UNIVERSITY OF CALGARY

Worldview at Play: How Personal Epistemological Beliefs Interact with Video Games

By

Michael Magee

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE

DEGREE OF DOCTOR OF PHILOSOPHY

GRADUATE DIVISION OF EDUCATIONAL RESEARCH

CALGARY, ALBERTA

SEPTEMBER, 2011

Your file Votre référence
ISBN: 978-0-494-81464-2
Our file Notre référence
ISBN: 978-0-494-81464-2

UNIVERSITY OF CALGARY

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Worldview at Play: How Personal Epistemological Beliefs Interact with Video Games" submitted by Michael Magee in partial fulfillment of the requirements for the degree of Doctorate of Philosophy.

____

Supervisor, (Dr. Gail Kopp, Graduate Division of Educational Research)

____

(Dr. Hanan Yaniv, Graduate Division of Educational Research)

____

(Dr. Ian Winchester, Graduate Division of Educational Research)

____

(Dr. Paul Stortz, History)

____

External Examiner, (Dr. Art Stinner, Faculty of Education, University of Manitoba)

____

Date

Abstract

The purpose of this dissertation is the presentation of an examination of learning in video games using the theoretical framework of personal epistemological beliefs. Video game play represents a significant activity among North American adolescents. They have spent thousands of hours learning how to play them by the time they reach the age of 18 and there is a wide range of both positive and negative outcomes that have been attributed to that experience. This dissertation utilized an undergraduate population to examine how personal epistemological beliefs interacted with the experience of learning in video games. A proposition was presented that the process of learning to play could lead to a growth in sophistication of personal epistemological beliefs. This growth is also a stated goal of formal education. A case study was undertaken that used a mixed methods approach to examine personal epistemological stances towards knowledge and knowing in an undergraduate and video game environment. The results indicated that personal epistemological beliefs could be used to describe learning in video game. The results also indicated that these personal beliefs were flexible and they would accommodate the requirements of the learning context. This resulted in a different perspective towards learning between the undergraduate and video game context. There were also differences in personal epistemological stances when playing video games. These different stances depended on the learning requirements of the game design of the video game and the motivations the player had in learning to play the video game. The implications of the results indicate that the value of learning how to play video games requires an examination of the game design as well as the underlying personal motivations behind learning to play the game.

Acknowledgements

I wish to express my gratitude to my supervisor, Dr. Gail Kopp for her continued support and guidance. I would also like to thank my committee members, Dr. Ian Winchester and Dr. Hanan Yaniv for their helpful feedback and guidance throughout my PhD.

I also wish to thank my colleagues, both here in Canada, and internationally for their advice and suggestions as I worked through the maze of personal epistemological beliefs research.

I would like to give a thank you as well to the staff of the GDER office. These have been a challenging few years for the department and they have done an excellent job. They have always been willing to put in the extra work necessary to make sure that student needs are addressed.

My family has also been a great help to me throughout the entire process and I would like to thank them deeply for their love and support. A special thanks to my Mother, Father, Jackie and Goose.

Table of Contents

List of Tables

List of Figures

Chapter 1 Introduction

1.1 Problem

Video games have become almost ubiquitous in modern society. People play these games on their computers, on game consoles in their living rooms, on cell phones as well as any number of mobile devices. Many people have been playing these games for a very long time, some since they were four years old (Rideout, Vanderwater, Wartella, 2003. This makes video games an exciting, engaging, and entertaining life experience that is an integral part of the lives of those game players. It isn't surprising, that as part of our human tendency to understand the world around us, we have started to spend a considerable amount of time trying to understand the nature of that video game experience. Among those discussions are an increasing number of claims about the value of video games and their ability to bestow beneficial cognitive effects on video game players. Some of the positive effects include critical thinking and problem solving skills that indicate a level of sophistication in the way game players approach knowledge and knowing (Bialystok, 2006; Aldrich, 2005). The experience that is being described sounds similar to the kind of maturation of thinking that has been stated as a goal of formal education. That goal is typically achieved by assisting learners construct an understanding about how and why they learn. This is not a simple task as each learner is a unique combination of prior knowledge and personal epistemology that filters the world around them. This allows each individual to come to their own understanding of the complex world around them but creates a very diverse landscape of learners for education.

Researchers face similar challenges when evaluating the claims that are being made about the beneficial effects of video games. They must acknowledge a diverse range of approaches to learning and wide range of influences on the game play experience. Despite a large body of opinion, there has been little research about if and why video games are actually providing positive benefits in terms of cognitive development. This isn't surprising given the recent arrival of video games in modern culture but this provides a challenge in framing research problems about the effect of video game play. The core of the problem that faced this research study was a need to explore how personal epistemology interacts with video game play. Epistemology has been a subject of debate since humans began to discuss the world in philosophical terms. A basic definition is that our personal epistemology influences our perspective on the nature of knowledge. When we come to know something, and justify that knowledge that has been created within ourselves, we utilize our epistemological perspectives. In this way our epistemology plays a key role in satisfying our human need to interpret and make sense of the world around us.

Video games are now part of our experience in the world. Although there was an assumption that personal epistemology must somehow play a role in learning to play video games, the next problem was how to explore that experience in a way that was meaningful to the field of educational research. In order to address these initial problems it was necessary to find a valid research paradigm that focuses on the development of an individual's perceptions of knowledge and knowing as a process rather than a product. This focus on process was based on the recognition that many video game players had an encyclopedic knowledge of an imaginary video game world. Yet the product of learning in a video game was assumed to have limited potential in real world settings. This made the process of learning and constructing knowledge during video game play the most promising domain for educational research. Once a research paradigm that focuses on the learning process could be identified, the last problem was how to use that paradigm to discuss learning in video games in a meaningful way.

1.2 Purpose

The purpose of this multi-case study is to explore a sample of undergraduate students' perspectives about knowing and knowledge in a videogame context to determine if those experiences are facilitating the growth and development of their personal epistemological beliefs.

1.3 Background and context

Video games have become pervasive in our society in the last two decades. Computers, consoles, and mobile devices have allowed games to be almost ubiquitous in the lives of the youth that play them. Not surprisingly, 97% of teens currently play video games. As they become adults the level of game play drops but not by a significant amount. Eighty-two percent of adult fulltime post-secondary students continue to play games (Lenhart et al., 2008). The amount of time spent playing video games is substantial. The 24% of video game players who play games for one hour a day will have reached over 4,000 hours of play before the age of 18. The 10% of the teenage players who are hard-core players will be at four plus hours of video game player per day and will be closer to 16,000 hours of play by the same age (Lenhart). These estimates are based on game play beginning at the average age of seven. It is likely that the numbers are higher as 50% of 4-6-year-olds play video games and 25% play several times a week or more. The 50% of 4-6-year-olds who are playing games are averaging an hour every day that they play (Rideout et al., 2003). All of the gathered data consistently indicates that video games are a significant part of most children's lives today.

Despite the considerable amount of time spent in these environments, we still know little about the impact of that activity. There is some evidence that playing entertainment video games like *Civilization III* in educational contexts boosted interest in historical topics and makes students aware of the depth of factors related to historical events (Lenhart, 2008). This kind of evidence is limited and most video game play does not occur in the classroom. Gameplay is occurring in the informal settings of the entertainment video game industry. Education, and specifically educational technology, has been interested to see what this new technology means for education and learning. Some of this interest has been focused on the ability of games to teach content as well as expose students to different ways of learning while they play. The process of learning how to play video games is as interesting to educational researchers as any knowledge that may be gained during the game play experience (Gee, 2003). Game play represents a new opportunity to explore how we learn and make sense of our experiences in a technology-mediated environment. Despite all the excitement about this evolving technology, there is little evidence that these tools will provide any kind of benefit to their long-term players, in either knowledge or process. Much of the published work is psychological in nature and focuses on the positive or detrimental psychological conditions that result from long term video game play. There have been some excellent works published by educational researchers but these works are primarily phenomenological in nature. Gee's (2003) *What Video Games have to Teach us About Learning and Literacy* is an in-depth and very personal exploration of Gee's experience of learning to play video games. He explores this new domain from the perspective of an educational researcher. As the research community comes to their own personal understanding of video games the field is reaching a point where research needs to begin looking outward towards a new generation of video game players.

The lack of extensive formal study has led to a division in the public commentary about the value of video games. On one end of the spectrum are those who believe that regular video game play provides beneficial effects that differentiate game players from non-game players (Prensky, 2004). This belief is also supported by many parents, 63% of whom believe that games are a positive part of their children's lives (ESA, 2009). In the 0-6-year-old age range the percentage of parents who think games mostly help a child's learning drops to 22% (Rideout et al., 2003). On the other end of the debate are those who view video games as a waste of time at the very least and a detrimental and harmful experience at their worst. Despite the polarization, it remains true that games are having a continued impact on society. They represent the most pervasive interactive technology-mediated experience for young people and are powered by an industry that is worth $12.5 billion a year and growing in the U.S. alone ("Video Games", 2007). They deserve our attention and critical analysis.

Those who see the beneficial results of video games have a long list of positive effects. These include a host of cognitive skills such as an increased ability to problem solve, filter misleading perceptual information, tolerate failure, exhibit greater creativity in problem solving, and exhibit higher levels of competitiveness and greater optimism

(Bialystok, 2006; Aldrich, 2005). This gamer generation accepts a chaotic and rapidly changing environment as something normal and expected (Hagood, 2000). The long periods of online video game play with other game players has also been observed to lead to an increase in social skills and time management skills (BBC, 2006). Overall, the phenomenon has been termed "the sleeper curve" by Johnson (2005) and he considers it "the single most important new force altering the mental development of young people today" (p. 12). The term came from the observation that the phenomena was occurring silently in the background and has escaped the notice of society. The modern video game experience is requiring players to exhibit a greater degree of cognitive complexity just to make sense of their gaming experience (Johnson. There is even some scientific evidence from neuroscience that purports that prolonged exposure to the environmental conditions of video gaming will change the way the brain thinks (Prensky, 2001). Many of these conclusions are based on generalized, intuitive perspectives on what may be occurring during video game play. Despite this lack of rigour many of these observations are beginning to make their way into the popular media under the guise of truths without ever having been examined under any kind of academic scrutiny. There is a growing requirement to examine the claims that video game play is providing a series of cognitive benefits that are providing game players with an advantage in the real world.

In opposition to this general perception of the beneficial effects of video games is the viewpoint that games represent a complete waste of time and their only potential benefit is an increase in eye/hand coordination (Gee, 2003 ; Wang & Perry, 2006). They are not only being viewed as having minimal positive effect but also as being potentially damaging due to the addictive behaviour exhibited by some video game players

(Chumbley & Griffiths, 2006; Wan & Chiou, 2006). This negative perception is also linked to the violent nature of many of the games and the indications that this has residual effects on violent and aggressive behaviour in real life (Arriaga, Esteves, Carneiro, & Monteiro, 2006; Bartholow, Bushman, & Sestir, 2006). This research indicating video games may actually be harmful, has been convincing, to a point where legislation is being introduced in the U.S. to restrict access to video games by younger players (Lavallee, 2006). The negative impact of video games in terms of addiction and violence is attracting a growing amount of research interest. This is resulting in an increasing body of research that is questioning, rather than providing support for, the positive impact of video games.

