-paced interconnected world (Casner-Lotto, 2006; Ananiadou & Claro, 2009). As collaboration and teamwork played such an

integral role in the *StarCraft 2* course, several different extensive bodies of research were consulted including research on groups and teams (Sundstrom, De Meuse, & Futrell, 1990; Katzenbach & Smith, 1994; Kozlowski & Ilgen, 2006; Forsyth, 2009), collaboration (Gray, 1989; Wood & Gray, 1991; Rochelle & Teasley, 1995; Gardner, 2005; Macdonald, 2003; Tyre & von Hippel, 1997), and teamwork (Salas, Burke, & Cannon-Bowers, 2001; Jones & George, 1998; Salas, Sims, & Burke, 2005; Rousseau, Aubė, & Savoie, 2006). All of these areas of research proved to be invaluable in helping guide, design, interpret, and understand both the *StarCraft 2* course and the subsequent research study.

This *StarCraft 2* research used a commercially available digital game in an academic environment similar to Yang (2012), who took the commercially available strategy game *SimCity* and studied its use and effect on learning achievement and found that when used appropriately along with suitable design and assessment, DGBL can foster learning motivation and problem solving. Learners taking part in carefully planned and implemented DGBL instruction can achieve similar academic achievement as learners experiencing traditional instruction. This research also closely aligns with and builds upon work done by Gros (2007), who examined the educational use of another commercial RTS game—*Age of Empires II*—from the perspective that effective DGBL includes four main stages of learning: experimentation, reflection, activity, and discussion. Similar to Gros' (2007) framework, during the experimentation phase, learners in the *StarCraft 2* course had a chance to plan, strategize, and play collaborative matches. During the reflection phase, they were able to look back and evaluate their decisions. In the activity phase, using other tools, resources, and materials in addition to the game, learners completed assignments specifically designed with their game-play in

mind. In the *StarCraft 2* course, the discussion phase where learners discussed what they had learned and experienced was sometimes part of a larger assignment or in some cases was the entire assignment. All the course content and assignments contained at least three of the four elements.

The course was also designed specifically to be as collaborative as possible. The *StarCraft 2* course design followed a similar framework as the three-phase model Collazos, Guerrero, Pino, Ochoa, and Stahl (2007) developed for teaching collaboration using digital games. First, initiation conditions for the collaboration were set where the following factors were considered: type of activity, nature of collaborators, group heterogeneity, interdependences, collaboration setting, collaboration conditions, and collaboration period. Second, the collaboration was structured taking into account the following: activities, people and roles, tools, and group processes and products. Third, the collaboration was maintained by multiple iterations of both digital game-play and academic group projects. The *StarCraft 2* course design built upon both Gros' (2007) framework of integrating digital gaming into instruction and Collazos et al.'s (2007) framework of facilitating collaboration via digital games to create the framework for collaboration learners would follow and use in the course.

The *StarCraft 2* course was designed as an online course to provide learners with the opportunity and practice to collaborate virtually. In an increasingly interconnected world, learners must be able to collaborate with others virtually from a distance in addition to working with peers face-to-face. Online education is becoming increasingly prevalent and major economic and educational forces (Harasim, 2000; Means, Toyama, Murphy, Bakia, & Jones, 2009; Bonk, 2002; Allen & Seaman, 2008). It has been shown to be as effective as traditional face-to-face instruction (Bernard et al., 2004; Swan, 2003;

Johnson, Aragon, Shaik, & Plama-Rivas, 2000; Carey, 2001; Dutton, Dutton, & Perry, 2001; Arbagh, 2000; Lam, 2009). These factors and continuous technological advances mean learners have a high chance of taking online courses—for educational or professional development purposes—sometime during their lives and careers. The course followed Cooper's (2001) recommendations about effective online learning by always keeping the subject matter, the instructor, and the learner in mind at all times when it came to the online course structure, content, and activities.

The online *StarCraft 2* course follows a research avenue identified by Moreno-Ger, Burgos, and Torrente (2009). They note how "the integration of online Web-based learning and educational gaming can result in mutual benefits" (p. 682) and that the increasingly collaborative and interactive features of learning management systems (LMS) are the same as those that are present in digital games. It is important to keep in mind that there is a major difference between this previous work and the *StarCraft 2* research. While Moreno-Ger et al. (2009) focused on educational games either embedded in LMSs or deployed through them to allow the course instructor to direct and control the learning, the *StarCraft 2* course used an LMS only to deliver the content and administer assignments. It was through carefully designed content and assignments that the course instructor was able to facilitate learning in the digital game environment. This research of an online DGBL course follows much of Gros' (2007) framework for integrating digital gaming into the curriculum and also takes into account many of the perspectives of Moreno-Ger et al. (2009) have regarding integrating DGBL with online learning.

Support Learner Collaboration

Just as researchers and educators should carefully plan the design and implementation of DGBL, if the instruction includes any learner collaboration, they should also pay special attention to supporting learners—who may or may not have much prior collaboration experience—as they engage in the collaborative activities and game-play. To help overcome or even avoid any group problems, researchers and educators should follow Colbeck, Campbell, and Bjorklund's (2000) advice and include information such as group communication strategies, group scheduling tips, and information on how to work with different personalities in the scaffolding information provided during the first part of the course. The results from this research also suggest learners need to be provided with ample guidance and resources on how to choose effective leaders and what constitutes effective leadership since it is a major factor which helps determine group effectiveness and success (Burke et al., 2006). All of this support should be brought up early in the course and also reinforced throughout its duration. Effective group collaboration relies heavily on social relationships (Stacey, 2007) so groups should also be given specific guidance in how to work with people from different backgrounds and how to manage conflict. Providing adequate guidance and scaffolding can help groups mitigate, avoid, and handle many future problems that may potentially arise.

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Draw upon Theory from Other Fields

While educational theory will provide the most guidance when it comes to designing effective DGBL approaches, researchers and educators should not hesitate to draw upon theory in other fields to help guide their decision making and design frameworks. When designing collaborative DGBL, researchers and educators should be guided by multiple leadership, group dynamics, and collaboration theories. Leadership and collaboration are closely intertwined and as this research has shown, it is impossible to examine one without the other. Future research should avoid the oversights of this study's design—which did not include leadership as a variable to be studied—and always include it as an integral factor in collaborative environments and contexts.

Create DGBL-Specific Quantitative Research Instruments

During this research, a search for a suitable instrument to examine the *StarCraft 2* course was conducted. Unfortunately, no suitable instrument was found and an existing quantitative scale had to be modified. However, the existing scale had to be modified to such an extent that it may as well have been a new instrument, which undermined the decision to modify rather than create. Other researchers and educators should do everything in their power to avoid this predicament and instead consider creating DGBL-

specific research instruments. One of the challenges of studying DGBL is that it merges academics and digital game-play. Many existing validated instruments were designed for solely academic or professional contexts. There is also a lack of validated instruments designed to specifically measure digital game contexts. As this *StarCraft 2* research has shown, modifying existing instruments for DGBL contexts—which may become an extremely time-consuming and involved process—may result in them being modified to the extent they become essentially completely new instruments. This defeats the purpose of the modification process, which is to avoid creating an instrument from scratch. Therefore, if a significant amount of time and resources are going to be invested already, the logical approach is to instead use them to create new research instruments specifically designed to examine DGBL contexts.

Caveats

When considering this research it is important to keep a few caveats in mind. First, the course was only eight weeks. With an intervention this short, there may simply have not been enough time for much effect and those that were seen may have been minimal. Group formation entirely random and was rushed. By the time the groups were finally solidifying, the course was over. Second, the course was conducted online which minimized face-to-face interaction, although some groups did meet occasionally in person. Social interaction was a major theme in the data and the online nature of the course may have inhibited some of the social dynamics that would have otherwise developed in a more traditional face-to-face environment or even in a blended learning environment. Third, the modified Group Environment Questionnaire (GEQ) had to be modified extensively to fit the online digital game context. This instrument was initially chosen because of its documented validity and reliability of its scores in past test

administrations. Designing and developing an instrument from scratch for the *StarCraft 2* course would have been too time and resource intensive so modifying an existing instrument was seen as a better alternative. However, the instrument ended up being modified so heavily to fit the unique digital game based environment of the *StarCraft 2* course that it became almost an entirely different instrument. As such, to ensure its validity and reliability, a full validation study would need to have been conducted. Fourth, the sample size was extremely small with six participants for the quantitative part of the research and three participants for the qualitative part. The entire course enrollment was only 16 students. Due to the nature of the course and the fact that males are much more likely to play digital games and RTS games like *StarCraft 1 and StarCraft 2*, the course enrollment was entirely male which means the research only examines collaboration in a DGBL course from the male perspective. Fifth, there were serious validity and reliability concerns with the modified GEQ due to the extremely small sample size and extensive instrument modification. However, despite these caveats, this preliminary research still offers valuable insight into the implications and potential of DGBL course implementation and study.

Future Directions

While this research certainly has its drawbacks and limitations, it has nevertheless proven it is possible—albeit on a very small scale in this particular case—for well-planned innovative education to become more widely accepted at the highest levels of academia. It is clear that Bob Dylan is right and that the times are indeed changing and that change is being driven by innovation. The *StarCraft 2* course has demonstrated that in education—a field still dominated by the traditional direct instruction educational methods common since Plato and Aristotle—innovation and change can still take root

and flourish. The business leader and best-selling author C. William Pollard recognized the necessity of thinking outside the box when he said that “learning and innovation go hand in hand. The arrogance of success is to think that what you did yesterday will be sufficient for tomorrow” (Pollard, 1996, p. 114). Researchers and educators must not simply rely on what worked in the past since yesterday’s methods may not be the best approach for tomorrow’s learners. This link between education and innovation was also readily apparent to the late management consultant, educator, and author Peter Drucker, who noted that “since we live in an age of innovation, a practical education must prepare a man for work that does not yet exist and cannot yet be clearly defined” (Drucker, 1957, p. 126). His words seem to ring especially true in a world where technology and the ways humans communicate continue evolving. After all, researchers and educators have a firm and clear mandate according to the popular *Did You Know* YouTube video about the exponential change that defines today’s society, since “we are currently preparing students for jobs that don’t yet exist using technologies that haven’t yet been invented in order to solve problems we don’t even know are problems yet” (Hale, 2008). The late economist and Harvard business professor Ted Levitt perhaps sums up just what has driven humanity and human progress through the ages when he declares that “just as energy is the basis of life itself, and ideas the source of innovation, so is innovation the vital spark of all human change, improvement and progress” (Minow, 2011). However, the scholar and organizational consultant Warren Bennis cautions that this progress will not come easily since “innovation by definition will not be accepted at first. It takes repeated attempts, endless demonstrations, monotonous rehearsals before innovation can be accepted and internalized by an organization. This requires ‘courageous patience’” (Bennis & Namus, 1997, p. 49). For innovative educational approaches to

become more widely accepted and implemented, researchers and educators must embrace innovation and change and demonstrate remarkable “courageous patience” and persistence as they continue to research, design, and implement innovative ideas and methods in education. This section discusses just a few of the many avenues future researchers and educators may choose to follow based on this *StarCraft 2* course research.

While the dynamic complexity of the DGBL field is certainly challenging, this makes it an exciting area to study and research. By developing and applying more systematic approaches to DGBL—in the design of academic instruction, in game choice, and in research methodology—researchers and educators can gain clearer insight into how digital games exactly influence teaching and learning. This research generated some very preliminary indications that a DGBL course specifically focused on teaching collaboration can influence participants’ experiences, attitudes, feelings, and perceptions towards working with others.