With so many opinions about the video game playing experience, many different research approaches have developed to study their efforts. Finding a research paradigm that is relevant to education required an examination of some areas of research that might have an overlapping interest with the proposed effects of video games. Personal epistemological belief structure research is one such area that was initially interested in the impact of a formal post-secondary education on the personal beliefs a student held towards knowledge and knowing. It has grown to be interested in how those beliefs affect the nature of the learning phenomenon and the meaning that learners place on learning in many different contexts including post-secondary, K-12, and real life decision-making. Personal epistemological belief research specifically focuses on how we develop and mature over time and how that affects the way we think about knowledge and knowing. It is not interested in the kinds of knowledge we develop during a formal education experience but rather how our overall thinking changes and matures during that experience. The belief is that perceptions towards learning are reflected in the way students approach an educational situation. As students' personal epistemological beliefs grow in sophistication they become more capable of dealing with complexity and ambiguity. The maturity and sophistication of an individual's personal epistemological beliefs have been linked to that individual's effectiveness in learning in complex and ambiguous environments as well as teaching others in inquiry-based educational environments. Most of the research describes the growth of personal epistemological beliefs as a progression of attitudes towards knowledge. Their perspective toward knowledge begins with a simple, reductivist perspective and evolves to a complex, relativistic perspective. This progression is not seen as inevitable or even permanent. There are numerous descriptions of individuals retreating backwards to a simpler epistemological stance. An individual would develop a more sophisticated epistemological stance that allowed them to succeed in addressing a problem. They would not stay fixed at this new point and this could be the result of several factors. The retreat is usually described as a retreat from the stress and anxiety of viewing the world from this new epistemological perspective or as a result of the new epistemological stance resulting in a failure in dealing with subsequent problems. The individual would move back towards an epistemological perspective that was less stressful and had provided a longer record of success when dealing with challenges in the world.

When learners solidify their new position and begin to utilize their new stance on a regular basis, they begin to view knowledge differently. They no longer see knowledge as an absolute that can be viewed as a black-and-white, simple, static entity but begin to understand its subjective nature and its context specificity. Eventually an individual evaluates knowledge based on evidence that has been used to generate that knowledge. At this point, no knowledge is simply accepted as truth; it requires solid justification and is subject to change. Examples of how this progression manifests itself include both traditional academic performance and problem-solving ability in ill-structured domains among adult learners (Braten & Stromso, 2006; Spiro, Feltovich, & Coulson, 1996). The nature of this progression is the subject of a number of different research perspectives and there is no immediate consensus on how this progression occurs (Bendixen & Rule, 2004; Hofer & Pintrich, 1997). This progression does not require an individual to always view the world as ambiguous and uncertain. It provides freedom for an individual to use their own judgment about when they will view knowledge as certain or ambiguous (Chandler, Hallett & Sokol , 2002; Spiro et al.). For example, it would be difficult to discuss a topic if variables, such as the force of gravity on an object, were always scrutinized as being objective and real. There is always the potential that different contextual cues could be observed and these might require a re-evaluation of that knowledge but most people do not have to address the failure of gravity in their lives. The progress does not trap the individual in any one way of thinking but rather supports a degree of flexibility where judgment can assess each new context.

The maturation of our thinking during our education is considered by many to be the real value of a post-secondary education (Kuhn & Weinstock, 2002). It affects our interpretation of knowledge in our everyday lives and guides us in evaluating and acting on the world. As a research paradigm that looks at a developmental process rather than knowledge as a product, it seems an appropriate framework for this study. It became the approach used in analyzing the changes that might occur in a videogame environment.

The content of the video games most likely has little relevance in the real world. So understanding the knowledge created in those contexts isn't useful. An encyclopedic knowledge of the fictional and virtual world in World of Warcraft may be interesting in the game world. The types of thinking and the approaches to learning used to create that knowledge may be extremely interesting and relevant in a much wider context.

1.4 Research questions

1. What differences can be detected in perspectives about knowledge and knowing between different types of video game players using current academic research instruments?

2. How can the paradigms of epistemological belief structure research, which are used to explore conceptions towards knowledge and knowing in a formal educational setting, be used to explore similar conceptions in video games?

3. What is the video game player's perspective on learning how to solve challenges in a video game environment?

4. How do video game players develop the knowledge they perceive as necessary to succeed in a videogame?

5. How does a video game player's perspective towards knowledge and knowing differ from perspectives towards knowledge and knowing in post-secondary setting?

6. How are the video game player's perspectives towards knowledge and knowing in a video game utilized outside of that context?

1.5 Research design overview

Under the approval of the University of Calgary's Conjoint Faculties Research Ethics Board (CFREB), the researcher studied the perceptions of 107 undergraduate students at the University of Calgary. The participants came from a variety of faculties and study years. The investigation of those students represented a mixed methodology. A survey instrument was implemented using quantitative research methods. Interviews were also conducted using qualitative research methods.

The survey instrument was administered online and was taken voluntarily by the research subjects. The recruitment process was done both in class and through e-mail. Students who wished to participate in the study followed a hyperlink to the online survey. Part of the online survey was the Epistemological Beliefs Sampler (EBS). Additional survey questions were asked about the subject's demographics and video game play activities. The data was downloaded and subjected to a statistical analysis. These analyses were undertaken to determine the validity of the data and any patterns that may have been revealed. These students were also asked if they wish to participate in an interview about their videogame play. They provided a pseudonym and an e-mail address if they wished to be contacted about the interview.

Interviews were used to collect data on students' perspectives towards knowledge and knowing in a videogame environment. The interviews began with a common question and then expanded into an open framework. All interviews were digitally recorded and transcribed verbatim.

There have been no previous studies of personal epistemological belief structures in videogame play environments. Triangulation and validation of the rubric used to organize and make sense of the interviews was based on a comprehensive review of the relevant literature. Coding categories were developed and refined on an ongoing basis guided by the study's conceptual framework of epistemological belief structure research. Other strategies were utilized to provide additional validity. These included inter-rater reliability reviews during the coding process of the transcribed interviews and peer review at different stages as the study progressed.

1.6 Assumptions

Based on the researcher's experience and background as a videogame designer, an instructional designer, and a videogame player there were four assumptions made in regard to this study. The first assumption is that most game players have been playing video games for a considerable portion of their lives and that experience has resulted in several strategies to learn how to play those games. The second assumption is that the conceptual framework of personal epistemological beliefs can be used to explore conceptions of learning in the learning environments of video games. The third assumption is that videogames are designed in such a way that they encourage and facilitate learning that is both simple and sophisticated. Video game play is voluntary and it is assumed that video games present a wide range of challenges to game players that can require many different approaches to learning. The range of challenges is considered necessary in order to attract and retain game players and make the game successful. The fourth assumption is that the learning requirement of the more sophisticated and complex video games can facilitate cognitive development without the conscious awareness of the game player or implicit design of the game designer.

Although these were assumptions at the planning and design phase of the research study they were not left unchallenged during the course of the study. The first assumption, that the participants had spent a considerable amount of time playing video games, was addressed during the interviews by direct questioning. The second assumption, that a conceptual framework used in formal learning could be used to describe video games, was addressed during the rubric development that took place in content analysis of the interviews phase of the research. Although the formal conceptual framework of personal epistemological belief structures was the basis of the initial rubric, inductive reasoning was used to expand the categories of that rubric and other researchers reviewed and validated the work. The third assumption was addressed during the interview process when participants were asked to describe how they approached learning in a variety of different video games. The fourth assumption was addressed during the interview phase of the research. Questions were focused on discussing if the participants were conscious of their own epistemological perspectives and that they could use these perspectives to describe how they learned in video games.

1.7 Rationale and significance

I choose the framework of personal epistemological beliefs to explore video game player attitudes towards knowing and knowledge. It is a research framework that has identified the increasing importance of personal epistemological beliefs in the study of how perspectives towards knowledge and knowing affect how we learn in a formal educational setting and in the real world. Although there are many different ways to explore the complex phenomenon of the video game experience, personal epistemological beliefs have shown relevance to learning and have the potential to inform future research in the domain of video games.

There are two main reasons that personal epistemological beliefs are considered important in this? research framework. The first is that the maturation of personal epistemology is a stated goal of education. The maturation of these beliefs has been shown to facilitate successful learning in a formal learning environment. They have been recognized as important factor in designing instruction and curriculum (Schommer, 1994). The second reason is epistemological beliefs are believed to generalize across domains and maturity of those beliefs is considered critical to thriving in the world. They will provide an individual with the disposition and critical thinking ability necessary to succeed in a knowledge-based, democratic society. There is growing concern over the lack of mature epistemological perspectives in adult populations (Kuhn & Weinstock, 2002). This concern is based on a belief that the knowledge economy is creating a dynamic and complex world that demands an ability to deal with uncertainty and ambiguity almost daily. Success in this world will require a more mature or sophisticated epistemology that is able to accommodate these rapidly evolving challenges. Development of such an epistemology will occur in an educational setting that focuses on developing knowledge processes and not just knowledge products (Brownlee & Berthelsen, 2006). Despite this need, a study found 47% of the participants to be absolutist in their approach to knowledge, 39 % were relativist and only 14% were evaluativist in nature (Chandler, Hallett, & Sokol, 2002). This meant that most of the study participants viewed knowledge as absolute and could describe it in black and white or right and wrong terms. The relativists viewed knowledge as mostly contextual and didn't believe there was really a correct answer for anything as all knowledge was a matter of opinion. The evaluativist portion of the group believed that there could be multiple versions of a truth that was based in several different contextual perspectives. They also believed that it was important to evaluate all of those truths and that one could be judged to be more valid than the others based on the proof presented for that truth.

Video games were chosen as a context for the study as they are one of the most pervasive activities of adolescents today. Most youth today have been playing for years with many of them starting from a very early age (Rideout et al., 2003). This preoccupation occurs at a time that is considered to be a critical period for the development of epistemological understanding (Kuhn & Weinstock, 2002). One of the goals of personal epistemological research is to identify the kinds of real world activities in which epistemological understandings figure heavily (Kuhn & Weinstock). Video games represent both an activity at a critical point of development and an opportunity to identify the manifestation of personal epistemology beyond formal educational settings.

In an attempt to engage this debate and move beyond rhetorical statements on both sides of the discussion, this study tries to determine the way game players approach knowledge and knowing from an personal epistemological perspective.

1.8 The researcher

At the time this study was conducted, the researcher was a consultant working in a variety of technology and educational contexts. This included both a corporate and a post-secondary environment. In corporate settings he was involved in corporate training and e-learning as well as entrepreneurial projects with technology start-ups. In the educational context the researcher has conducted several funded research projects on the use of technology in K-12 and post-secondary environments. This has included the development and deployment of serious games. He has also developed curriculum at the post-secondary level for a wide range of programs from graduate classes to apprenticeship programs. The researcher brings practical experience as a working professional in the field of instructional and game design.

The researcher acknowledges that these experiences may be valuable in the current study but they also serve as a liability in terms of biasing his judgment in the research design and interpretation of findings. The researcher maintains an ongoing critical self-reflection and analysis by way of writing and ongoing conversations with both academic peers and personal contacts. A number of procedural safeguards were undertaken such as testing for statistical validity, and using other evaluators to check the validity of the content analysis done on the interviews.

Chapter 2 Literature Review

2.1 Introduction

The literature review provided an understanding of the context, history, development, and current research directions in the study of personal epistemology in relation to education and learning. It provides a similar context about the context and structure surrounding video game play.

In conducting the literature review, the researcher sought out multiple information resources. This included online databases, books, peer-reviewed articles, dissertations, and professional journals. These sources were accessed through web portals that included ERIC (via Ebsco), Google Scholar, Google Books, PsycINFO, and ACM Digital Library. There was no specific limitation or framework used to search these resources although given the nature of video game play, the material reviewed was defined by a historical framework that related to their ubiquitous appearance in society in the 1990s.

2.2 Epistemological Belief Structures

2.2.1 Introduction

Research into the epistemological beliefs of individuals began as a qualitative research field. Interviews were conducted with students at Harvard University between 1954 and 1963 (Perry, 1999). The goal of this work was to come to a better understanding of how the personal beliefs of students affected their theories about the nature of knowledge, understanding, and learning, and how those beliefs changed during the course of a liberal arts undergraduate education.

Since then, there have been many attempts to organize personal epistemological beliefs research. The ontological development was motivated by a need to categorize the stages and components of personal epistemology. Like most research, developing universally recognized categories is an important step to having a common language for discussing the subject. The complexity of personal epistemology and the relatively recent development of personal epistemological beliefs research led to many different perspectives on how to organize the research. Hofer and Pintrich (1997) have organized the research into three categories. The first category is how individuals interpret their educational experiences. This approach was originated by Perry (1999) as he attempted to develop a developmental scheme that occurred during the undergraduate years. The second category organized personal epistemology into stages along a linear developmental path. Researchers focused on understanding the influence each stage would have on an individual's general approach to thinking and reasoning. The third category is the most recent and it looks at the epistemological belief structure as a system. The system is made up of independent components. Schommer (1994) has one of the most popular organizational frameworks in the research and her categories included components such as Quick Learning, Simple Knowledge, and Certain Knowledge. Each of these components had its own developmental path. This path started at a naïve and unsophisticated epistemology and developed into a mature perspective. Much of this research was focused on learning in formal educational settings.

2.2.2 Interpretation of educational experiences

Initial work on epistemological belief structures began with Perry's (1999) work at Harvard University. The research was focused on understanding the epistemological changes during a liberal arts undergraduate education. The work resulted in a structured sequence of developmental stages. Students would move through nine positions in this developmental scheme. The nine positions were organized into four main categories. These were described as dualism, multiplicity, relativism, and commitment. In dualism the student had an absolutist, right-and-wrong view of the world. They also believe that authorities are expected to possess the truth and are able to transmit it to the learner. When learners begin to understand knowledge in terms of multiplicity, they begin to admit that there is diversity in the world that results in uncertainties that exist as well as absolute truths. They are not as reliant on authorities for absolute truth but they still believe that opinions and truths can be labeled as right or wrong. In relativism the student makes a significant shift away from a dualistic perspective of the world (Perry, 1999). They begin to see meaning in the world as actively and personally constructed. They also realize that knowledge is relative to their own personal interpretations and contextually based. Commitment has more of a qualitative change in the individual and is not correlated with a formative change. The focus in the commitment phase is on personal responsibility for building knowledge based on evidence and forging a commitment to relativism.

Perry's (1999) work was based upon a predominantly affluent white, male population and the male-centric bias of the study triggered the work of Belenky, Clinchy, Goldberger, and Tarule (1986). This work was designed to counter the trend towards this male sample becoming the basis for normative view of epistemological beliefs (Hofer & Pintrich, 1997). They conducted their study using only women as participants. The work resulted in a framework for women's ways of knowing that had similar developmental stages as Perry's model. The model provided five separate stages that were known as positions of silence, received knowledge, subjective knowledge, procedural knowledge, and constructed knowledge. Positions of silence did not have a true correspondence to Perry's model, as it is a completely passive position that listens solely to an external authority. Received knowledge is a dualistic perspective that views all ideas as having a right or wrong designation. All knowledge is perceived as being outside of the self and originating from an authoritative source. These sources of knowledge are often seen as experts and professionals in a subject area. This external knowledge can be received and transmitted by the individual. Subjective knowledge is also dualistic in nature but the knowledge originates in the individual. The individual believes in the absolute nature of knowledge and sees their personal opinions about the world in those terms. Procedural knowledge is a shift towards the individual making her own meaning through the application of objective and systematic procedures of analysis. Belenky et al. outlined two epistemological orientations that can occur within procedural knowledge acquisition. These have been described as separate knowing and connected knowing. Separate knowing sets a distance from the subject of inquiry. It has a detached approach that has been compared to critical thinking (Hofer & Pintrich, 1997). Connected knowing is still composed of a procedural approach but it uses a more empathic way of understanding. It attempts to identify and connect with the subject as a way of coming to understand it. Constructed knowledge combines the objective and subjective approaches to knowledge. It recognizes that all knowledge is constructed but is also acknowledges that the individual is an integral part of that knowledge (Belenky, et al.).

2.2.3 Epistemological Beliefs and effects on reasoning

Kitchener, Lynch, Fischer, and Wood (1993) looked at the effect of epistemological beliefs on reasoning ability. Their work focused more on how personal epistemology manifested itself rather than understanding the exact nature of the construct itself. The work resulted in the finding that the way people justified their beliefs was based on their underlying assumptions about knowledge (King & Kitchener, 1994). In order to investigate the nature of this phenomenon, they examined how people understand the process of knowing and the way they use that understanding to interact with ill-structured problems (King & Kitchener). An ill-structured problem is defined as a problem where the solution was uncertain and open to interpretation. They would present an ill-structured problem to the participants and then ask the participants to state and justify their positions on the problem. The resulting model was made up of three levels that defined a pre-reflective, quasi-reflective, and reflective level. The pre-reflective level is composed of three stages. In stage 1 knowledge is simple, concrete, and absolute, and in no need of justification. In stage 2 the individual believes that correct knowledge is known only by authorities. In stage 3 there is the recognition that uncertainty exists in knowledge and that authorities may not possess an absolute truth. The quasi-reflective level is composed of two stages. In stage 4 the individual begins to understand the subjective nature of knowledge and begins to place value on his or her personal opinions on a subject. The individual begins to understand knowledge in terms of abstraction rather than just an absolute. In stage 5 the individual understands that knowledge is contextual and relative. They are able to comprehend and compare abstractions with one another. Reflective thinking, the ultimate outcome of this sequence, is composed of stages 6 and 7. In stage 6 the individual becomes the active constructor of knowledge rather than simply a receiver. Knowledge is perceived as contextual and uncertain in nature. Stage 7 is the pinnacle of the development stage model and is characterized by critical inquiry and probabilistic justification.

Kuhn (Kuhn, 1991; Kuhn & Park, 2005) looked at argumentative reasoning as a measure of thinking ability. Like the work of King and Kitchener (1994), Kuhn observed the behaviour of individuals in response to ill-structured problems that had no single solution. The work resulted in four categories being developed. These include realist, absolutist, multiplist, and evaluative (Kuhn & Park). These stages were developmental in nature and similar to earlier perspectives on cognitive progression. A realist is usually a pre-school child that believes that reality is received in the same way as every other individual. There can be no discrepancy in the knowledge about the world as everyone receives the same version of reality. The absolutist viewpoint holds that knowledge is an accumulation of facts and expertise. Although it is possible for experts to be wrong, any discrepancy can be solved by reference back to the actual object in the real world. The multiplist does not believe in the certainty of facts and is skeptical about expertise. They believe that all knowledge is subjective and any opinion is as valid as any other. They tend to disregard expertise and give more weight to emotions than critical thinking. An evaluative thinker does not believe in the certainty of facts but also acknowledges the uncertainty of the subjective nature of knowledge. The difference is that they can evaluate the claims that one or many experts may have on subject knowledge and recognize it as having merit.

2.2.4 Epistemological Beliefs as a System

Schommer-Atkins (2004) and Schommer-Aikins and Easter (2006) examined the existing research and challenged the idea that epistemological beliefs were one-dimensional and progressed in a fixed unidirectional manner. Based on a questionnaire and subsequent factor analysis there were five factors that were derived from the initial work. These included Fixed Ability, Quick Learning, Source of Knowledge, Simple Knowledge, and Certain Knowledge. All of these components are on a scale that ranges from an immature or naïve perspective to a mature or sophisticated one. For example, fixed ability defines intelligence as a fixed and unchanging construct on one end of the scale and something that is incremental and subject to improvement on the other end. Quick learning is characterized by the perspective that learning happens quickly or not at all on one end and the belief that learning is gradual and takes time on the other. Simple knowledge defines knowledge as an isolated and unambiguous entity versus knowledge being highly interrelated. Certain knowledge has the belief that knowledge is absolute and unchanging on one end of the scale and that knowledge is tentative and evolving on the other.

The research presented a new viewpoint on epistemological beliefs that initiated a number of new perspectives. It suggested that epistemological beliefs might be made up of several independent components that exist in isolation from one another rather than as a cohesive whole. It was also the first study to make extensive use of a quantitative instrument that would allow large-scale data gathering to occur. It also used path analysis to link epistemological beliefs to academic performance (Schommer-Aikins & Easter, 2006).

A similar approach that defined specific components of epistemological beliefs was put forward by Spiro et al. (1996). It only dealt with two specific components to epistemological beliefs. One dealt with the simplicity of knowledge while the other looked at beliefs about sources of knowledge. Simplicity of knowledge ranged from a simple, reductive worldview to a complex and flexible perspective on knowledge. Source of knowledge addressed the passive reception of knowledge versus active learning and construction of knowledge on the other. In order to determine where an individual was located on these scales, an instrument called the Cognitive Flexibility Instrument was designed to assess beliefs about knowledge. The results of this survey instrument were then compared to an individual's ability to problem solve in ill-structure domains. The results showed that those with a reductive world view and a passive perspective towards knowledge were less likely to be successful in problem solving in an ill-structured domain.