There are four main avenues that future research about the design, development, and study of DGBL courses could follow. The first possible future avenue could be that researchers interested in using major COTS games should choose to develop DGBL courses that use multiple games to help participants learn collaboration and teamwork. Course developers could pick at least one other more gender-inclusive digital game in addition to RTS games like the *StarCraft* series that would appeal to both males and females. Games such as *Minecraft* which are not competitive and which focus on creation and building could be included in the curriculum. Turn-based strategy games such as those in the *Civilization* series could also be used since they have a broader scope that includes culture and geography and have goals in addition to just eliminating

opponents, the main objective in RTS games. Strategy games like those in the *SimCity* series could also be more inclusive environments in which male and female learners could explore and learn. RTS games should still be part of the curriculum—albeit in a reduced role—because they offer a unique and authentic environment for participants to collaborate in real-time and encourage sound decision making in high-pressure situations. However, the addition of other digital games would offer learners different perspectives and environments in which to learn and hopefully also draw a more diverse enrollment.

The second possible future avenue of research could be to design and examine DGBL courses that are blended, rather than entirely online. In this research, participants reported the course positively influenced their feelings and perceptions towards the social aspects of collaboration during the semester. They felt some aspects of increased team cohesion as their groups continued to collaborate throughout the semester. This course was online so it is possible that participants could have felt an even greater degree of positive change had the course been in-person or blended. While participants in the online *StarCraft 2* course were able to gain more experience collaborating virtually with their group, the more intense in-person interaction of a blended learning environment could have given them an even more meaningful experience. Gaining collaboration experience in a hybrid online-traditional face-to-face context could be valuable to participants because this is what they would most likely be faced with in an increasingly interconnected and technological professional world. The blended environment would also allow for the use of non-digital games such as traditional board games, where learners could play games such as *Risk* or *Settlers of Catan*. The games could be set up where each “player” is replaced by groups, so that each decision must

undergo group discussion and consensus. Incorporating non-digital games could therefore offer yet another environment where learners would be encouraged to collaborate. Beginning the blended DGBL course with non-digital games could go a long way in helping groups get comfortable with dealing with some of the intricacies of group collaboration (i.e. establishing communication frameworks, scheduling, developing workflow, choosing leadership, and delegating group roles).

The third possible future avenue of research could be to include leadership skills to any DGBL course that focuses on or relies on teamwork and collaboration. Leadership is integral to effective group communication and function and focusing more effort on helping learners develop and practice these skills can go a long way in mitigating or even avoiding potential small group problems. This in turn would help keep groups running more smoothly, thereby maximizing collaborative and individual learning in the DGBL environment. Leadership skills, like collaboration skills are highly prized and sought after in the all fields in the professional world. Future research aimed at helping learners perfect these skills could have wide-ranging implications and applications for diverse fields.

The fourth avenue of potential future research could be to invest the considerable time and resources to create a research instrument specifically designed to study groups, group dynamics, leadership, and collaboration in virtual and DGBL learning. The instrument could be informed by existing instruments on traditional face-to-face teamwork and collaboration. In conjunction with a well-designed ongoing DGBL course, the instrument could then undergo a full validation study. As DGBL becomes more prevalent, such a validated instrument may prove to be extremely informative and helpful

in guiding educators and researchers. Its creation could also help generate more robust DGBL research, something that the field needs.

Overall, the online *StarCraft 2* course has explored the feasibility of a completely online DGBL course revolving around an extremely popular RTS game. After reflection on the design, implementation, and study of this course, using a solely-online DGBL course may not be the best approach when it comes to teaching participants about collaboration and when it comes to being as inclusive of potential learners as possible. This is not to say that the *StarCraft 2* course has been a mistake. Rather, it has shown some preliminary indication DGBL courses have merit and potential and that further improvements and refinements in design and implementation can help increase their effectiveness. The documented design and approaches brought forth in this *StarCraft 2* course research can help serve as a guide and springboard for future work in the DGBL field.

Conclusions

Throughout history, from the first cavemen glancing longingly upward, to Icarus' wax feathers, to Leonardo da Vinci's fantastical flying machines, humans have always looked to the birds in the air and dreamed of what it was like to fly. The Wright brothers not only had this dream, but were also driven to actually achieve it. They embraced change and innovation. However, innovation rarely gets things right the first time and the brothers went through much trial and error, bumps and bruises, and wrecked flying contraptions before they finally achieved sustained human powered flight. However, once that innovation took hold, it continued to inspire and encourage human ingenuity. Even today their innovation is continuing to be built upon in the form of ever larger, faster, and powerful aircraft. The Wright brothers themselves could never have foreseen

that not only would countless millions routinely fly around the world, but that humans would also make their mark in space. Just as the Wright brothers explored the whole new frontier of flight, researchers and educators today are continuing to explore a brave new world where technological advances have made possible things that in the past were only pipedreams. DGBL in particular represents an extremely promising area of inquiry because the experiential nature of games represents a convergence of many different concepts such as critical thinking, problem solving, competition, collaboration, motivation, leadership, and personality. Better understanding these concepts and others as well as the many different dynamics that occur in the virtual interconnected worlds of digital games can help researchers and educators improve education as well as positively contribute to the human experience.

The *StarCraft 2* course was like one of the Wright brothers' first attempts at powered human flight. It had its design flaws and its achievements were rather limited. However, this innovative educational approach shows much promise. Now it is up to future researchers and educators to continue to build upon this research foundation and to help DGBL become more effective and widely accepted and implemented. While the scope of this preliminary research is limited, it can still offer a valuable perspective regarding the design, development, implementation, and study of a DGBL course. This research sought to contribute to and expand the field of DGBL in two ways. It discussed the design of a DGBL course and also documented the implementation of a mixed-methods approach that examined the effect the DGBL course had on collaboration. A mixed-methods approach was used because collecting and analyzing both quantitative and qualitative data had the greatest potential in facilitating a clearer and fuller

understanding of the complex learning and interaction inherent within digital game environments.

Both the quantitative and qualitative data analysis indicated there is potential for DGBL approaches in helping learners practice and enjoy collaboration. Although limited in scope, statistical significance, and generalizability, this preliminary research found preliminary evidence that the *StarCraft 2* course did have a positive effect on learners' attitudes towards working with others and how they felt about the collaboration process. This preliminary evidence provides some indication of the potential of the DGBL course approach in helping learners experience, practice, and master crucial real-world skills such as collaboration in an enjoyable, innovative, and meaningful way. Future research needs to build on this documented implementation of a DGBL course approach using popular commercial off-the-shelf games. It also needs to further explore the complex social dynamics of leadership and more closely examine the application of both leadership and collaboration theory. The lessons learned from the design, development, implementation, and study of the *StarCraft 2* course has resulted in the generation of valuable guidance and frameworks others may find helpful as they design and study their own DGBL courses and learning environments. In many ways, educational researchers continually explore new frontiers much like history's great explorers or *Star Trek's* spacefaring crew who continue to "boldly go where no one has gone before" (Duane, Reaves, & Bowman, 1987). Education is centered on developing and shaping the mind, which is powerful and capable of effecting great change—both positive and negative. Winston Churchill once said "the empires of the future are the empires of the mind" (Churchill, 1993, p. 29). His words especially true in today's information-driven digital age, where social and geographical boundaries have become increasingly irrelevant as

the Internet and mobile communications technologies effortlessly transcend social groups, time, and space. Researchers and educators must be willing to embrace innovative educational methods today in order to prepare tomorrow's leaders and citizens for an increasingly technological and interconnected future driven by information and knowledge. Education can help shape that future and innovation can help lead and provide the driving force forward. As they are the researchers and practitioners most in tune with technology and its use in education, educational technologists are at the forefront of helping chart and guide education's future. It falls on them to design, develop, implement, and study innovative instructional approaches like DGBL and to ensure they are not only pedagogically effective, but also socially responsible and equitable. Technology has provided access to and the ability to wield power when it comes to transforming and improving education. However, as Spider-man's uncle once cautioned him, "with great power comes great responsibility" (Ziskin & Raimi, 2002) and it would be wise for researchers and educators to follow this advice. When carefully and responsibly designed, approaches such as DGBL have great potential in positively shaping and improving 21st century education.

APPENDIX A
COURSE SYLLABUS

EDG 4930: 21st Century Skills in StarCraft
Tentative Plan for the Course
Fall 2012

Instructor: Nate Poling, M.Ed
Office Location: Norman Hall, G518J
Office Hours: Monday, 1-3 pm or by appointment, or always by email
Email: npoling@coe.ufl.edu
(Please include your full name *and* course title in all email messages.)

Important Reminders:

1. Remember this course is not ABOUT StarCraft. Rather, it uses the game as a tool to help you practice and better understand crucial 21 century skills that can help you academically and professionally regardless of your major or interests.
2. The course is entirely online, so it is important that you stay current and pace yourself accordingly.
3. The course is highly academic so in addition to required game play, it also requires a substantial amount of collaboration, communication, reading, writing, analysis, and synthesis.
4. Tasks, assignments and rubrics are all clearly organized and will be available to you within the online course management system (Moodle). http://online.education.ufl.edu
5. I have designed this course using StarCraft, a game that we all love. It is my goal to help you develop and practice important skills that you can use academically and professionally for your advantage. It is my job to facilitate development and application of these skills as well as help guide you in connecting StarCraft concepts to the real world. A lot of planning has gone into the course and many hurdles have been cleared. I certainly hope that you will find the course to be enjoyable, useful, engaging, and worthwhile.

A. Description of the Course: 21st Century Skills in StarCraft is an 8 week online course that uses the popular real time strategy (RTS) game StarCraft 2 to teach valuable 21st Century Skills through a hands-on approach. With society becoming increasingly technology-based and fast-paced, it is important for professionals to be highly proficient in skills such as critical thinking, problem solving, resource management, decision making, and collaboration. These skills are fundamental in StarCraft 2 and therefore make the game a highly effective environment for students to analyze and take action in complex situations. Computer and video games of all types have become a major part of today's entertainment and technology worlds. Also, online education is an area of intense growth with many employers and professions using online courses and workshops for career development. This course synthesizes the three threads of 21st Century skill development, gaming, and online education into an innovative and experiential approach that encourages students to identify, learn, and practice crucial skills and apply and relate them to real-world situations. It does not teach about StarCraft 2, but rather aims to utilize the game and the complex situations that arise within it to present and develop the important skills professionals will undoubtedly need in the 21st century workplace.

This course includes required weekly game play, viewing and analysis of recorded matches, written assignments which emphasize analysis and synthesis of real/game-world concepts, and collaboration with other students. Due to the unique and innovative nature of this course, there are several requirements that students must meet. Students taking this course must have access to computer (PC or Mac) and Internet resources outside of UF labs since it requires the installation and playing of a computer game. Students must also have at least basic knowledge of and experience playing StarCraft 2. There is no required textbook, but students are required to purchase a copy of StarCraft 2

if they do not own one already. Students must also be independent, self-motivated, and able and willing to learn in an entirely online environment. Enrollment is limited to 24.

B. Goals of the Course: 1) Learners will connect in-game and real-world skills and knowledge. 2) Learners will realize and understand that 21st century skills apply to both the academic/professional world and the game world. 3) Learners will be able to relate and apply innovative and creative approaches to their academic and professional endeavors. 4) Learners will develop a strong understanding of 21st century skills through application and examination of theories and concepts. 4) Learners will develop and apply their collaborative skills as they interact in small groups to achieve common goals.

C. Objectives of the Course:

1. Learners will practice, apply, and analyze 21st century skills (problem solving, critical thinking, time/resource management, decision making and collaboration) and how they relate to StarCraft and the real world, and their chosen major/professional field.
2. Learners will understand the importance of creativity and innovation and apply that knowledge in different contexts.
3. Learners will be able to explain and evaluate the implications, benefits, and shortcomings of different strategies and approaches in both the StarCraft 2 environment and the real world academic environment.
4. Learners will develop their information, media, and technology literacies by finding and evaluating different sources of information and organizing that information using different technology tools.
5. Learners will collaborate and work in groups to practice communication, leadership, and teamwork.
6. Learners will practice their reflection skills and understand how reflecting on past decisions can inform current and future practice.
7. Learners will be able to clearly identify and connect academic, professional, and game concepts in multiple contexts (StarCraft 2, the real world, the professional world, the academic world).