2.2.5 Summary of personal epistemology studies

There have been a considerable number of theoretical perspectives as well as research programs based on those perspectives (see Table 1). One of the best summaries of this work was by Hofer and Pintrich (1997) who attempted to identify common themes through the literature as well as identify methodological issues and gaps in the existing research. They proposed two general areas that represent the main elements of the epistemological belief structure of an individual. These were the nature of knowledge and the nature of knowing. Each of these areas had an additional two parameters. The nature of knowing was composed of (a) source of knowledge and (b) justification of knowledge. The nature of knowledge had two parameters known as (a) certainty of knowledge and (b) simplicity of knowledge. These parameters are not independent as in Schommer-Atkins's (2004) models but rather interdependent as they all have an influence on the way an individual thinks about knowledge. This work is the most comprehensive attempt to differentiate personal beliefs and the way those beliefs are expressed as an individual makes sense of the world.

Table 1

Components of Existing Epistemological Beliefs Research (Hofer & Pintrich, 1997)

	Core dimensions of epistemological theories		Peripheral beliefs about learning, instruction and intelligence	
Researcher(s)	Nature of knowledge	Nature of knowing	Nature of learning and instruction	Nature of intelligence
Perry	*Certainty of knowledge:* Absolute←→Relativism	*Source of knowledge:* Authority ←→Self		
Belenky et al.		*Source of knowledge:* Passively received ←→ Personally constructed External ←→ Self-made		
King & Kitchener	*Certainty of knowledge:* Absolute, certain ←→ Uncertain, contextual	*Justification for knowing:* Knowledge needs no justification ←→ Knowledge is constructed and constantly being re-evaluated		
		Source of knowledge: Authority ←→ knower is the constructor of meaning		
Kuhn	*Certainty of knowledge:* Certain, right/ wrong ←→ Merit of knowledge based on relative merits	*Justification for knowing:* Acceptance of expertise ←→ Evaluation of expertise		
Schommer-Atkins	*Certainty of knowledge:* Absolute ←→ Dynamic and tentative	*Source of knowledge:* Obtained from authority ←→ Personally derived through reasoning	*Quick Learning:* Quickly or not at all ←→ Learning takes time	*Innate ability:* Intelligence is fixed at birth ←→ Intelligence can develop incrementally
	Simplicity of knowledge: Isolated, certain			

	facts ←→ Interrelated concepts			
Spiro et al.	*Certainty of knowledge:* Orderly and teleologically homogeneous ←→ Disorderly and heterogeneous	*Source of knowledge:* Depends on authority ←→ Active learning, personally constructed		
	Simplicity of knowledge: Reductive worldview ←→ Complex and interrelated.			

2.2.6 Perspectives on Personal Epistemological Belief Change

Although the development of a common descriptive framework for personal epistemological beliefs has been a priority, understanding how those beliefs grow and develop has also received attention in the literature. The process of moving through epistemological belief stages is described in all of the models. What is missing in most of the models is a discussion about why that movement is occurring change (Bendixen, 2002; Hofer, 2005; Kuhn & Weinstock, 2002). There are a number of sources of information that provide some hypotheses about the cause of epistemological change. These come from cognitive psychology, conceptual change research, and Bendixen's study on affective and motivational factors during epistemological doubt. This is still a small amount of research on a complex subject that needs to describe change factors such as affect, motivation, and context.

Piaget (1987) described change as a disturbance that drove transition in the individual. This disturbance was then addressed and resolved allowing the individual to return to a neutral state of "equilibriation" (p. 6). Equilibration is defined as the creation of a balance between the individual and his or her environment. Merleau-Ponty (as cited in Freeman, 2000) had a similar concept and believed an individual was motivated by a disequilibrium between the individual and the world. In a moral setting this is seen as the struggle that occurs when principles need to be reconciled in the face of experience (Gilligan & Kohlberg, 1978).

The motivation to address this disequilibrium is strongest when it interferes with our goals. We are much less motivated to question our approach to life if it is not directly important to our tasks (Depraz, Varela, & Vermersch, 2003). We are heavily tuned towards our goals and to the positive information that we receive in feedback. It is not until negative information begins to appear with an absence of positive information that our attention becomes focused on the way we are organizing our actions. At this point, reflection becomes a more attractive strategy as it gives us time to reconsider our current strategies and beliefs. Reflection is not a natural activity for people as it makes us stop thinking about what we are doing and begin to look at how we are going it (Depraz et al.).

The process of reflection involves the process of both assimilation and accommodation as an individual makes sense of the world. Assimilation is the incorporation of the external world into our existing cognitive structure. This new knowledge is the result of both the individual's action upon the environment and the reflection upon the result (Gallagher, 1978). The environment acts on us as well and accommodation by an individual allows him or her to adjust to the external world. Both of these processes work together to allow us to generalize and abstract the object into an internal construct, or memory, that we understand (Merleau-Ponty, 1945). All of this results in an ongoing construction of knowledge that is connected to earlier understanding. It is retrospective in its integration into existing knowledge as well as constructed through the development of new relationships (Gallagher).

The literature on epistemological belief structures seems to be in agreement with these ideas but there is little explicit discussion of the process. In the Perry (1999) scheme there is an acknowledgement that there were two dynamics at work. One was the confrontation of diversity and uncertainty that came about from new learning (Moore, 2002). This was never fully explored by Perry but later researchers came to a similar understanding. In order for change to begin there must be a dissonance between expectations and actual outcomes (King & Kitchener, 1994). The contradiction that results will create a state of epistemic doubt that causes an individual to re-interpret their previous beliefs and either re-interpret or reject them (Bendixen, 2002).

The research area of conceptual change provided an additional perspective on how individuals learn in formal educational settings and this became the basis of further work in the field of personal epistemological beliefs. In the framework of conceptual change there are four conditions that need to be in place for conceptual change. Initially, the individual must be dissatisfied with their existing conception. Secondly, the new conception that is offered as a solution must be intelligible. Thirdly, the new conception must applicable and plausible. Finally, the new conception must stand against future challenges and lead to further learning (Pintrich, Marx, & Boyle, 1993; Posner, Strike, Hewson, & Gertzog, 1982). The nature of switching from one conception to another has been described in terms of status. Status is the extent to which a conception is "intelligible, plausible and fruitful" (Yuruk, Ozdemir, & Beeth, 2003, p. 6).

Conceptual change became the basis for Bendixen's (2002) research on the process of change of epistemological beliefs. In the study, students at the university level experienced epistemic doubt when they were exposed to multiple viewpoints that were unlike their own. The anxiety and confusion that followed were resolved in two different ways. The majority of the students entered into a state of reflection where they resolved their epistemic doubt. Those students gained a more relativistic perspective that allowed them to consider multiple perspectives. They also gained confidence in their ability to resolve situations of epistemic doubt. A small minority of the students resolved their doubt by giving up control of their epistemological beliefs to an authoritative or higher power. The resolution seems consistent with some observations on deflections from the linear and progressive path of most epistemological belief schemes. There was some consideration that the observed process was much more fluid and recursive than early constructs had indicated (Moore, 2002). Some individuals paused at certain points in the process, taking a break from the process. Others actually retreated, moving backwards and away from the diversity of relativism to an earlier perspective. Within conceptual change research, the individuals who exhibited this backwards movement were termed retrogressors (Gilligan & Kohlberg, 1978).

A similar phenomenon has been reported in the field of psychology. Research indicated that individuals will selectively focus their attention on aspects of a problem that confirm their existing epistemology. Humans have a mechanism that allows them to actively avoid addressing dissonance. This concept of confirmation bias is exhibited when a person ignores information that does not fit into their preferred hypothesis about the world. The phenomena was detected in a recent fMRI study that noted that when emotion was involved in decision making that decisions used a different part of the brain than when an individual was involved in rational, “cold” reasoning. In this particular study, the subjects were shown information that threatened their perceptions of their political candidate in the 2004 U.S. Presidential elections (Westen, Blago, Harenski, Kilts, & Hamann, 2006).

Most of this research focuses on generalized conceptual change within an individual. The research of Kuhn and Weinstock (2002) indicated that certain concepts are more resistant to change. They recognized four concepts that appear to have different degrees of susceptibility to conceptual change. These include personal taste, aesthetics, morals, and the concept of a single truth. Within their proposed epistemological framework an individual progresses from an absolutist to a multiplist and finally an evaluativist. When an individual moves from being an absolutist, seeing knowledge mainly in terms of right and wrong, to a multiplist, recognizing that each individual has their own perspective on right and wrong, these domains tend to change in the order:Personal taste → Aesthetics → Morals → Single Truth

The change in an individual’s understanding of personal taste is the simplest. It occurs when an individual recognizes that everyone has a different perception of the world. This becomes obvious when observing how individuals have different emotional reactions to the same event. Aesthetics is the next concept to undergo revision. This occurs when the individual recognizes that everyone has different tastes in areas such as clothing and music. Value or moral judgments are a difficult concept to change as the idea of absolute standards is strong. The last domain is the concept of a single truth. An individual realizes that there may be conflicting claims about the definition of a fact and that all those claims may have an element of truth (Kuhn & Weinstock, 2002.

The growth of an individual from multiplist to evaluativist has a predicted reverse order of change:

Single Truth→ Morals → Aesthetics → Personal taste

The concept of a single truth is central to the evaluativist stance. The evaluativist perspective is defined by an understanding that there can be multiple versions of the truth. All of those versions need to be personally evaluated based on the evidence presented in order to determine which version is more accurate. Morals is the next concept to undergo revision. It comes with the recognition that there may be multiple views on the definition of morality but that those views can be evaluated to determine which one is more moral. An evaluativistic perspective towards the concept of aesthetics becomes more difficult as it would mean the accepting a belief that one form of music or art could be evaluated as superior to others. The last concept, personal taste, is likely to remain at a multiplist level unless someone is willing to accept that one individual's personal tastes could be judged as having more merit than another's (Kuhn & Weinstock, 2002).

2.2.7 Summary

Personal epistemological belief research is a continuation of a western philosophical tradition that describes a linear progression towards enlightenment (Bowers, 2005). This is a lucrative idea as it intuitively makes sense that the experiences we have in the world will affect our perceptions of things, hopefully improving the successes we have each time we experience it again. Even though we are constantly exposed to new experiences that may challenge our beliefs about the world, our growth and progress is not guaranteed. It is possible to stay at one point or even revert back to an earlier perspective if the world requires that kind of thinking for our survival. This perspective takes away some of the value judgments inherent in the idea of naïve and mature beliefs and replaces it with the idea that availing beliefs are used to increase the chance of learning in a given situation (Muis, 2004). This perspective views personal epistemology as much more dynamic than many of the theoretical approaches that have a progressive set of stages. This dynamic model of epistemology is consistent with what modern neuroscience is telling us about the brain. Modern medical imaging is helping us understand that the brain works as a nonlinear, dynamic network that is constantly changing. This means that it is most likely that our personal epistemological beliefs settle into only the briefest of stasis as we are being constantly tuned by our existing knowledge and environment, both of which are continually changing (Globus, 1995).

This means that context can have a substantial impact on the kinds of thinking in which we engage (Muis, Bendixen, & Haerle, 2006). Our beliefs are not static and unchanging throughout our ongoing experience. Culture is one example of a powerful context that influences the kind of thinking we express, often to the point where different linguistic and cultural contexts can result in a plethora of thinking patterns. Our philosophical understanding of our experience has benefited considerably from the biological research into the nature of the brain. Our brain serves to help us filter, organize, and make sense of the world. It also effectively blinds us to many things as well, often without any kind of conscious decision to do so.

2.3 Computer Games

2.3.1 Introduction

Video games are another context that might have a different effect of the expression of personal epistemology. Video games do not represent a homogenous context though as there are many different game designs available to the video game player. Even the definition of video game is a loosely bound concept that is evolving as technology and game play change over time. This study does not begin with the assumption that all forms of computer games have the potential to engage epistemological thinking in the same way. There are many different aspects to game design and implementation that affect the types of challenges that will be experienced by the game player. This study reviewed game design models and game genres that seemed most likely to challenge the personal epistemological assumptions of the game player. The criterion was video game experiences that appeared to have elements of uncertainty, ambiguity, and complexity. As indicated in the review of personal epistemology and conceptual change, an environment that was complex and uncertain was more likely to challenge existing beliefs as it had the greatest chance of causing disequilibrium.

2.3.1 Definition of computer games

Computer games cover a wide range of technologies and interactive multimedia. Coming up with a common definition has been a difficult exercise for game designers. This isn't a unique problem as many concepts we deal with have blurred edges.

Wittgenstein's (1958) perspective on the definition of game is helpful as he addressed the idea of defining a concept with vague boundaries. He believed that it was important to be able to discuss concepts that may seem indistinct. In order to talk about a vague concept we can provide examples and dictate that they be interpreted in a particular way (Wittgenstein). This approach is not only applicable but is the only pragmatic way to approach a definition of video games. Below are a variety of definitions of video games that have been created by the game design community. This is followed by a number of examples of video games themselves. Those examples are provided to offer some guidance in coming to an understanding of the words "video game" for the reader. It is unlikely that everyone will identify the exact same picture of the concept but as Wittgenstein says, another's definition of a concept may not be identical to yours but it should be "akin to it" (p. 36).

Rollins and Adams (2003):

> A game is a form of interactive entertainment that takes place in an artificial universe that is governed by rules.

Lindley (2003):

> A game is a goal-directed and competitive activity conducted within a framework of agreed rules.)

Crawford (1982):

> A game is a self-contained system with explicit rules that cover all actions within that system. It represents a subjective representation of a subset of reality.

There are three components, which at a high level of abstraction, appear to be common to most of the definitions: (a) a game has explicit rules; (b) has some form of interaction; and (c) occurs in a defined, constructed space. Most game designers would agree with this very vague definition but the creation of formal taxonomies or frameworks that go beyond this seems to elicit a great amount of debate within the profession.

2.3.2 Definition of Game Design

A game design is a formal approach that defines game play and how to make it work (Rollins & Adams, 2003). It is the set of abstract statements that takes a game from a concept to an operational entity.

The way game designers define and implement their design varies considerably. There is no common approach to game development and much of the framework used to implement a game design is implicit and intuitive. The lack of a common language to describe game design and implementation is a problem. Some groups have been working on this in order to improve communication amongst game designers as well as the team of programmers and artists who need to implement that design. In trying to develop frameworks or common points of reference in game design there has been considerable cannibalization from more mature media types such as film (King & Krzywinska, 2002). The lack of a mature framework within the game industry points out the relative youth of the discipline but also identifies a limitation in utilizing a comprehensive and detailed language that can be used to discuss it in research.

Educational researchers represent one of the groups that have been trying to create a framework around games. They have been focused on understanding the nature of the learning opportunities within video games. Educational researchers recognized that game designers are thinking about the same sorts of challenges that face teachers and instructional designers involved in teaching and learning (Gee, 2003). Game designers have not reacted positively to this attempt to build a formal academic framework of learning in games (Prensky, 2004). They see the terminology and semantics of the academic community as far too complicated and limiting. Without a common language much of the dialogue about game design has been taking place within the communities of game design and educational research but rarely between those two communities.

2.3.4 Game genres

The most common way that video games are classified and described is by game genre. This ontology is based on certain characteristics of design and game play that are common. The game genre often creates an expectation for the game player about the kind of experience and challenges they will encounter when they begin playing a game. The problem with classifying games into genres is that games are becoming so complex that they often blend together several different genres within a single game. This creates a further blurring of the lines that delineate the game genre categories.

Action/ Arcade

These fast-paced games are usually based on reflex responses and reaction time. They have also been called "twitch" games (Pedersen, 2009, p.34). The description is based on the quick movements of the fingers on a game controller that is often required to succeed in these games. Action games are more focused on speed than complexity and one of the most common types is the first person shooter (Rollings & Adams, 2003). Examples would include games such as Halo, Call of Duty, and Quake. There are non-violent types of action games but these only represent a small part of the market.

Strategy

These games often require both long and short term planning as well as execution of those plans. Logic, inference, lateral thinking, and morals-based decision-making elements are all part of strategy game play. The turn-based strategy games allow the player to consider their move before committing. The more common real-time strategy games apply constant pressure to the player, limiting the amount of time they have to consider their options and develop a strategy (Rollings & Adams, 2003). In these real-time strategy games the participants must create game units and structures during the game. They must also accumulate resources that can be used during the building process. Examples would include Command & Conquer, Starcraft, and Age of Empires.

Adventure

These games contain a series of linked puzzles that the player must solve to progress through the game. The game player takes on the role of a protagonist and is drawn through a narrative. Often there are puzzles that need to be solved in order for the storyline to progress (Friedl, 2003). Examples would include Zork, King's Quest, and the Myst series of games.

Simulation

Simulations are games that model a complex and often real-world entity. All of this occurs within a high fidelity game environment that is as close as possible to the real world. There are two general categories within game simulations. These are vehicle simulations and management simulations (Pedersen, 2009). Vehicle simulations are designed to simulate the experience of flying a plane, driving a car, or moving in some kind of vehicle. Management simulations are designed to create something within an ongoing process (Rollings & Adams, 2003). They often involve the task of maintaining a business, such as an amusement park, or building something like a city or a railroad. Each of these games would come with a relevant set of tools for building and managing those industries. Examples of vehicle simulations include Flight Simulator and Need for Speed. Examples of management simulation would include SimCity, Eve Online, and Railroad Tycoon.

Role-playing

Role-playing games usually involve a system that allows the player to continually improve their skills throughout the game. The player is in control of this skill development and it allows them to create a character that reflects their own personal preferences and goals (Friedl, 2003). Examples of role-playing games would include World of Warcraft, Diablo, Fallout, and Knights of the Old Republic.

2.3.5 Game Artificial Intelligence (AI) and Human Intelligence

When a game design is implemented there needs to be something that is controlling how that game design interacts with the game player. There are usually only two options. The first one is that the game itself controls the interactive experience. This is accomplished programmatically by an artificial intelligence (AI) that was designed to carry out the rules and challenges created by the game designer. The second option is that other human players utilize the tools offered by the game design to interact with the game player.

The video game player then reacts to either machine-based or human behaviour. The level of complexity of those interactions can vary considerably. The sophistication and nature of the AI will change with the context of the game. It is often the case that there are multiple AIs within a single game, with each of these acting in a different context. Human intelligence represents a largely unpredictable interaction as there is no guarantee about the consistency or logic of human behaviour in the game.

Game AI is not like academic AI in how it defines itself. Academic AI is attempting to create a computer program that can act and think like a human being. It is designed to manifest itself as a virtual representation of the behavioural and cognitive aspects of a person (Sharples, Hogg, Hutchinson, Torrance, & Young, 1989). This is part of an ongoing research community that is attempting to build artificial entities as a way of understanding the nature of intelligence.

Game AI is different from academic AI for a number of reasons. Game AI is not trying to understand the nature of intelligence or trying to make a decision-making program that is always rational. Game AI is designed to make the computer-controlled elements of the game appear, on the surface, to behave in an intelligent manner. It is designed to provide a "theory of mind" for the game player (Schwab, 2004, p. 4). In other words, it is designed only to make the player believe that there is some form of intelligence at work, reacting to their decisions. This intelligence can be influenced by a number of things other than just rationality. The game designer doesn't have to worry about how the program reached that intelligent behaviour, only that it has acted in that way (Schwab). These decisions are the result of the current environment in the game and the game player's actions. The sophistication of game AI has increased rapidly in the past few years. As computer processors become more powerful and the AI is becoming more of a selling feature to engage game players, it continues to evolve (Schwab).

The relevance of game AI to learning lies in the behaviour of the game player. The player's development of hypotheses about how to solve problems in the game is directly influenced by the reaction of the elements of the game. The player is essentially trying to learn the nature of the AI's intelligence and attempting to develop a solution that will overcome the challenges presented by that intelligence. Many games are trying to program the same kind of learning into their game AIs as well. This is creating game AIs that are trying to learn from the player's behaviour and present new and novel challenges to the player. The game player is then forced to re-test their theories about the game world constantly. This interplay between human intelligence and computer intelligence can often create an environment that is unpredictable and uncertain. This means that different players may experience the game in much different ways. These are the kinds of game play experiences that are increasingly being demanded by game players (Schwab, 2004).

The kinds of challenges presented by human intelligence are the ultimate goal of most modelling efforts for AI development in video games. The level of sophistication provided by human intelligence has yet to be matched and this will likely remain the case for the immediate future. Human players are extremely complex and provide a broad range of challenges for programmers to replicate. These include issues related to emotion, knowledge, and identity that take place both online, in a game world, and offline when the players discuss and debate the meaning of the experience of the gameplay (Friedl, 2003).

2.3.6 The Game Play Experience

The game design, game AI, other players, and the challenges in the game all combine to create the game play experience. That experience can be described as points in the game where decisions are made, strategies tested, and outcomes are made explicit. The skills and knowledge the player has developed to be successful in the game are finally evaluated. In instructional design terms, the game experience represents the opportunity to test knowledge, create new knowledge, and undertake remediation in the event of failure. The experience is very similar to the description of constructivist learning activities where a student constructs new knowledge by mediating and interpreting their experience with their existing knowledge (Black & McClintock, 1996, ; Riesbeck, 1996).

2.4 Games and Education

Understanding why the field of education is interested in video games requires an examination of where game design aligns with the methodologies of educational technology, instructional design, and learning theories. The recent expansion of multimedia technologies and powerful desktop computers has resulted in a large increase in the amount of multimedia being created for education. The cost of these technologies has also dropped allowing education access to the same kind of sophisticated technology that is used in the game industry. The challenge then isn't access to technology but rather finding an educational philosophy that aligns with approaches to video game design.