D. Tentative Course Topic Outline:

Week 1: 21st Century Skills Overview, Problem Solving, and Evaluating Resources
Week 2: The Importance of Teaching, Training, and Instructional Skills
Week 3: Micro and Macro management—Levels of Decision Making and Group Collaboration
Week 4: Creativity and Standardization
Week 5: Flexibility and Adaptability
Week 6: Risk Management and Learning from the Pros
Week 7: Information Literacy and Research Skills
Week 8: Connecting it All and Final Project

E. Assignments:
Assignments for the course are listed below. Rubrics on how you will be assessed, due dates, and more detailed assignment descriptions/rationale are located in the online course management system. Please note that that some assignments may change, be modified, or eliminated and that if this happens, you will have ample warning via the online course management system and via your UF Gatorlink email.

Assignment Title	**Format**	**Points**
Week 1		
Introduction forum Post	ForumPost	10
Gaming in Education Opinion Forum Post	Forum Post	10
HUMINT ID Report 1	Table	10

Week 2		
Training and Development Forum Post	Forum Post	10
Skills Training Presentation Assignment	Presentation Creation	15
Game Play and Reflection Paper 1 Assignment	Reflection Paper	10
HUMINT ID Report 2	Table	10
Week 3		
Leadership and Personality Analysis Assignment	Paper	10
GroupCraft 1	Group Assignment	25
GroupCraft 1 Self-Evaluation	Self-Evaluation	5
HUMINT ID Report 3	Table	10
Week 4		
GroupCraft 2	Group Assignment	25
GroupCraft 2 Self-Evaluation	Self-Evaluation	5
"What Do StarCraft Terms Really Mean?" Forum Post	Forum Post	10
HUMINT ID Report 4	Table	10
Week 5		
Game Play and Reflection Paper 2 Assignment	Reflection Paper	10
"ZOMG I H8 Playing as the" . . . Forum Post	Forum Post	10
HUMINT ID Report 5	Table	10
Week 6		
Learning from the Pros Forum Post	Forum Post	10
GroupCraft 3	Group Assignment	25
GroupCraft 3 Self-Evaluation	Self-Evaluation	5
HUMINT ID Report 6	Table	10
Week 7		
StarCraft Fan Fiction	Paper	15
StarCraft Narrative Timeline Research	Paper	15
HUMINT ID Report 7	Table	10
Week 8		
Final Project Paper	Paper	20
Final Project Presentation	Presentation	20
	TENTATIVE TOTAL	335

Late work will not be accepted. However, if you have extenuating circumstances (medical or otherwise), let me know and we can work to resolve those. Please also note that you are expected and required to play StarCraft for the minimum allotted time.

F. Grading:
This semester, student assessment will be guided by the following scale and rubric:

A = 93 or above	B- = 80-82	D+ = 67-69
A- = 90-92	C+ = 77-79	D = 63-66
B+ = 87-89	C = 73-76	D- = 60-62
B = 83-86	C- = 70-72	E = 59 or below

G. Participation and Attendance
As this is an entirely online course, your participation will be evaluated from your forum posts, timely submission of assignments, collaborative activities, and self-evaluations. It is expected that you regularly log into the online course management system to complete assignments and course material and also that you regularly check your UF Gatorlink email.

H. Code of Conduct
This course uses a game we all love—StarCraft 2—to teach about important real-life skills that are necessary to survive and thrive in a fast-paced 21st century environment. There is a large collaborative emphasis in the course. Collaboration often can be difficult and frustrating. Many times it may be easier to "go it alone" instead of working together with others. However, this isn't how the real world works. You will be interacting and collaborating with other StarCraft learners of varying skill-levels, background, and academic experience. Add to this the competitive aspect of game play and sometimes tensions can arise/boil over. Remember, this course is about learning important concepts that transcend StarCraft 2 gameplay. It aims to provide you with an opportunity to practice the skills you'll need to be successful in the future—including collaboration.

Remember the old adage we all are taught…"It's not if you win or lose, but rather how much you learn from your game play…" Ok, so I made that up, but you get what I mean.

Basically, I know collaboration and competition can create tension. But for any group to successfully complete their task or mission, they must somehow find ways to work together towards that common goal.

As such, each of you is expected to show patience and respect for your fellow learners, your clan-mates, and your opponents (although I do realize that a little of the standard StarCraft friendly good-natured trash talk is inevitable…) If you have questions or concerns, refer to the group conflict resolution resource in the online course management system or email me ASAP.

I. Required Items:

1. Personal computer capable of running StarCraft II
2. A personal reliable internet connection capable of extended online play
3. Legitimate retail copy of StarCraft II

J. University of Florida Policies:
Academic Honesty: As a result of completing the registration form at the University of Florida, every student has signed the following statement: "I understand the University of Florida expects its students to be honest in all their academic work. I agree to adhere to this commitment to academic honesty, and understand that my failure to comply with this commitment may result in disciplinary action, up to and including expulsion from the University."

Acceptable Use Policy: Please read the University of Florida Acceptable Use Policy. It is expected that you abide by this policy.

Software Use: All faculty, staff, and students of the University of Florida are required and expected to obey laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate.

Accommodations for Students with Disabilities: Students with disabilities, who need modifications to complete assignments successfully and otherwise satisfy course criteria, are encouraged to meet with the instructor as early in the course as possible to identify and plan specific accommodations. Students WILL be asked for documentation from the Office for Students with Disabilities to assist in planning accommodations. Please see me during office hours to discuss any accommodations you might need.

University of Florida Counseling Services: Resources are available on campus for students having personal problems or lacking clear career and academic goals which interfere with their academic performance. These resources include:

1. University Counseling Center, 301 Peabody Hall, 392-1575, personal and career counseling.
2. Student Mental Health, Student Health Care Center, 392-1171, for personal counseling.
3. Sexual Assault Recovery Services (SARS), Student Health Care Center, 392-1161, for sexual assault counseling.
4. Career Resource Center, Reitz Union, 392-1601, career development assistance and counseling.

UF Computer Policy: In keeping with the University of Florida's student computer policy all assignments completed for this class must be typed using a word processing program. Use of spell-checking and grammar-checking programs is strongly encouraged. Points will be deducted from assignment with excessive spelling/grammar errors. Use of desktop publishing software and computer generated graphics for course product that may eventually be included in student's portfolios is also strongly encouraged.

Technology Assistance: The course instructor will hold weekly office hours in the technology laboratory and will be available for assistance. In addition, students may use the services of other technology assistants during lab times. However, all students are encouraged to attempt to complete assignments early enough such that instructors and mentors can provide assistance during regular work days and during regularly scheduled hours. In extreme emergencies, students may attempt to make appointments with course instructors or mentors. However, late work will be penalized according to the late policy.

Response times: Allow 24 hours for replies to emails. This may be extended to 48 hours if the email is left over a weekend or holiday.

Student Concerns: If you have any concerns or questions about any situation in the course please contact me ASAP.

APPENDIX B
COURSE DESCRIPTION

EDG4930 HNR 21st Century Skills in StarCraft

Credits: 2
Writing or Math Req: None
Gen Ed: None

Section	Instructor	Times	Locations
07EH	Nate Poling	TBA	WEB LECT

21st Century Skills *in StarCraft* is an 8 week online course that uses the popular real time strategy (RTS) game StarCraft 2 to teach valuable 21st Century Skills through an experiential learning approach. With society becoming increasingly technology-based and fast-paced, it is important for professionals to be highly proficient in skills such as collaboration, critical thinking, problem solving, resource management, and adaptive decision making. These skills are fundamental in *StarCraft 2* and therefore make the game a highly effective environment for students to analyze and take action in complex situations. Computer and video games of all types have become a major part of today's entertainment and technology worlds. Also, online education is an area of intense growth with many employers and professions using online courses and workshops for career development. This course synthesizes the three threads of 21st Century skill development, gaming, and online education into an innovative and experiential academic course that encourages students to identify, learn, and practice crucial skills and apply and relate them to real-world situations. It does not teach about StarCraft 2 or about how to become a better player, but rather aims to utilize the game and the complex situations that arise within it to present and develop some of the important skills professionals will undoubtedly need in the 21st Century workplace. This course includes required weekly game play, collaborative projects, use of Web 2.0 tools, viewing and analysis of recorded matches, written assignments which emphasize analysis and synthesis of real/game-world concepts, and collaboration with other students. Due to the unique and innovative nature of this course, there are several requirements that students must meet.

Students taking this course must have access to computer (PC or Mac) and Internet resources outside of UF labs since it requires the installation and playing of a computer game. Students must also have at least intermediate knowledge of and experience playing *StarCraft 2* and own their own copy of the game. Students must also be independent, self-motivated, and able and willing to learn in an entirely online environment. Since this course revolves so heavily on collaboration and teamwork, students must also be willing to work collaboratively with others in both the *StarCraft 2*

environment and in a small group project environment. There will be 2 mandatory in-person informational meetings prior to the beginning of the course. Enrollment is limited to 24.

Nate Poling is an Educational Technology PhD student and course instructor at the University of Florida. His research interests revolve around video/computer games and the implications they have for teaching, learning, and training. He currently teaches EDG 4930 21st Century Skills in StarCraft, IDH 3931 (Un)common Reading: Undead which is a zombie literature course, and EME2040 Introduction to Educational Technology.

APPENDIX C
GROUP CRAFT ASSIGNMENT 1

GroupCraft Assignment 1: Small Group Strategies and Effectiveness (25 points)

Important note: I am looking for just one submission per group. Please make sure each member's name is on the submission.

1.) Meet for a 3 v 3 strategy session with your clan. Discuss and plan out your approaches to the upcoming collaborative matches you will be playing. Keep in mind that 3 v 3 can be quite complex. 1 v 1 can be fast paced and complicated, but 3 v 3 can quickly become much more complex.

The following are questions meant to help guide your meeting. Be sure to make record of your initial group responses. You don't have to explicitly answer each one, but be prepared to reflect and discuss your group performance in 2-3 well-written paragraphs later:

- Consider the StarCraft 2 race composition of your own team and also the potential composition of your opponents.
- What strategies will you use?
- Are there general team strategies that will work versus anyone?
- Are there general team strategies that only work versus certain opponents? Realize that making an exhaustive matchup list with all possible combination would take forever so don’t spend all your time thinking about this, but provide at least a few examples of what you would do if certain matchups/situations arise. Perhaps more general and adaptable strategies are appropriate? That being said, what value is there to specific strategies such as TvP or TvT or ZvP etc?
- What roles will each of you play?
- Will you focus on each opponent one by one or keep all 3 occupied?
- How will you communicate in game?
- What will your overall strategy be?

2.) Regardless of whether the meeting is face to face or conducted from a distance, be sure to keep notes about what you talk about. Keeping records of meetings is crucial as they can be invaluable when your boss wants to know how the planning session went or if a future client wants them for their records.

3.) Play at least a couple of 3 v 3 matches. You may play more if you want to and have time.

Decisions at all levels are rarely decided by the skills, information, and efforts of an individual. Usually they are the result of a collaborative effort by a group or organization. Groups often are the most effective way to think creatively, make important decisions, and analyze complex problems. The power of groups lies in utilizing the ideas and talents of many people as opposed to just one person. However, groups do not always

produce innovative solutions. Frequently, collaborative effects are hampered by common group and decision making pitfalls. Even high-level decision making organizations such as the White House make common and preventable decision making mistakes. Many political scientists believe that George W. Bush's administration suffered from "groupthink" which untimely led the US into a war based on false justifications. Organizations and governments all around the world are guilty of bad group practices. Yet, there is still hope for groups everywhere. Understanding the pitfalls and analyzing your own group's decision making dynamics will dramatically reduce the common mistakes that can plague collaborative efforts. Reflection can also help improve your own collaborative skills, which that can enable you to more effectively contribute to and lead groups in the future.

4.) Your group will study 9 common group and decision making blunders and decision-making obstacles listed below. Take a moment to review each of the concepts below. Each is linked to a Wikipedia article that goes in greater depth than the definition. (Although it is generally not accepted as an academic source, Wikipedia is a great resource to get a first look at a subject and can help guide your research endeavors.)

1. Affective conflict
2. Anchoring bias
3. Confirmation bias
4. Consensus
5. Devil’s advocacy
6. Groupthink
7. Indecisive culture
8. Process losses
9. Sunk-cost effect/dilemma

5.) Examine and analyze the notes from your strategy making session. You don't have to turn anything in here, but make sure you reflect on your meeting.

6.) Next, in another 2-3 paragraph rationale address the following question. Which of the three decision-making pitfalls did your group feel they avoided successfully? Make sure to explain your answer and cite examples from your strategy sessions where appropriate.

7.) After you have done step 6, think about the next question. Which of the three decision-making pitfalls did your group feel they experienced/committed to some degree. Make sure to explain your answer and cite examples from your strategy sessions where appropriate. (2-3 paragraphs)

8.) Now that you have met with your group, played collaboratively with them, and analyzed your performance and dynamics, it is time to ensure that you do not replicate your mistakes in the future. For step 8, your group will come up with strategies to prevent such group dynamic and decision making errors from reoccurring. Be specific on what rules or systems your group will implement in the future. (2-3 paragraphs)

9.) In 2-3 well-written and well thought out paragraphs, reflect on the effectiveness of your collaboration. What does it say about your clan with regards to collaboration? What does it say about each individual member? What insight can you gather from what you have learned about the group and the individual members with regards to real-world collaboration?

10.) Lastly, upload a Word document that includes all the elements that you have created. It should include the following you have created in steps 1-9:

- Your actual meeting notes and a 2-3 paragraph post-game reflection on your meeting decisions. Consider giving examples of decisions you made during the meeting. Did you follow through? What resulted? How close were your meeting decisions and what actually transpired during the matches? Basically, what did you initially plan and what happened in reality?
- 2-3 paragraph rationale detailing the 3 pitfalls you feel your group avoided
- 2-3 paragraph rationale detailing the 3 pitfalls you feel like your group suffered in any degree.
- 2-3 paragraph rationale where you come up with strategies to prevent group errors and to improve group efficiency/effectiveness
- 2-3 paragraph reflection on your group collaboration and what it means to real world applications.

11.) Under the separate individual contribution file upload section in Moodle, you will reflect upon your own efforts and contributions. For the self-assessment, give yourself a score that you feel you deserve out of 5 and provide a brief rationale/justification (1 paragraph minimum, where you honestly reflect on your own efforts at meetings, game play, and whatever work you were assigned by your group). The entire project is worth 30 points, with 5 being based on your self-assessment

APPENDIX D
GROUP CRAFT ASSIGNMENT 2

GroupCraft Assignment 2: Collaboration in Analyzing Build Orders and Creativity (25 points)

For this collaborative activity you will work with your clan to explore the concepts of build orders, strategies, and innovation. The end product will be a visual organization web that will help you solidify some of your StarCraft knowledge using real world procedures such as collaborative brainstorming. You will now learn a couple of Internet tools to create concept webs. We'll be using the collaborative concept mapping tools bubbl.us or Gliffy

Every group will be different as everyone has different ways of working together. Also, your process will differ depending on which communication method you choose (i.e. in person, over Skype, via a Google Doc, via IM etc.) With companies and organizations increasingly becoming more globalized, it is very possible in your future job that you will be asked to collaborate and brainstorm new innovative ideas with your counterpart who lives in another country and time zone.

1. Communicate with your group to set ground rules for your collaborative brainstorming session. What method will you use to meet? Why? What rules will govern your meeting so that it is productive and effective? How will you organize your ideas? What will be your procedure in choosing and discarding ideas?

2. Brainstorm and make a list about build orders, strategies, and innovative approaches for each of the 3 races. You may want to reflect on some of the lessons you learned or concepts you discussed for last week's collaborative activity. Some questions you may want to consider to help you get started include: What specific build orders are there for each? What makes them successful? How can you organize and group them into different categories? What common elements are there? What are the underlying real world concepts behind the builds or strategies? What situations do you use them?

3. Now look at your list and organize it. You may make hierarchal connections or even discard some of your ideas.

4. Work together to create a visual concept web using your finalized list of ideas. This visual representation should be a useful tool for your own quick reference or to help guide more novice and inexperienced players. You'll be embedding this image into a Word document. You'll have to export the image as a PNG or JPEG format image.

5. Finally, work together to come up with a project rationale. Your 2 page double spaced rationale should consist of the following elements:

- Brief overview/summary of your clan’s brainstorming process and how you divided up the group tasks/responsibilities.
- Embedded bubbl.us or Gliffy image.
- Explanation of your visual organizational web.

Finally, you will be uploading 2 files into Moodle. First, each clan should upload a single Word document with their image and rationale here into this Moodle activity. The document should include your names, your visual image, and your rationale section. Remember, I just need one image/image rationale file from each clan. Second, each clan member should upload a Word document in this week's module section labeled "Group Collaboration Self Evaluation" that includes a paragraph where they evaluate their own contribution to the group process, give themselves a score out of 5, and provide rationale for that score.

APPENDIX E
GROUP CRAFT ASSIGNMENT 3

Risk is a major factor in many professional fields. Of course, some fields revolve more around risk and risk management than others. Fields such as the sciences, medicine, and engineering must constantly consider risk in decisions and procedures (e.g. there are always certain elements of risk involved with experiment or prototype design). Even other fields such as political science, performing arts, and theatre must take risk into account (e.g. there is always an element of risk and chance when it comes to organizing and performing a complicated play or musical or when making political decisions). A solid understanding of risk, its underlying causes, and strategies of how to manage/address it is often the difference between success and failure (both in the real world and on the StarCraft 2 battlefield). Sometimes taking risks is a good thing, and in other situations it can be a bad thing. It is important to remember that risk is often context-specific. However, useful tools such as risk/impact probability charts combined with knowledge of risk will undoubtedly provide you with ways to effectively manage it.

For this GroupCraft exercise, you will be playing only 2 matches, one at the beginning of the exercise, and one towards the end. Please respond to each of the following prompts and make sure each section is clearly labeled and organized.

1. First off, play one 3v3 match with your group without any risk management preparation at all. Briefly describe what happened and the results. Why did things happen and end up the way they did? (1 paragraph)

2. Now that you have finished your one match, do a little more research on risk tolerances. What are the risk-tolerances of each of your group's members? What is your risk-tolerance as a group? How does this tolerance level translate to how you approach your StarCraft match preparation, execution, and reflection? (2 paragraphs)

3. Review this resource. Identify 5 sources of risk (threats) within a typical StarCraft 2 match. For each of these discuss which risk management strategy you will use (avoid, transfer, mitigate) and provide details of those plans. Conduct additional research as necessary. (2 paragraphs)

4. Using the same resource as above, identify 5 sources of positive risk (opportunities) within a typical StarCraft 2 match. For each of these discuss which risk management strategy you will use (share, enhance, exploit) and provide details of those plans. Conduct additional research as necessary.

5. Now take the 5 risks (threats) you have already identified and place them on a risk impact/risk probability chart. For simplicity and ease of use, use the one that is available as an Excel template. Now think of 10 more risks (threats) and place them accordingly in the matrix. (2 paragraphs)

6. Reflect on your completed risk impact/risk probability chart. Overall, how will your group use the information provided in the matrix? What specific steps will you be taking both in and out of game? (2 paragraphs)

7. Now that you all have a better understanding of risk and ways to manage it, play one 3v3 match. What were the results of the match? How did things play out? How did you apply what you learned about risk into your StarCraft match preparation and game play? Did it make a difference in your group/individual performances? How can you take what you learned in this game/academic exercise and apply it to the real world? (2 paragraphs)

8. Upload both your group document and Excel risk chart into Moodle.

9. Like the first GroupCraft, you will be evaluating yourself under a separate section in this week's Moodle module.

APPENDIX F
GAME PLAY AND REFLECTION PAPER

Rationale:
People often spend a lot of time and resources planning and implementing a project, but neglect to reflect on or evaluate that implementation and planning. As you have already learned in your StarCraft matches and in this course, reflection on past and current decisions can be invaluable in informing future decisions and direction. The most successful individuals and organizations always invest time and resources into looking back, evaluating, and reflecting so they can constantly improve. This iterative process can be helpful not only in the real world, but also in StarCraft. These are skills that employers often highly value.

Task:
Often, the best and most effective decisions follow an ITERATIVE process. There is a constant cycle of brainstorming, analysis, implementation, and reflection. It's not uncommon for project leaders or organization management teams to rinse,wash, and repeat several times. It is important to analyze and reflect at different points of a project or decision making process. This assignment tries to get you to model this by basically going through 5 iterations of the analysis/implementation/reflection process and then having you learn from the overall decision making/reflection process.

You will play 5 individual StarCraft 2 matches versus a human opponent. For EACH, follow the steps below and document your progress/information under the appropriate headings. (Note: Your completed assignment should have a total of 6 subheadings, one for each of the 5 matches, and 1 for overall analysis.)

Important: Remember to complete each written analysis BEFORE each match. This will actually make your task easier because you won't have to recall details way after the matches are over since they may tend to blend together.

Match Iteration 1:

1. Jot down a brief list of what discuss/strategies/build orders you plan on trying before you begin each match.
2. Play your match. Note whether it was a win or a loss.
3. Reflect on your match, paying special attention to decisions made and the outcome. How well did your plan work? How closely did you stick to it? What were the results of your decision? Why did things unfold as they did and how do you ensure that you either replicate/avoid further occurrences?
4. Learn from your match. What are you going to do better next match? What things are you going to change and why? How will you make sure that you DO win again or DON'T lose again?

Match Iteration 2:
Rinse, wash, and repeat

The Fold Cycle:
The last stage of the rinse, wash, repeat cycle is what I like to think of as the fold cycle. This is where you analyze, organize, and make sense of what you've learned and experienced. After each of the 5 mini-analyses, we'll look at the big picture. Look at each of your match mini-analyses and note your decisions, outcomes, and what you learned from what you jotted down. Are there any patterns to what you experienced/learned? Compare the decisions/results from Match 1 with Match 5. What differences are there? Overall, how are the decisions and results the matches different/the same? What did you learn about your game play and mastery of 21st century skills? How do the decisions you made in each individual match iteration inform your understanding of your own overall decision making capabilities?

Please submit your assignment in Word document format to me via Moodle upload. Make sure you include your name, date, and group/clan at the top of the page.

APPENDIX G
LEADERSHIP SURVEY AND MEYERS-BRIGGS PERSONALITY TYPE SURVEY ACTIVITY

Note: You may want to complete this assignment before meeting for your GroupCraft Assignment 1.

A good way to ensure successful collaboration is for each member to understand their leadership and personality profile. This information can go a long way in minimizing conflict and maximizing group effectiveness. This assignment is designed to help you identify important information that will assist with both in-game and real-world collaboration. In the forum below post an entry that addresses the following:

1. Complete the leadership survey at http://www.nwlink.com/~donclark/leader/survstyl.html and record your results within your post.

2. Complete the Meyers-Briggs Personality Type survey at http://www.humanmetrics.com/cgi-win/JTypes2.asp and record your results within your post.