One model of learning used in educational technology is the instructivist or transmission model. It is based on an information-processing model of the human cognitive system. This model focuses on how human memory acquires, encodes, retrieves and uses information (Moore, Burton, & Myers., 1996). This perspective believes that education could send messages to students through various channels such as audio, video, and text. It was defined as a very mechanistic and structured approach to learning.

Constructivism takes a different perspective towards learning. It is not a new idea as it was introduced in the 1950s by Piaget (1955). It sees learning as a dynamic process where the individual constructs their own knowledge and meaning. This occurs through a dynamic interaction of an experience and the learner's existing knowledge (Davis, Sumara, & Luce-Kapler, 2000). Learning is not about memorizing information presented to students by an instructor. In implementing constructivism in the classroom the instructor is focused on creating learning experiences that try to generate understanding rather than achieve a performance goal (Glaserfeld, 1995).

The philosophy behind constructivism is currently being used as a basis for teaching in many classrooms as it is considered an effective way to facilitate learning in students (Gagnon & Collay, 2006). Educational technology has also tried to create technology-mediated environments that don't necessarily replicate the classroom but can facilitate constructivist teaching. Those constructivist design approaches emphasized a learning experience where learners can construct their own, unique knowledge from multiple sources of information. Unfortunately, much of the multimedia being developed would often define and delimit the information and actions that were available to the learner. The instructional design that created the blueprint for these experiences seemed to be a tenuous compromise for educators, accepting an inherent belief that these kinds of structured approaches could facilitate the creation of personally relevant knowledge.

Often the multimedia would not allow the learners to explore, discover, and evolve their own individual perspective on the subject. In reality, the limitation of the technology often made it far too difficult and expensive to really build the kinds of open environments required for constructivist learning to happen.

At the same time that educational technology struggled with combining technology with a constructivist approach to learning there was something interesting going on in the world of computer games. Video games were dynamic, seemingly unrestricted in terms of types of activity available to them. They were also operating outside of traditional educational settings. As video games grew in sophistication and realism they began to increasingly resemble the kinds of educational resources that constructivist educational technologists had been trying to create. Video games have the capacity to create open and ambiguous environments that are designed to engage and challenge the game player. The game player could interact in a variety of ways with an interactive system that allowed for a wide range of behaviours. These systems were more than just a collection of facts. The knowledge in the game was generated by the game player themselves. This knowledge was utilized by the player as they tried to resolve the challenges that were presented to them in the game. Each new challenge provided an opportunity for the player to build his or her new knowledge and augment existing cases that were already in his or her memory. Games represented an experience where learning was both interactive and dynamic. These more open game designs seemed to provide an opportunity to explore a constructivist approach to learning. The constructivist description of learning had a student constructing new knowledge by mediating and interpreting his or her experience with his or her existing knowledge (Black &

McClintock, 1996; Riesbeck, 1996). This description was very similar to descriptions of video game play.

As researchers in educational technology became more familiar with video games they started to become interested in their potential to facilitate a constructivist learning environment. There were few educational games so much of the interest developed after they examined learning in entertainment based video games (Gee, 2003). This research has identified a number of factors that are believed to facilitate learning. These attributes include a risk-free environment, social interaction, and a player-centric design for engagement, knowledge acquisition, and problem solving.

A risk-free environment allows the game players to fail and then provides them with the chances to go back and modify their strategy until they have achieved a successful result. Failure is seen as a necessary experience for learning in a game environment (Aldrich, 2005). There are three advantages to removing risk during game play. One is the ability to improve the skills of players in a way that does not affect actual outcomes (Walker, 1995). This is most relevant in situations where failure in real life might cause human harm or injury. The second positive effect is that game players do not come to fear failure. Failure becomes part of the learning process that will lead to an improvement in a game player's knowledge of the game, not the end of his or her involvement in it (Carstens & Beck, 2005). The third, and perhaps most powerful effect of failure, is the ability to foster creativity. Game play constantly encourages new thinking through the experience. In a creative approach to problems a player is looking for patterns that might exist in seemingly chaotic environments (Kahn, 1996). The game player is constantly forming new hypotheses and new experiments to test those ideas. In comparing the results of those experiments with the hypotheses they create, they can then gain an understanding about the validity of their insight.

Another alignment with a constructivist perspective on education is the player-centric nature of video games. This makes the outcomes of the game completely dependent on the player's actions (Aldrich, 2005). Ultimately the goal of the game designer in creating these kinds of experiences for the game player is mimesis. This is the creation of an experience that is so immersive that it mimics reality. The player forgets about the artificial nature of the game world and becomes totally engaged in a world where they can play, explore and ultimately learn (Dede, 1996).

Much of the knowledge gained during game play has limited application in the real world. Often the subject areas are not based in in any real historical or political context. The lack of any relevance to the real world would seem to indicate that they have little educational value. Although this is true, constructivist approaches to learning have identified at least two dimensions to learning that are relevant. The first element is that video game learning can engage the personal interest of an individual. Being personally invested in developing knowledge is going to have a permanent impact on the knowledge of that person (Shank & Cleary, 1995). Video games do an excellent job of motivating learners into developing large amounts of knowledge about the game world. The second element is that knowledge is not merely memorized. The knowledge developed in a game needs to be converted into an appropriate pattern of behaviour each time a new challenge is presented to the player. Video games aren't predictable and require players to examine their strategies and constantly modify them between game challenges (Rollings & Adams, 2003).

2.5 Summary

Personal epistemological belief structure research and video games may seem to be an apparent mismatch meeting between the academic and the entertainment world. This apparent mismatch can be reconciled by an understanding that both of them try to understand how to engage and facilitate the growth and learning of individuals. Personal epistemology belief researchers are motivated to investigate this domain because of the value they place in the growth and maturation of thinking of students in an educational setting. Game designers are motivated by a need to engage game players and motivate them to learn how to play their games. Ultimately the goal of video game companies isn't the personal growth of the game player but rather making money. Understanding how and where the educators and video companies intersect is still a challenge.

There are also a number of theoretical issues outstanding in both personal epistemological research and video games. There are many different perspectives on the nature of personal epistemology and how it progresses. The debate continues as researchers attempt to reconcile the numerous perspectives about personal epistemology. Video game research is even newer than personal epistemological belief research. Despite being a ubiquitous part of our society we still lack a depth of research knowledge about the effects of video games. This is complicated by the constantly changing nature of video games and the fact that much of the knowledge about the how and why design decisions are made is hidden within the game industry itself. The frequent use of implicit knowledge by game designers means that much of the knowledge about video games remains within a commercial industry. There is still a considerable amount to be known about their impact on society.

Chapter 3 Organizational framework for learning influences in video games

3.1 Introduction

During the course of the research, it became apparent that there was need of an additional framework to organize and make sense of the interpretations that were created from the data analysis. This recognition was related to the recognition of many additional influences on learning that didn't fit into the personal epistemological beliefs framework. Self-regulated learning was chosen as that framework. It was separate but related to the original organizational framework of personal epistemological beliefs. Self-regulated learning has been used in past research to organize personal epistemological beliefs into a more integrated construct that takes several different influences on learning into account.

3.2 Personal Epistemology and Self-regulated Learning

Much of the current research on personal epistemological beliefs focuses on identifying and describing the different stages or components of personal epistemology. The complexity of the construct alone has been the source of much debate among researchers. Another focus of the research relates to the impact of personal epistemology on learning. This comes in the form of descriptions about how these beliefs relate to academic performance in formal learning environments. The large amount of research energy that has gone into describing personal epistemological beliefs and understanding their causal effects has resulted in less time being spent on explaining how personal epistemological beliefs actually operate during learning.

The research community around personal epistemological beliefs is building a critical mass of research materials. As it reviews, coordinates, and integrates that research there is an increasing recognition that personal epistemology is not a separate and discrete part of us but rather a component that forms part of the many internal influences that interact with our environment. Winne (2001) identified a number of internal influences and hypothesized how these would work as part of the process of self-regulated learning (SRL). Subsequent researchers have suggested additional components for the model. Some of these proposed models of SRL included personal epistemology as a component. It was critical to review these models and choose a framework that was relevant for the organization and explanation of the finding of this study. A number of SRL frameworks were reviewed and relevant components were chosen. Some additional components were added to build the final framework.

The elements that had previously been used to discuss SRL include the components of personal epistemology, social factors, affective and motivation factors, and metacognition. This study added elements of external context that included game design and Artificial Intelligence (AI). The resulting framework for describing SRL among the participants provided a logical and cohesive way to describe and make sense of the research findings. The integration of SRL research approaches with personal epistemological belief structures is not a novel approach as it has been discussed by several different researchers (Schommer-Aikins, 2004; Muis, 2007; Bromme, Pieschl, & Stahl, 2010). A common element in these integrated approaches discusses learners as being involved in several stages during learning that include the identification of the learning task, planning how to address that learning task, enactment of the plan, and then monitoring the results. Some of the most recent descriptions of this framework that included epistemological beliefs included Muis and Bromme et al.. These studies had the most explicit description of epistemological beliefs within a SRL framework. The work tries to understand both how and why epistemic beliefs impact learning and were a starting point for building a framework to discuss personal epistemology as part of learning how to play a video game.

The SRL framework was modified and re-designed to organize the current research findings into a coherent model. It is not an attempt to define a proscriptive model of the learning process. In the academic model a learner may revert back to earlier phases or even skip some if it meets his or her needs (Muis, 2007). The SRL framework is defined by a number of identified phases. The phases define an order but, as previously mentioned, the process is not restricted to an ordered sequence that is linked in a linear fashion (see Figure 1). The ultimate purpose of self-regulated learning is to achieve the goals that are defined by the learner and not to go through a number of required steps. The same premise was used during the explanation of the current findings.