3. According to your results, what is your leadership style and what is your personality type? How accurate are these results? To what extent do they describe you?

4. How do you think your personality type and leadership style will influence how you interact and communicate with your clan both in-game and in real world contexts.

5. What does what you have learned through your reflection and your personality/leadership style mean for your clan and how it functions? What are some benefits and pitfalls that you will need to keep in mind? How can you improve your group performance and collaboration? Give some specific examples.

APPENDIX H
IRB FOR THE QUANTITATIVE PHASE OF THE STUDY

UF | Institutional Review Board
UNIVERSITY of FLORIDA

PO Box 112250
Gainesville, FL 32611-2250
352-392-0433 (Phone)
352-392-9234 (Fax)
irb2@ufl.edu

DATE: September 4, 2012

TO: Nathaniel D. Poling
PO Box 117048
Campus

FROM: Ira S. Fischler, PhD; Chair
University of Florida
Institutional Review Board 02

SUBJECT: **Approval of UFIRB # 2012-U-0904**
From StarCraft to GroupCraft: Examining Collaboration, Teamwork, Team Cohesion, and Equity within an Undergraduate Honors Digital Game-Based Course

SPONSOR: None

I am pleased to advise you that the University of Florida Institutional Review Board has recommended approval of this protocol. Based on its review, the UFIRB determined that this research presents no more than minimal risk to participants. Your protocol was approved as an expedited study under category 7: *Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.*

Given this status, it is essential that you obtain signed documentation of informed consent from each participant. Enclosed is the dated, IRB-approved informed consent to be used when recruiting participants for the research. If you wish to make any changes to this protocol, *including the need to increase the number of participants authorized*, you must disclose your plans before you implement them so that the Board can assess their impact on your protocol. In addition, you must report to the Board any unexpected complications that affect your participants.

It is essential that each of your participants sign a copy of your approved informed consent that bears the IRB approval stamp and expiration date.

Your approval is valid through **September 4, 2013. If you have not completed the protocol by this date, please telephone our office (392-0433), and we will discuss the renewal process with you. Additionally, should you complete the study before the expiration date, please submit the study closure report to our office.** The form can be located at http://irb.ufl.edu/irb02/Continuing_Review.html. It is important that you keep your Department Chair informed about the status of this research protocol.

ISF:dl

Informed Consent

Protocol Title: From StarCraft to GroupCraft: Examining Collaboration, Teamwork, Team Cohesion, and Equity within an Undergraduate Honors Digital Game-Based Course

Please read this consent document carefully before you decide to participate in this study.

Purpose of the research study:

The main purpose of this study is to record and examine learner experiences of and attitudes towards collaboration and teamwork in the StarCraft course. It also aims to advance the research in using digital game-based learning in education.

What you will be asked to do in the study:

If you choose to participate in this study, you will be asked to complete a short 28-item questionnaire at the end of Week 4 of the StarCraft course and also complete the same 28-item questionnaire at the end of Week 8 of the course. The questionnaire will be administered via the online course management system and aims to collect some important demographical information and also to examine and record your experiences of collaboration and teamwork in the StarCraft 2 course. Each administration of the questionnaire will last approximately 30 minutes, which will equate to a total of a 1 hour time commitment for the entire study. You will also be asked for your permission to have your final course papers analyzed using document analysis techniques. This part of the study will take no time on your part and aims to provide a rich context and further information regarding your collaboration and teamwork experiences in the course.

After this portion of the study and after the course has ended, you will have the chance to continue your participation in the study. Your participation in the first part of the study doesn't mean you have to participate in the second part. In this second portion of the study you will be asked to participate in a 5-7 member focus group that will last approximately 1 hour and which will be audio recorded and transcribed. The focus group will be preceded by a short questionnaire designed to record some important demographical information. The focus group will discuss your digital gaming experiences and your experiences in the StarCraft 2 course. The data you provide will be kept confidential. You will have an opportunity to review and check the focus group transcripts.

All of the data you provide by participating in this study will help advance the research on digital game-based learning. Please note that the data you provide will be used anonymously for academic research such as scholarly publications and presentations. Participation in this study is completely voluntary. While the course instructor is also the primary researcher of this study, participation/non-participation will have absolutely no effect on your course grade. All the data collected in this study will not be viewed/analyzed until after the course has ended and grades have been finalized with the registrar. Also, the researcher will not know the identities of participants until after grades are finalized. The data you provide will be kept confidential and will not be shared with your group members. Artifacts/assignments for analysis will not be chosen until after the semester has ended and final course grades have been submitted to the registrar. These precautions have been instituted to eliminate researcher bias.

Time required:

1 hour for the quantitative questionnaire
1 hour for the focus group (if you elect to participate further in the study)

Risks and Benefits:

I do not anticipate any risk to you as there will be no incriminating or controversial data collected and all materials will be kept either locked in my office or stored on a firewall and password protected laptop which will always remain with me or locked in my office. I do not foresee any direct benefit to you for participating in this study.

Compensation:

None. Participation/non-participation will have absolutely no effect on your course grade and performance.

Confidentiality:

Your identity will be kept confidential to the extent provided by law. Your information will be assigned a code number. The list connecting your name to this number will be kept in a locked file in my faculty supervisor's office. When the study is completed and the data have been analyzed, the list will be destroyed. Your name will not be used in any report.

Voluntary participation:

Your participation in this study is completely voluntary. There is no penalty for not participating.

Right to withdraw from the study:

You have the right to withdraw from the study at any time without consequence.

Whom to contact if you have questions about the study:

Nathaniel Poling, PhD Candidate, Educational Technology, School of Teaching and Learning, UF College of Education, npoling@ufl.edu, phone 352-273-4179.

Dr. Kara Dawson, PhD, Educational Technology, School of Teaching and Learning, UF College of Education, dawson@coe.ufl.edu, phone 352-273-4177.

Whom to contact about your rights as a research participant in the study:

IRB02 Office, Box 112250, University of Florida, Gainesville, FL 32611-2250; phone 392-0433.

Agreement:

I have read the procedure described above. I voluntarily agree to participate in the procedure and I have received a copy of this description.

Participant: _____ Date: _____

Principal Investigator: _____ Date: _____

Approved by
University of Florida
Institutional Review Board 02
Protocol # 2012-U-0904
For Use Through 09-04-2013

APPENDIX I
IRB FOR THE QUALITATIVE PHASE OF THE STUDY

UF | Institutional Review Board
UNIVERSITY of FLORIDA

PO Box 112250
Gainesville, FL 32611-2250
352-392-0433 (Phone)
352-392-9234 (Fax)
irb2@ufl.edu

October 11, 2012

TO: Nathaniel D. Poling
PO Box 117048
Campus

FROM: Ira S. Fischler, PhD; Chair
University of Florida
Institutional Review Board

SUBJECT: **Revision of Protocol #2012-U-0904**
From StarCraft to GroupCraft: Examining Collaboration, Teamwork, Team Cohesion, and Equity within an Undergraduate Honors Digital Game-Based Course

SPONSOR: None

The request to revise the above referenced protocol has been reviewed and approved. Approval of this study is valid through September 4, 2013.

The Board must review any further revisions to this protocol, including the need to increase the number of participants authorized prior to implementation.

IF:dl

- Added an individual interview portion
- Added new consent

Informed Consent for Interview Part of Study

Protocol Title: From StarCraft to GroupCraft: Examining Collaboration, Teamwork, Team Cohesion, and Equity within an Undergraduate Honors Digital Game-Based Course

Please read this consent document carefully before you decide to participate in this study.

Purpose of the research study:

The main purpose of this study is to record and examine learner experiences of and attitudes towards collaboration and teamwork in the StarCraft course. It also aims to advance the research in using digital game-based learning in education.

What you will be asked to do in the study:

During this portion of the StarCraft research study, you will be asked to participate in an individual interview with the primary investigator that will last approximately 1 hour and which will be recorded and transcribed. The interview will be preceded by a short questionnaire designed to record some important demographical information. The interview will discuss your digital gaming experiences, your digital gaming history, your background, and your experiences in the StarCraft 2 course. The data you provide will be kept confidential. You will have an opportunity to review and check the individual interview transcripts.

All of the data you provide by participating in this study will help advance the research on digital game-based learning. Please note that the data you provide will be used anonymously for academic research such as scholarly publications and presentations. Participation in this study is completely voluntary. While the course instructor is also the primary researcher of this study, participation/non-participation will have absolutely no effect on your course grade as the course has ended at the time of these interviews and final grades have already been submitted to the registrar. The data you provide will be kept confidential and will not be shared with your group members.

Time required:

1 hour for the individual interview

Risks and Benefits:

I do not anticipate any risk to you as there will be no incriminating or controversial data collected and all materials will be kept either locked in my office or stored on a firewall and password protected laptop which will always remain with me or locked in my office. I do not foresee any direct benefit to you for participating in this study.

Compensation:

None. Participation/non-participation will have absolutely no effect on your course grade and performance.

Confidentiality:

Your identity will be kept confidential to the extent provided by law. Your information will be assigned a code number. The list connecting your name to this number will be kept in a locked file in my faculty supervisor's office. When the study is completed and the data have been analyzed, the list will be destroyed. Your name will not be used in any report.

Voluntary participation:

Your participation in this study is completely voluntary. There is no penalty for not participating.

Right to withdraw from the study:

You have the right to withdraw from the study at any time without consequence.

Whom to contact if you have questions about the study:

Nathaniel Poling, PhD Candidate, Educational Technology, School of Teaching and Learning, UF College of Education, npoling@ufl.edu, phone 352-273-4179.

Dr. Kara Dawson, PhD, Educational Technology, School of Teaching and Learning, UF College of Education, dawson@coe.ufl.edu, phone 352-273-4177.

Whom to contact about your rights as a research participant in the study:

IRB02 Office, Box 112250, University of Florida, Gainesville, FL 32611-2250; phone 392-0433.

Agreement:

I have read the procedure described above. I voluntarily agree to participate in the procedure and I have received a copy of this description.

Participant: _____ Date: _____

Principal Investigator: _____ Date: _____

Approved by
University of Florida
Institutional Review Board 02
Protocol # 2012-U-0904
For Use Through 9-04-2013

APPENDIX J
THE MODIFIED GROUP ENVIRONMENT QUESTIONNAIRE

1. Overall, I do not enjoy engaging in the game-related social interactions (e.g. Skype/Facebook conversations, planning sessions, collaborative game play) of this group.*
2. Overall, I do not enjoy engaging in the academic social interactions (e.g. group projects, planning meetings, Skype/Facebook conversations) of this group.*
3. Overall, I do not do my best at being personally involved and committed during group game play.*
4. I am not open to continuing to play collaboratively with my group after the course ends.*
5. I am unhappy with my group's desire to win games.*
6. I am personally invested in helping my group win games.
7. I have made some good friends in this group.
8. I am open to staying in contact with members of my group after the course ends.
9. This group does not give me enough opportunities to improve my personal game-play skills.*
10. This group does not give me enough opportunities to improve my collaborative skills.*
11. I prefer to play collaboratively with my group members rather than collaboratively with people not in my group.
12. I enjoy working with my current group members in this course more than working with other groups.
13. Overall, I do not like the work style (e.g. communication, planning, time management) of this group.*
14. Overall, I do not like the play style (e.g. communication, competitiveness, strategies) of this group.*
15. During this semester, this group is a meaningful social group to me.
16. Our group is united in trying to achieve its goals for game play.
17. Our group is united in trying to reach its goals for academic performance.
18. Members of our group would rather play collaboratively with non-group members than play together as a group.*
19. We all take responsibility for losing any game.
20. We all take responsibility for any performance that is below expectations on submitted group work.
21. Our group members rarely socialize together outside of the course.*
22. Our group members have conflicting expectations for the group's game play performance.*

23. Our group members have conflicting expectations for the group's academic performance.*
24. Our group is open to spending time together inside or outside of the game after the course is over.
25. If members of our group have problems during game play, other members are willing and wanting to help.
26. If members of our group have problems during academic projects, other members are willing and wanting to help.
27. Members of our group do not communicate openly about each member's responsibilities regarding game play.*
28. Members of our group do not communicate openly about each member's responsibilities regarding academic projects.*

*Items must be reverse scored

APPENDIX K
INDIVIDUAL INTERVIEW PROTOCOL

Opening Question:

- So what's your favorite StarCraft race what makes them your favorite?

Introductory Question:

- So what do you feel you've gotten out of the collaborative element of the course now that it's complete?

- Take a few moments and jot down how you would define "collaboration."

- Take a few moments and jot down how you would define "teamwork."

- In what ways—if any—do you think your definitions have changed or evolved over the course of the class and your StarCraft game play?

Transition Question:

- How would you describe your attitudes and perspectives on collaboration and teamwork?
    - Follow up probe: To what extent—if any—did the StarCraft course influence or change those attitudes and perspectives?

- Tell me more about your history with digital gaming and your gaming preferences and experiences.

- What is your experience level with real-time strategy games and StarCraft in particular?

- How did your StarCraft and digital gaming experience influence your experience in this course?

- What personal perspectives and details do you think have influenced your digital game play?

- What personal perspectives and details do you think have influenced your experiences in the course?

- Think back to when you were still taking the course. Tell me about some of your collaborative and teamwork-oriented experiences during the course.

- How close did you feel to your group during the group projects and group game play? What kind of group dynamics did your group have? How did you communicate? What was the group climate like?

- What would you say most characterizes your collaborative experiences that you've had?

- What other factors—if any—do you think influenced your attitudes towards and experiences with collaboration and teamwork in this course?
    - Follow up probe: Factors could include year in school, major, experience with digital gaming in general, and familiarity with StarCraft.

All-Things-Considered-Question:

- If asked to provide a brief statement about how the StarCraft course influenced or did not influence your attitudes and perspectives on collaboration and teamwork, what would you say?

Summary Question

- Now that we've discussed your attitudes towards collaboration and teamwork and experiences in the StarCraft course, I want to provide quick summary of what we've discussed. [Facilitator gives summary of individual interview.] Does this summary sound complete to you?

Final Question

- Is there anything that we've accidentally missed or overlooked that we should discuss?

Demographic Information

(1) How many years have you played digital video/computer games?

(2) How many years have you played real-time strategy games?

(3) How many years have you played either StarCraft 1 or StarCraft 2?

(4) What year in school are you?

(5) What is your major?

(6) What was your approximate high school GPA? (You may just give a ballpark estimate.)

(7) What approximately is your current UF GPA? (You may give a ballpark estimate. If this is your first semester, guestimate based on your grades so far.)

LIST OF REFERENCES

Aha, D.W., Molineaux, M., & Ponsen, M. (2005). Learning to win: Case-based plan selection in a real-time strategy game. Proceedings of the Sixth International Conference on Case Based Reasoning (pp. 5-20). Chicago, IL: Springer.

Allen, I. E., & Seaman, J. (2008). *Staying the course*. Babson Survey Research Group: The Sloan Consortium.

Ananiadou, K., & Claro, M. (2009). 21st century skills and competences for new millennium learners in OECD countries (No. 41). OECD Publishing.

Ancona, D. G., & Caldwell, D. (1992). Cross-functional teams: Blessing or curse for new product development. *Transforming Organizations*, *154*, 166.

Anderson, N. R., & West, M. A. (1998). Measuring climate for work group innovation: Development and validation of the team climate inventory. *Journal of Organizational Behavior, 19*(3), 235-258.

Arbaugh, J. B. (2000). Virtual classroom versus physical classroom: An exploratory study of class discussion patterns and student learning in an asynchronous internet-based MBA course. *Journal of Management Education, 24*(2), 213.

Audretsch, D. B., & Thurik, A. R. (2000). Capitalism and democracy in the 21st century: From the managed to the entrepreneurial economy. *Journal of Evolutionary Economics*, *10*(1), 17-34.

Bailey, C. J., & Card, K. A. (2009). Effective pedagogical practices for online teaching: Perception of experienced instructors. *The Internet and Higher Education, 12*(3), 152-155.

Baltes, B. B., Dickson, M. W., Sherman, M. P., Bauer, C. C., & LaGanke, J. S. (2002). Computer-mediated communication and group decision making: A meta-analysis. *Organizational Behavior and Human Decision Processes, 87*(1), 156-179.

Beal, D. J., Cohen, R. R., Burke, M. J., & McLendon, C. L. (2003). Cohesion and performance in groups: A meta-analytic clarification of construct relations. *Journal of Applied Psychology*, *88*(6), 989-1004.

Beasley, B., & Standley, T. C. (2002). Shirts vs. skins: Clothing as an indicator of gender role stereotyping in video games. *Mass Communication & Society*, *5*(3), 279-293.

Becker, K. (2007). Pedagogy in Commercial Video Games. In D. Gibson, C. Aldrich & M. Prensky (Eds.), Games and Simulations in Online Learning: Research and Development Frameworks, Hershey, PA: Information Science, 21-47.

Begg, M., Dewhurst, D., & Macleod, H. (2005). Game-informed learning: Applying computer game processes to higher education. Innovate, *1*(6).

Bennis, W., Namus B. (1997). *Leaders: The strategies for taking charge*. New York, NY.

Bernard, R. M., Abrami, P. C., Lou, Y., Borokhovski, E., Wade, A., Wozney, L., Huang, B. (2004). How does distance education compare with classroom instruction? A meta-analysis of the empirical literature. *Review of Educational Research*, *74*(3), 379.

Boeije, H. (2002). A purposeful approach to the constant comparative method in the analysis of qualitative interviews. *Quality and Quantity, 36*(4), 391-409.

Bonk CJ. (2002). *Online training in an online world*. Bloomington, IN: CourseShare.com. Retrieved from http://www.CourseShare.com/reports.php.

Brawley, L. R., Carron, A. V., & Widmeyer, W. N. (1987). Assessing the cohesion of teams: Validity of the Group Environment Questionnaire. *Journal of Sport Psychology*, *9*, 275-294.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning*. Educational Researcher*, *18*(1), 32.

Bruneel, J., D'Este, P., & Salter, A. (2010). Investigating the factors that diminish the barriers to university–industry collaboration. *Research Policy, 39*(7), 858-868.

Burke, C. S., Stagl, K. C., Klein, C., Goodwin, G. F., Salas, E., & Halpin, S. M. (2006). What type of leadership behaviors are functional in teams? A meta-analysis. *The Leadership Quarterly, 17*(3), 288-307.

Carey, J. M. (2001). Effective student outcomes: A comparison of online and face-to-face delivery modes. Paper presented at the Distance Education Online Symposium, *11*(9).

Carless, S. A., & De Paola, C. (2000). The measurement of cohesion in work teams. *Small Group Research*, *31*(1), 71.

Carron, A. V., Widmeyer, W. N., and Brawley, L. R. (1988). Group cohesion and individual adherence to physical activity. *J. Sport Exer. Psychol*. *10,* 127-138.

Carron, A. V., Brawley, L. R., & Widmeyer, W. N. (1998). *The measurement of cohesiveness in sport groups*. In J. L. Duda, Advances in sport and exercise psychology measurement (pp. 213–226). Morgantown, WV: Fitness Information Technology.

Carron, A. V., Bray, S. R., & Eys, M. A. (2002). Team cohesion and team success in sport. Journal of Sports Sciences, *20*(2), 119-126.

Casner-Lotto, J., & Barrington, L. (2006). *Are they really ready to work? Employers' perspectives on the basic knowledge and applied skills of new entrants to the 21st century US workforce*. Partnership for 21st Century Skills. 1 Massachusetts Avenue NW Suite 700, Washington, DC 20001.

Charmaz, K. (2000). *Grounded theory: Objectivist and constructivist methods*. In N. Denzin & Y. Lincoln (Eds.), Handbook of qualitative research (2nd ed., pp. 509-535). Thousand Oaks, CA: Sage.

Churchill, W.S. (1993). *The price of greatness is responsibility*. *Finest Hour, 80*. Retrieved July 9, 2013 from: http://www.winstonchurchill.org/images/finesthour/Vol.01%20No.80.pdf

Clark, R. E. (1983). Reconsidering research on learning from media. *Review of Educational Research*, *53*, 445–459.

Cohen, S. G., & Bailey, D. E. (1997). What makes teams work: Group effectiveness research from the shop floor to the executive suite. *Journal of Management, 23*(3), 239-290.

Colbeck, C. L., Campbell, S. E., & Bjorklund, S. A. (2000). Grouping in the dark: What college students learn from group projects. *Journal of Higher Education*, *71*(1), 60-83.

Collaboration. [Def. 1]. (n.d.). *Merriam-Webster Online.* In Merriam-Webster. Retrieved July 3, 2013, from http://www.merriam-webster.com/dictionary/collaboration.

Collazos, C., Guerrero, L. A., Pino, J. A., Ochoa, S. F., & Stahl, G. (2007). Designing collaborative learning environments using digital games. *Journal of Universal Computer Science*, *13*(7), 1022-1032.

Cooper, L. W. (2001). A comparison of online and traditional computer applications classes. *T.H.E. Journal*, *28*(8), 52-58.

Cooperation. [Def. 2]. (n.d.). *Merriam-Webster Online.* In Merriam-Webster. Retrieved July 3, 2013, from http://www.merriam-webster.com/dictionary/cooperation.

Coordination. [Def. 2]. (n.d.). *Merriam-Webster Online.* In Merriam-Webster. Retrieved July 3, 2013, from http://www.merriam-webster.com/dictionary/coordination.

Corti, K. (2006). *Games-based learning; a serious business application*. PixelLearning. Coventry, UK.

Creswell, J. W. (1998*). Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks. CA: Sage.

Creswell, J. W., & Plano Clark, V. L. (2007). Designing and conducting mixed methods research. Thousand Oaks, CA: Sage.

Creswell, J. W. (2009). Research design: Qualitative, quantitative, and mixed methods approaches (3rd ed.). Thousand Oaks, CA: Sage Publications.

Cummings, J. N., & Kiesler, S. (2008). Who collaborates successfully?: Prior experience reduces collaboration barriers in distributed interdisciplinary research. Paper presented at the Proceedings of the 2008 ACM Conference on Computer Supported Cooperative Work, 437-446.

De Dreu, C. K. W., & Weingart, L. R. (2003). Task versus relationship conflict, team performance, and team member satisfaction: A meta-analysis. *Journal of Applied Psychology*, *88*(4), 741.

Dede, D. (2008). Theoretical perspectives influencing the use of information technology in teaching and learning. In J. Voogt & G. Knezek (Eds*.), International handbook of information technology in primary and secondary education*. New York: Springer.

Delwiche, A. (2006). Massively multiplayer online games (MMOs) in the new media classroom. *Educational Technology & Society*, *9*(3), 160-172.

Denning, P. J., & Yaholkovsky, P. (2008). Getting to we. Communications of the ACM, *51*(4), 19-24.

Devine, D. J., Clayton, L. D., Philips, J. L., Dunford, B. B., & Melner, S. B. (1999). Teams in organizations. *Small Group Research*, *30*(6), 678.

Dietz, T. L. (1998). An examination of violence and gender role portrayals in video games: Implications for gender socialization and aggressive behavior. *Sex Roles*, *38*(5), 425-442.

Downs, E., & Smith, S. L. (2010). Keeping abreast of hypersexuality: A video game character content analysis. *Sex Roles*, *62*(11), 721-733.

Drucker, P. (1957). *The landmarks of tomorrow*. New York: Harper & Row.