The model was created with an academic context in mind; it was designed to look at studying tasks when a student decides to learn about a particular topic. There are four basic phases of self-regulated learning that include task conditions, planning, enactment, and evaluation (Butler & Winne, 1995). The four areas that regulate the process include cognition (for example, prior knowledge about domain or tactics, knowledge and beliefs), motivation and affect (for example, anxiety, self-efficacy), behaviour (for example, time, effort.) and context (for example, resources, social context) (Bromme et al., 2010). The model proposed by Muis (2007) incorporates personal epistemology to replace the "Knowledge & Beliefs" component of the earlier Butler and Winne (1995) model. The resulting construct focuses primarily on the internal system that controls and monitors the

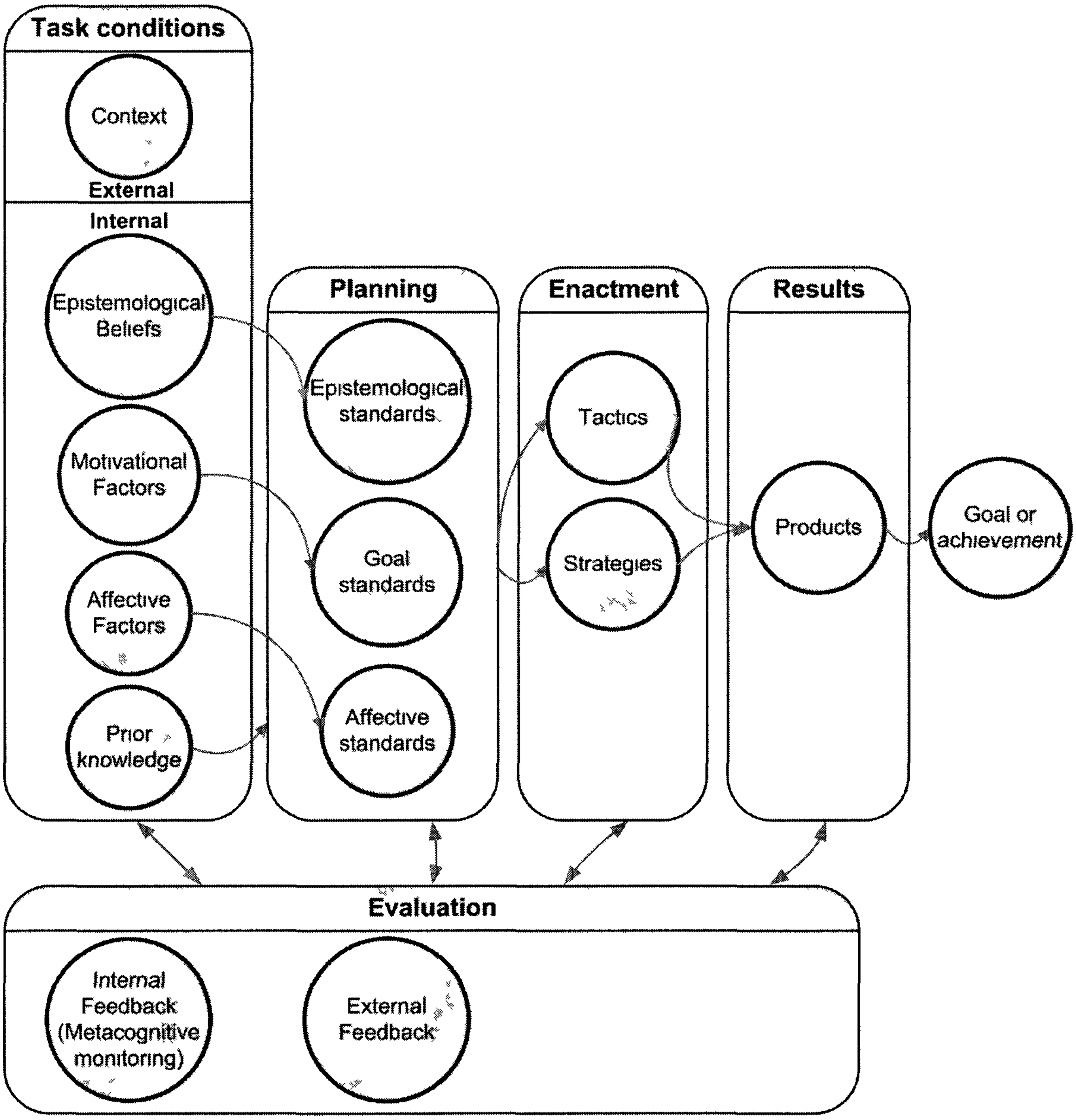


Figure 1. **SRL model of learning in a video game context**

SRL process. The external context was not specifically excluded by Muis's model and for the purpose of this research study it has been added. It is an important part of describing the overall process of learning in a video game environment.

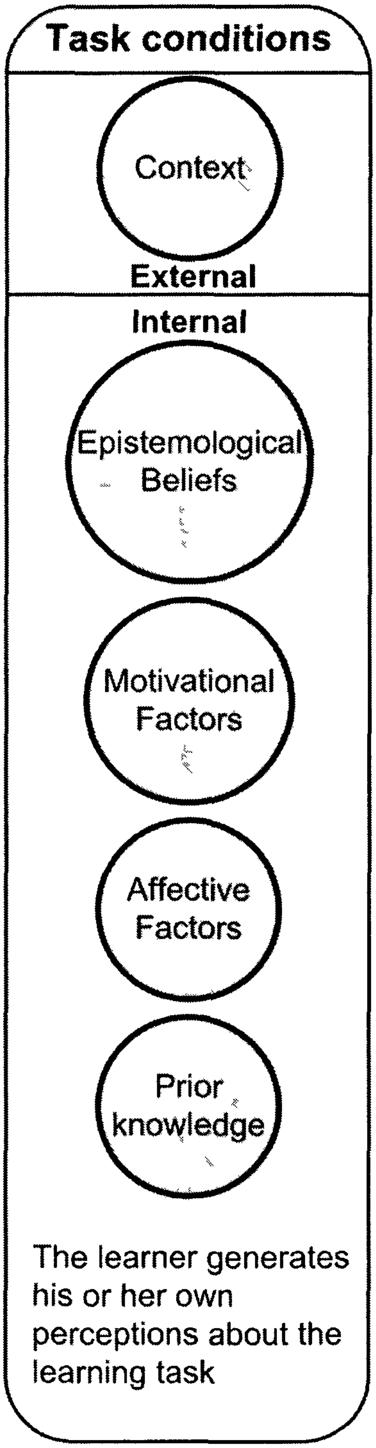


Figure 2. **Internal and external task conditions**

In order to explain the model it needs to be broken down in terms of a video gamer's perspective on learning how to play a game. There are several components necessary to (a) create a game player's perception of the learning task in the game, (b) plan how to address that task, and finally, (c) put that plan into action.

A task is a learner generated perception of what they are required to learn in a specific context. In the context of playing video games these task conditions are usually generated externally by the game and internally by the game player. These task conditions are described as the context (external conditions) and the cognitive and affective conditions (internal conditions) (see Figure 2).

The external context includes the delineations of behaviour and task context. An example of an external source that helps define a task would be the constraints a game designer had placed upon the game player. These would include contextual elements such as the game genre. The design would explain how player success is measured as well as any behavioural constraints on the player such as time limits, types of game movements, or actions allowed. Other external factors would include the social group within which the game is being played. The social context is complex but is most evident in multiplayer games or when gaming is part of socialization.

The internal task conditions are defined by the game player themselves. The elements of those internal task conditions include cognition as well as motivation and emotion (Muis, 2007). The cognitive elements include such aspects as prior memory and epistemological beliefs. Prior memory is considered to be one of the most important aspects in determining tasks (Winne, 2001). The game player relies on his or her experience with similar games and genres to help recognize and define the tasks in the game. Epistemological beliefs play a role in understanding the task that has been put before him or her. They help the individual anticipate the nature of the knowledge to be learned (Bromme et al., 2010). Personal epistemology also helps an individual recognize dissonance between what he or she believes about knowledge and knowing and how he or she is expected to approach knowledge and knowing in a game environment. Affect and motivation provide the emotional component surrounding the identified task. They present a strong influence for the learner in identifying the important aspects of a task and prioritizing which task conditions will be most important. Affect is usually not included in discussions of personal epistemology research as learning is often viewed as a cold cognition process that doesn't have an emotional component. This limited perspective on personal epistemology has been recognized by researchers and some have developed integrated models of epistemological belief structure development that include emotion (Bendixen & Rule, 2004). In the video game context, affect is a significant part of learning. This entire SRL process may recycle a number of times before the task is defined and it is not necessarily explicit or intentional (Muis, 2007).

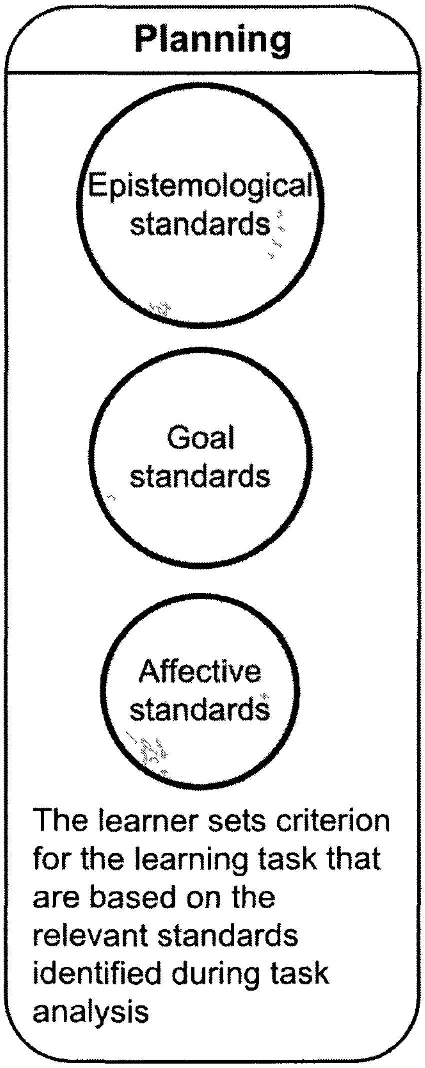


Figure 3. **Planning Phase**

Once the player has identified the tasks needed to succeed in a particular game environment he or she sets about planning how he or she is going to address those tasks (see Figure 3). During the task analysis the learner identifies the standards that are relevant to the planning process (Muis, 1997). These standards become the criterion that an individual sets for a learning task (Bromme et al., 2010). The tactics or strategies that are developed during the planning session either come to mind or are retrieved from long term memory (Winne, 2001).

This collection of standards chosen during the planning process is also used as a comparison for evaluating the outcomes created when the learner puts his or her plan into action. It is the combination of all these standards that define the complete goal of the learner. The importance of a standard and its relevance to planning how a learner is going to learn will depend on the learner's perspective of the task. These standards would include the personal epistemological standards of the game player if those had been identified as relevant to the task.

There is often little or no formal education associated with video games therefore the standards chosen during the planning process are left completely up to the game player. The choice of the standard is related to the underlying motivation to learn how to play the game. Unlike formal education settings, emotion can be a strong influence on setting task conditions in video games. Game designers often talk about the importance of creating emotional engagement in game players as a way to attract and retain those players. Although many goals are set based on internal standards, some are defined by the external context as well.

The game player then begins the enactment phase where he or she carries out his or her plan. There is an ongoing comparison between the products being created by the enactment, in this case the results of the game play, and the goals that had been defined in the previous stage. Internal feedback is created when the player compares his or her progress with his or her goals. External feedback is created by the game itself as it responds to the actions of the game player. The feedback can be used to determine if the goals are being achieved (Muis, 2007).

3.3 Summary

This chapter presents an overview of the process of self-regulated learning and how it can be used to describe learning in a video game context. During the analysis of the interviews there were several influences on learning identified that were outside of the framework of personal epistemological belief structures. The SRL framework was added to the research to organize those additional influences and assist in describing the process of learning to play video games.