Duane, D., & Reaves, M. (Writer), & Bowman, R. (Director). (1987). Where no one has gone before. [Television series]. In P. Justman (Producer), Star Trek: The next generation. Los Angeles, CA: Paramount Television.

Duffy, Th.M., & Cunningham, D.J. (1996). Constructivism: implications for the design and delivery of instruction. In D.H. Jonassen, *Handbook of Research for Educational Communications and Technology* (pp. 170-198). New York: Macmillan.

Duffy, T. M., & Jonassen, D. H. (1992). Constructivism and the technology of instruction: A conversation. Hillsdale, NJ. Lawrence Erlbaum Associates.

Dutton, J., Dutton, M., & Perry, J. (2001). Do online students perform as well as lecture students? *Journal of Engineering Education*, *90*(1), 131-136.

Dylan, Bob. "The Times They Are a Changin.'" *The Times They Are a Changin'*. Columbia Records,1964. [Video file]. Retrieved Retrieved July 9, 2013, from: http://www.youtube.com/watch?v=vCWdCKPtnYE

Entertainment Software Association. (2011). Essential facts about the computer and video game industry. Retrieved from http://www.theesa.com/facts/pdfs/ESA_EF_2011.pdf.

Erzberger, C. & Kelle, U. (2003). Making inferences in mixed methods: The rules ofintegration. In A., Tashakkori & C. Teddlie, (Eds.), *Handbook of Mixed Methods in Social and Behavioral Research* (pp. 457 – 488). Thousand Oaks, CA: Sage.

Evans, C. R., & Dion, K. L. (1991). Group cohesion and performance. *Small Group Research*, *22*(2), 175.

Evans, N. J., & Jarvis, P. A. (1986). The group attitude scale A measure of attraction to group. *Small Group Research, 17*(2), 203-216.

Festinger, L. (1950). Informal social communication. *Psychological Review*, *57*(5), 271-282.

Forsyth, D. R. (2009). *Group dynamics*. Belmont, CA: Wadsworth.

Gardner, D.Ten lessons in collaboration. *OJIN: The Online Journal of Issues in Nursing, 10*(1)

Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: A research and practice model. *Simulation and Gaming*, *33*(4), 441-469.

Gee, J. P. (2003). What video games have to teach us about learning and literacy. Computers in Entertainment (CIE), *1*(1), 20.

Gee, J. P. (2007).Good video games, good learning. New York: Peter Lang.

Gentry, James W. (1990) What is experiential learning?" In James W. Gentry (ed.), *Guide to Business Gaming and Experiential Learning*. East Brunswick: Nichols/GP Publishing, pp. 9-20.

Gray, B. (1989). *Collaborating: Finding common ground for multiparty problems*. San Francisco: Jossey-Bass.

Gros, B. (2007). Digital games in education: The design of game-based learning. *Journal of Research on Technology in Education*, *40*(1), 23-38.

Gully, S. M., Devine, D. J., & Whitney, D. J. (1995). A meta-analysis of cohesion and performance. *Small Group Research*, *26*(4), 497.

Guzzo, R. A., & Dickson, M. W. (1996). Teams in organizations: Recent research on performance and effectiveness. *Annual Review of Psychology*, *47*(1), 307-338.

Hale, A. (2008, October 21). [Amybeth Hale]. *Did You Know?* [Video file]. Retrieved July 9, 2013, from http://www.youtube.com/watch?v=cL9Wu2kWwSY

Hall, D. T. (1996). Protean careers of the 21st century. *The Academy of Management Executive (1993), 10*(4), 8-16.

Harasim, L. (2000). Shift happens: Online education as a new paradigm in learning. *The Internet and Higher Education*, *3*(1-2), 41-61.

Hays, R. T. (2005). The effectiveness of instructional games: A literature review and discussion (Technical Report No. 2005-004). Naval Air Warfare Center Training Systems Division, Orlando, FL.

Hiltz, S. R., Zhang, Y., & Turoff, M. (2002). Studies of effectiveness of learning networks. *Elements of Quality Online Education, 3*, 15-40.

Hitt, M. A., Keats, B. W., & DeMarie, S. M. (1998). Navigating in the new competitive landscape: Building strategic flexibility and competitive advantage in the 21st century. *The Academy of Management Executive*, *12*(4), 22-42.

Hogan, R., Curphy, G. J., & Hogan, J. (1994). What we know about leadership: Effectiveness and personality. *American Psychologist*, *49*, 493-493.

Hogan, R., & Kaiser, R. B. (2005). What we know about leadership. *Review of General Psychology*, *9*(2), 169.

Hogg, M. A. (2001). A social identity theory of leadership. *Personality and Social Psychology Review, 5*(3), 184-200.

Hogg, M. A., & Knippenberg, D. v. (2003). Social identity and leadership processes in groups. *Advances in Experimental Social Psychology*, *35*, 1-52.

Howe, K. R. (1988). Against the quantitative-qualitative incompatibility thesis or dogmas die hard. *Educational Researcher*, *17*(8), 10-16.

Huang, H. M. (2002). Toward constructivism for adult learners in online learning environments. *British Journal of Educational Technology*, *33*(1), 27-37.

Hunkeler, D., & Sharp, J. E. (1997). Assigning functional groups: The influence of group size, academic record, practical experience, and learning style. *Journal of Engineering Education, 86*(4), 321-332.

Huxham, C. (2003). Theorizing collaboration practice. *Public Management Review*, *5*(3), 401-423.

Jehn, K. A., & Mannix, E. A. (2001). The dynamic nature of conflict: A longitudinal study of intragroup conflict and group performance*. Academy of Management Journal*, *44*(2), 238-251.

Jehn, K. A., & Shah, P. P. (1997). Interpersonal relationships and task performance: An examination of mediation processes in friendship and acquaintance groups. *Journal of Personality and Social Psychology*, *72*(4), 775.

Johnson, S. D., Aragon, S. R., Shaik, N., & Palma-Rivas, N. (2000). Comparative analysis of learner satisfaction and learning outcomes in online and face-to-face learning environments. *Journal of Interactive Learning Research*, *11*(1), 29-50.

Johnston, W. B., & Packer, A. H. 1987. *Workforce 2000*. Indianapolis, IN: Hudson Institute.

Jonassen, D. H. (2000). *Computers as mindtools for schools: Engaging critical thinking*. Columbus, OH: Merrill.

Jonassen, D. H. (2006). On the role of concepts in learning and instructional design. *Educational Technology Research and Development, 54*(2), 177-196.

Jones, G. R., & George, J. M. (1998). The experience and evolution of trust: Implications for cooperation and teamwork. *The Academy of Management Review*, *23*(3), 531-546.

Judge, T. A., Bono, J. E., Ilies, R., & Gerhardt, M. W. (2002). Personality and leadership: A qualitative and quantitative review. *Journal of Applied Psychology*, *87*(4), 765.

Kafai, Y. B. (1998). Video game designs by girls and boys: Variability and consistency of gender differences. From Barbie to Mortal Kombat: *Gender and Computer Games*, 90-114.

Kafai, Y. B. (2006). Playing and making games for learning. *Games and Culture*, *1*(1), 36.

Kanuka, H., & Anderson, T. (1998). Online social interchange, discord, and knowledge construction. *Journal of Distance Education*, *13*(1), 57-74.

Karau, S. J., & Williams, K. D. (1993). Social loafing: A meta-analytic review and theoretical integration. *Journal of Personality and Social Psychology, 65*(4), 681.

Kark, R., & Van Dijk, D. (2007). Motivation to lead, motivation to follow: The role of the self-regulatory focus in leadership processes. *Academy of Management Revie*w, *32*(2), 500-528.

Katzenbach, J. R., & Smith, D. K. (2005). The discipline of teams. *Harvard Business Review, 83*(7), 162.

Kerr, N. L., & Tindale, R. S. (2004). Group performance and decision making. *Annual Review of Psychology*, *55*, 623-655.

Kiili, K. (2005). Digital game-based learning: Towards an experiential gaming model. *The Internet and Higher Education, 8*(1), 13-24.

Kim, K. J., & Bonk, C. J. (2006). The future of online teaching and learning in higher education. *Educause Quarterly*, *29*, 22-30.

Kirriemuir, J., & McFarlane, A. (2004). Literature review in games and learning.

Kline, T. J. (1999). The team player inventory: Reliability and validity of a measure of predisposition toward organizational team-working environments*. Journal for Specialists in Group Work*, *24*(1), 102-112.

Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning and Education*, *4*(2), 193-212.

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall.

Korhonen, H., Montola, M., & Arrasvuori, J. (2009). Understanding playful user experience through digital games. Paper presented at the Proceedings of DPPI, *9*, 274-285.

Kozlowski, S. W. J., & Ilgen, D. R. (2006). Enhancing the effectiveness of work groups and teams. *Psychological Science in the Public Interest*, *7*(3), 77.

Kozma, R. (1994). Will media influence learning: Reframing the debate. *Educational Technology Research and Development*, 42, 7–19.

Krueger, R. A. (2009). *Focus groups: A practical guide for applied research*. Sage.

Lainema, T., & Makkonen, P. (2003). Applying constructivist approach to educational business games: Case REALGAME. *Simulation and Gaming*, *34*(1), 131-149.

Laing, R. D. (1967). *The Politics of Experience*. New York: Ballantine Books.

Laird, J., & VanLent, M. (2001). Human-level AI's killer application: Interactive computer games. *AI Magazine, 22*(2), 15.

Lam, M. (2009). Effectiveness of web-based courses on technical learning*. Journal of Education for Business*, *84*(6), 323-331.

Larreamendy-Joerns, J., & Leinhardt, G. (2006). Going the distance with online education. *Review of Educational Research, 76*(4), 567.

Lewis, K., Lange, D., & Gillis, L. (2005). Transactive memory systems, learning, and learning transfer. *Organization Science*, *16*(6), 581-598.

Li, F., Harmer, P., & Acock, A. (1996). The task and ego orientation in sport questionnaire: Construct equivalence and mean differences across gender. *Research Quarterly for Exercise and Sport, 67*(2), 228-238.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: Sage.

Macdonald, J. (2003). Assessing online collaborative learning: Process and product. *Computers & Education*, *40*(4), 377-391.

McLuhan, M., &.Quentin, F. (1967). *The Medium is the Message. An Inventory of Effects.* New York: Random House.

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2009). *Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies*. Washington, D.C.: U.S. Department of Education, Office of Planning, Evaluation, and Policy Development.

Michael, D. R., & Chen, S. L. (2005). *Serious games: Games that educate, train, and inform*. Boston, MA: Thompson Course Technology.

Minow, M. (2011). Fostering Innovation. *Harvard Law Bulletin, Summer*. Retrieved from: http://www.law.harvard.edu/news/bulletin/2011/summer/dean.php.

Mitchell, A., & Savill-Smith, C. (2004). *The use of computer and video games for learning: A review of the literature.* London: LSDA.

Moore, J. L., Dickson-Deane, C., & Galyen, K. (2011). e-learning, online learning, and distance learning environments: Are they the same? *The Internet and Higher Education, 14*(2), 129-135.

Moreno-Ger, P., Burgos, D., & Torrente, J. (2009). Digital games in eLearning environments current uses and emerging trends. *Simulation & Gaming*, *40*(5), 669-687.

Mullen, B. & Copper, C. (1994). The relation between group cohesiveness and performance: An integration. *Psychological Bulletin*, *115,* 210-227.

Nisbett, R. E., & Wilson, T. D. (1977). The halo effect: Evidence for unconscious alteration of judgments. *Journal of Personality and Social Psychology, 35*(4), 250-256.

Ogletree, S. M., & Drake, R. (2007). College students' video game participation and perceptions: Gender differences and implications. *Sex Roles*, *56*(7), 537-542.

Papastergiou, M. (2009). Digital game-based learning in high school computer science education: Impact on educational effectiveness and student motivation. *Computers & Education*, *52*(1), 1-12.

Paris, C. R., Salas, E., & Cannon-Bowers, J. A. (2000). Teamwork in multi-person systems: A review and analysis. *Ergonomics*, *43*(8), 1052-1075.

Partnership for 21st Century Skills. (2013). Framework for 21st century learning. Retrieved July 3, 2013, from http://www.p21.org/overview.

Patton, M. Q. (2002). *Qualitative evaluation and research methods (3rd ed.)*. Thousand Oaks, CA: Sage Publications, Inc.

Patton, M. Q. (2006). Foreword: trends and issues as context. *Research in the Schools*, *13*(1), i-ii.

Paulus, P. B., & Zee, K. (2004). Should there be a romance between teams and groups? *Journal of Occupational and Organizational Psychology, 77*(4), 475-480.

Pinelle, D., Wong, N., & Stach, T. (2008). *Heuristic evaluation for games: Usability principles for video game design*. Paper presented at the Proceeding of the Twenty-Sixth Annual SIGCHI Conference on Human Factors in Computing Systems, 1453-1462.

Pollard C. W. (1996). *The soul of the firm*. New York, NY: Harper Business.

Prensky, M. (2003). Digital game-based learning. *Computers in Entertainment (CIE)*, *1*(1), 21.

Provenzo, E. F. (1991). *Video kids: Making sense of Nintendo.* Cambridge, MA: Harvard University Press.

Reich, R. B. 1991. *The work of nations: Preparing ourselves for 21st-century capitalism*. New York: Knopf.

Reilly, T. (2001). Collaboration in action: An uncertain process. *Administration in Social Work, 25*(1), 53-74.

Rieber, L. P., & Noah, D. (2008). Games, simulations, and visual metaphors in education: Antagonism between enjoyment and learning. *Educational Media International*, *45*(2), 77-92.

Ritzhaupt, A. D., Frey, C., Poling, N., & Johnson, M. C. (2012). Playing games in school: Video games and simulations for primary and secondary education.

International Journal of Gaming and Computer-Mediated Simulations (IJGCMS), 4(2), 84-88.

Roschelle, J., & Teasley, S. D. (1994). The construction of shared knowledge in collaborative problem solving. *NATO ASI Series F Computer and Systems Sciences, 128*, 69-69.

Rousseau, V., Aubé, C., & Savoie, A. (2006). Teamwork behaviors. *Small Group Research*, *37*(5), 540.

Rovai, A. P. (2004). A constructivist approach to online college learning. *The Internet and Higher Education*, *7*(2), 79-93.

Ryan, G. W., & Bernard, H. R. (2000). Data management and analysis methods. In N. K. Denzin & Y. S. Lincoln (Eds.), Handbook of qualitative research (2nd ed., pp. 769–802). Thousand Oaks, CA: Sage.

Salas, E., Sims, D. E., & Burke, C. S. (2005). Is there a "Big five" in teamwork? *Small Group Research*, *36*(5), 555.

Sallin, R. (Producer), & Meyer, N. (Director). (1982). *StarTrek II: The Wrath of Khan*. [Motion Picture]. United States: Paramount Pictures.

Sapsed, J., Bessant, J., Partington, D., Tranfield, D., & Young, M. (2002). Teamworking and knowledge management: A review of converging themes. *International Journal of Management Reviews, 4*(1), 71-85.

Schein, E. H. (1996). Career anchors revisited: Implications for career development in the 21st century. The Academy of Management Executive (1993), 10(4), 80-88.

Scribner, J. P., Sawyer, R. K., Watson, S. T., & Myers, V. L. (2007). Teacher teams and distributed leadership: A study of group discourse and collaboration. *Educational Administration Quarterly*, *43*(1), 67-100.

Shaffer, D. W., Squire, K. R., Halverson, R., & Gee, J. P. (2005). Video games and the future of learning. *Phi Delta Kappan, 87*(2), 104.

Sharma, M., Holmes, M., Santamaria, J., Irani, A., Isbell, C., & Ram, A. (2007). Transfer learning in real-time strategy games using hybrid CBR/RL. Paper presented at the Proceedings of the Twentieth International Joint Conference on Artificial Intelligence.

Shih, J., Shih, B., Shih, C., Su, H., & Chuang, C. (2010). The influence of collaboration styles to children's cognitive performance in digital problem-solving game "William adventure": A comparative case study. *Computers & Education*, *55*(3), 982-993.

Singley, M. K., & Anderson, J. R. (1989). *The transfer of cognitive skill*. Harvard University Press.

Spink, K. S., & Carron, A. V. (1993). The effects of team building on the adherence patterns of female exercise participants. *Journal of Sport & Exercise Psychology*, *15*, 39-49.

Squire, K. (2002). Cultural framing of computer/video games. *Game Studies*, *2*(1), 1-7.

Squire, K. (2006). From content to context: Videogames as designed experience. *Educational Researcher*, *35*(8), 19.

Stacey, E. (2007). Collaborative learning in an online environment. *The Journal of Distance Education/Revue De l'Éducation à Distance*, *14*(2), 14-33.

Stogdill, R. M. (1948). Personal factors associated with leadership: A survey of the literature. *The Journal of Psychology, 25*(1), 35-71.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory (2nd ed.)*. Thousand Oaks, CA: Sage.

Sundstrom, E., De Meuse, K. P., & Futrell, D. (1990). Work teams: Applications and effectiveness. *American Psychologist*, *45*(2), 120-133.

Swan, K. (2003). Learning effectiveness online: What the research tells us. Elements of quality online education, *Practice and Direction*, 4, 13–46.

Tallent-Runnels, M. K., Thomas, J. A., Lan, W. Y., Cooper, S., Ahern, T. C., Shaw, S. M., & Liu, X. (2006). Teaching courses online: A review of the research. *Review of Educational Research*, *76*(1), 93.

Tapscott, D., & Williams, A. D. (2008). *Wikinomics: How mass collaboration changes everything*. New York: Penguin.

Tashakkori, A., & Teddlie, C. (1998). *Mixed methodology: Combining qualitative and quantitative approaches*. Thousand Oaks, CA: Sage.

Tashakkori, A., & Teddlie, C. (2003). *Handbook of mixed methods in social and behavioral research*. Thousand Oaks, CA: Sage.

Teamwork. [Def. 1]. (n.d.). *Merriam-Webster Online.* In Merriam-Webster. Retrieved July 3, 2013, from http://www.merriam-webster.com/dictionary/teamwork.

Thomas, E. J., Sexton, J. B., & Helmreich, R. L. (2003). Discrepant attitudes about teamwork among critical care nurses and physicians. *Critical Care Medicine*, *31*(3), 956.

Tyre, M. J., & Von Hippel, E. (1997). The situated nature of adaptive learning in organizations. *Organization Science*, *8*(1), 71-83.

Uhl-Bien, M. (2006). Relational leadership theory: Exploring the social processes of leadership and organizing. *The Leadership Quarterly*, *17*(6), 654-676.

Van Eck, R. (2006). Digital game-based learning: It's not just the digital natives who are restless. *Educause Review*, *41*(2), 16.

Von Glasersfeld, E. (1989). Constructivism in education. In T. Husen & T.N. Postlethwaite, Eds., *The international encyclopaedia of education* (pp.162-163). New York: Pergamon Press.

Wenger, E., McDermott, R. A., & Snyder, W. (2002). *Cultivating communities of practice: A guide to managing knowledge*. Boston, MA: Harvard Business Press.

Wenger, E. C., & Snyder, W. M. (2000). Communities of practice: The organizational frontier. *Harvard Business Review*, *78*(1), 139-146.

Westre, K. R., & Weiss, M. R. (1991). The relationship between perceived coaching behaviors and group cohesion in high school football teams. *The Sport Psychologist, 5*, 41-54.

Whitton, N. (2009). *Learning with digital games: A practical guide to engaging students in higher education*. New York: Routledge.

Widmeyer, W. N., Brawley, L. R., & Carron, A. V. (1985). *The measurement of cohesion in sport teams: The group environment questionnaire*. London: Sports Dynamics.

Willis, Gordon, Theresa DeMaio, and Brian Harris-Kojetin. 1999. Is the bandwagon headed to the methodological promised land? Evaluating the validity of cognitive interviewing techniques. In *Cognition and Survey Research*, ed. Monroe G. Sirken, Douglas J. Herrmann, Susan Schechter, Norbert Schwarz, Judith M. Tanur, and Roger Tourangeau. New York: Wiley.

Wilson, K. A., Bedwell, W. L., Lazzara, E. H., Salas, E., Burke, C. S., Estock, J. L., . . . Conkey, C. (2009). Relationships between game attributes and learning outcomes. *Simulation & Gaming*, *40*(2), 217.

Winer, M., & Ray, K. (1994). *Collaboration handbook: Creating, sustaining, and enjoying the journey*. Amherst H. Wilder Foundation, 919 Lafond, St. Paul, MN 55104.

Winn, J., & Heeter, C. (2009). Gaming, gender, and time: Who makes time to play? *Sex Roles*, *61*(1), 1-13.

Wood, D. J., & Gray, B. (1991). Toward a comprehensive theory of collaboration. *The Journal of Applied Behavioral Science*, *27*(2), 139.

Yang, Y. C. (2012). Building virtual cities, inspiring intelligent citizens: Digital games for developing students' problem solving and learning motivation. *Computers & Education, 59*(2), 365-377.

Yin, R.K. (2009). *Case study research Design and Methods. (4th ed.)*. USA: Sage publications.

Zaccaro, S. J., Foti, R. J., & Kenny, D. A. (1991). Self-monitoring and trait-based variance in leadership: An investigation of leader flexibility across multiple group situations. *Journal of Applied Psychology*, *76*, 308–315.

Zaccaro, S. J. (2007). Trait-based perspectives of leadership. *The American Psychologist*, *62*(1), 6.

Zagal, J. P., Rick, J., & Hsi, I. (2006). Collaborative games: Lessons learned from board games. *Simulation & Gaming*, *37*(1), 24-40.

Ziskin, L.E. (Producer), & Raimi, S. (Director). (2002). *Spider-man* [Motion picture]. United States: Columbia Pictures.

BIOGRAPHICAL SKETCH

From the classic simplicity of *Space Invaders* to the latest immersive and visually stunning game title, as a gamer, Nathaniel D. Poling, PhD, has always been drawn to digital games. As an educator he has always known that well-designed games can fully engage players and also have the potential to teach many important real-life skills and concepts in an innovative way. Nathaniel was able to combine his interest in digital games with his training in education during his doctoral studies. He designed, developed, and got approval to teach an innovative online digital game-based course based on the popular real-time strategy game *StarCraft 2,* which gave students an opportunity to experientially learn about important real-world skills such as collaboration, critical thinking, and problem solving. The course was offered for two years through the University's Honors Program.

In addition to designing, teaching, and researching the *StarCraft 2* course, Nathaniel also taught an undergraduate introduction to educational technology course and co-taught another innovative Honors Program course that focused on Zombie culture. This zombie culture class took a multimedia and participatory culture based approach in having students read and analyze two of Max Brooks' works—*The Zombie Survival Guide* and *World War Z*. Students used a variety of media in addition to the books to better understand the sociocultural implications often explored in zombie subculture. Nathaniel has also taught a graduate-level project management course that taught students how to design, develop, and implement educational projects. In addition to his teaching, he has worked with others across the university—including pediatrics department and the radiosurgery department—as an instructional design consultant. His research interests include using digital games and virtual environments in teaching and

training, instructional design, and curriculum development. Prior to embarking on his doctoral career, Nathaniel was an English and Communications double-major who then taught English and Language Arts for two years at the middle and high school level.