Chapter 4 Quantitative and Qualitative Methodologies

4.1 Introduction

The purpose of this study was to investigate and explore how the epistemological beliefs of undergraduate students manifest themselves while learning to play video games. The researcher believed that exploring this phenomenon would assist educators in understanding the process of learning how to play video games. This understanding would then allow for informed decisions to be made in the design and implementation of games for formal educational. This chapter outlines the thought processes and decisions surrounding the methodologies used to explore learning in video games. A mixed methods research design was used during the investigation. The study used a quantitative methodology (selected response survey items) in conjunction with qualitative methodologies (semi-structured interviews).

This chapter also addresses the issue of combining quantitative and qualitative research methods within the same study. The overlap of two methodological approaches and the appropriateness of using both methods for this research project is discussed.

In addition to the research methodology, this chapter will include discussion and description on the following areas: (a) the research questions, (b) the research sample and the population from which it was drawn, (c) an overview of the research design for the study, (d) the methods used for data collection, (e) the methods used for the analysis and synthesis of data, (f) the ethical considerations involved in the study, (g) the issues of trustworthiness and how the researcher dealt with them, and (h) the limitations of the study and the researcher's attempts to address them.

4.2 Research Methodology Summary

This research uses a mixed methods approach that utilizes both quantitative and qualitative research methods to gain an understanding of the personal epistemological beliefs of a group of undergraduate university students in relation to their university and video game playing experience.

4.2.1 Rationale for Research Methodology

There will always be a debate over the relative merits of quantitative and qualitative research methods. These are driven by the knowledge claims of the researcher and what they wish to show in the research. These knowledge claims are based on what the researcher believes knowledge to be (ontology) and how they can justify what they know (epistemology) (Bloomberg & Volpe, 2008). Due to this inherent bias, the researcher needs to be aware of his or her own beliefs as the approach to the research is developed. This developmental process informs the researcher as he or she attempts to understand the multiple realities of the research topic and identify appropriate methodologies to explore the subject.

Most researchers will develop a degree of expertise in one methodological approach but these methods all have different strengths and weaknesses. Mixed methodology mitigates those weaknesses by combining several different strategies or traditions of inquiry (Ridenour & Newman, 2008). Despite their considerable differences, there is overlap between the two approaches in the social sciences (Spicer, 2004). Quantitative research focuses on the collection of data to test a hypothesis about the research subject. It attempts to eliminate subjective bias by determining the relationship between two or more quantifiable variables through empirical research (Spicer). The approach can investigate relationships and study the cause-and-effect between phenomena. Qualitative research emphasizes contextual understanding from the viewpoints of the research participants. Using this approach implicitly defines an emphasis on exploration, description, and interpretation (Bloomberg & Volpe, 2008).

A mixed methodology research project combines both qualitative and quantitative research traditions. The arguments against combining qualitative and quantitative methods are based on the idea that the methods are fundamentally different in terms of what we are able to know as well as how we are able to know and have conflicting assumptions about the nature of the social world (Spicer, 2004). Some view the differences between the way quantitative and qualitative methods as irreconcilable in terms of their approach to how social reality should be studied.

This research was based on this researcher's belief that the use of both research methods in the study will bring different perspectives towards the overall research question. This will extend the value of the investigation as each method will build upon the strengths of the other. Both qualitative and quantitative methods will provide distinct yet complementary perspectives on the research topic.

4.2.2 Rationale for a Case Study methodology

A case study methodology was used to gather data using a mixed methods approach. The rationale for choosing the case study methodology was based on the characteristics of the research domain, specifically how personal epistemological beliefs interacted with learning in video games. The research domain had the following characteristics:

1. It focused on the individual subject, specifically the video game player.

2. It was new, complex, and covered a number of subject areas.
3. It required an identification of patterns and themes in order to understand its nature.

As a formal research methodology, the case study is an intensive description of the phenomenon or social units. It is focused on the subject of inquiry and discerning themes and patterns from the behaviour of that subject (Bloomberg & Volpe, 2008). Case studies are also considered useful when the phenomenon under investigation is broad and complex (Dube & Pare, 2003). When a research area is in its early stages case studies have been identified as an appropriate approach (Benbasat, Goldstein, & Mead, 1987). The case study approach provides a great deal of versatility and can be used with a variety of philosophical perspectives (Dube & Pare). The focus of the case study design is a depth of understanding of the situation and meaning of the context for those in it. The case study methodology seems to address most of the challenges presented by the characteristics of the research domain. It fits well with the present research which looked at understanding the meaning of video game play to the players. It also allowed for the two phases of research to gather information. The first phase utilized an online questionnaire to gather quantitative information while a series of semi-structured interviews were conducted in the second phase to gather qualitative data.

To ensure that this methodology was followed during the design and implementation of the study a validation check is also provided. Benbasat et al (1987) provided a number of parameters that could be used to define a case study. These are summarized, along with research study applications, in Table 2.

Table 2

Key characteristics of case studies

	Case study parameter	Research study application
1	Examines a phenomenon in its natural setting	The EBS instrument and survey was administered online. The interviews were conducted on campus or online. Both contexts were considered to be learning environments for the participants.
2	Data was collected by multiple means	Data was collected using (first phase) the EBS instrument, gaming profile questions and (second phase) interviews.
3	One or few groups are examined	In phase one the group was defined by their enrollment in an undergraduate program. In phase two, a subset of this group was defined by their experience in playing video games.
4	The complexity of the unit is studied intensively	The study group was examined for their video game play behaviour, their epistemological beliefs and how they perceive knowledge in both post-secondary and video game contexts.
5	Case studies are more suitable for exploration, classification and hypothesis development stages of the knowledge building process	A null hypothesis was implied in testing the relationship between the effects of personal epistemology in a post-secondary environment compared to a video game environment. It was not explicitly defined as part of the research design. The approach was more exploratory when approaching the interviews on the participant's relationship of personal epistemological beliefs and learning in video game environments. They represented a part of the building process for further research.
6	No experimental controls or manipulation are involved	There were no experimental controls or manipulation as part of the research
7	The investigator may not specify the set of independent and dependent variables in advance	Independent and dependent variables were not specified in advance
8	The results derived depend heavily on the integrative powers of the investigator.	The results from the study were drawn from the quantitative data obtained from the EBS and game behaviour survey in the first phase of the project. The results were carefully considered when conducting the

		interviews and analyzing the results of the interviews conducted in the second phase.
9	Changes in site selection and data collection methods could take place as the investigator develops new hypotheses.	The data collection methods did not change during the course of the research as initial planning had identified an appropriate approach
10	Case research is useful in the study of "why?" and "how?" questions because these deal with operational links.	The data collected during the survey instrument in phase one and the interviews in phase two followed a line of questioning focused on mostly "how?" questions. This is evident in the research questions developed.
11	The focus is on contemporary events.	The research area is current and contemporary. The area is under scrutiny with considerable academic and public curiosity and is expected to grow.

4.2.3 Rationale for the Epistemological Beliefs Sampler (EBS)

This study begins with a quantitative research framework. This approach is focused on looking for causal relationships and advancing the understanding of the relationship between variables.

The researcher for this project had neither the time nor the expertise to develop a survey instrument from conception to completion. This necessitated a review and evaluation of existing instruments in order to choose one that would be appropriate for this study.

The study of epistemological belief structures has a history of using both quantitative and qualitative methodologies. It began as a solely qualitative research domain that utilized extensive interview research methodologies (Perry, 1999). The research domain has continued to develop since the initial qualitative work of Perry in 1970 (Hofer & Pintrich, 1997). One of those developments is relevant to quantitative research. It has been the focus on the development of survey instruments as a way of providing a more objective and efficient method of measuring epistemological beliefs (Schommer-Aikins, 2004).

The development of a 63 item questionnaire by Schommer (1990) was based on an assumption that there were five epistemological dimensions that could be measured. It challenged the notion of a fixed set of developmental stages for epistemological beliefs (Schommer-Aikins, 2004). The rationale for the development of such an instrument was the ability to administer the instrument to groups and to provide data for statistical analysis. By creating a quantifiable dataset from the questionnaire the instrument allows for comparison with other data sets to determine if the measured epistemological belief systems have any correlation to other factors including academic performance (Schommer-Aikins & Easter, 2006).

While the 1990 instrument had been used over the following decade by Schommer and a number of other researchers, in more recent years some serious methodological questions have been raised (Clarebout, Elen, Luyten, & Bamps, 2001). These relate to reports on the inter-item reliabilities for the questions consistently associating with their assigned factors (Schraw, Bendixen, & Dunkle, 2002). The second issue is the lack of clarity about the procedures used to calculate the factors that linked the participant's answer scores to the different factors (Clarebout et al, 2001). Recognizing the considerable contributions of Schommer (1990) to the field of research in personal epistemological beliefs is certainly important. Her work was pioneering in the field and may not have been perfect but represented the best general model for quantitative studies about personal epistemology. It seemed prudent to evaluate other instruments that specifically addressed the methodological concerns of the EBS instrument. The work of Colbeck (2009) was based on the concepts explored by the original Schommer (1990) Epistemological Beliefs Questionnaire. He designed and developed the Epistemological Beliefs Sampler (EBS) after considerable consultation with Schommer-Aikins. Although based on Schommer-Aikin's work, the EBS instrument addressed a number of the methodological issues that had been raised about the statistical reliability, consistency, and visibility of the methods used to create and validate the original instrument (Colbeck).

1. The increased emphasis on statistical validity and rigour played a significant role in the choice of the EBS for the current study. The structure of the questionnaire was also based on the personal epistemological belief components identified by Schommer (1990). This was an important consideration as these same components were used to develop the rubric for content analysis of the interviews in the qualitative phase of the study. There were other design considerations that also supported the use of the EBS. These included the following:A vocabulary review that altered some of the language of the statements to match an English lexical perspective. This seemed more appropriate for a Canadian context and helped to limit any distortion of comprehension for the questions. An example of these changes included the replacement of the word "school" with the word "university" (Colbeck, 2009, p. 104).
2. The statements constructed for the EBS were constructed after a review of the original statements in Schommer's (1990) instrument. A number were identified as having little effect or creating confusion among the participants about how to interpret the questions. Other statements had been identified as redundant and

these were removed as well (Colbeck, 2009). This resulted in an instrument that was shorter in length and was designed to limit the chance of confusion for participants answering the questions.

3. The valences of the questions in the EBS were more evenly balanced. One of the design choices for personal epistemological belief surveys has been the creation of the matching of questions so that a participant will need to answer both positively and negatively, limiting the potential of answering the same for all questions. This would mean that a naïve individual might respond with a number 4 on a positive valence question and a number 2 on a negative valence question correlated to the same epistemological construct. The negative valence question would be re-coded to a number 4 when the data was reviewed.

4.2.4 Rationale for Content Analysis

Interviews were used for the qualitative phase of the research. Conducting these interviews was based on the belief that knowledge is constructed during the interview process. The conversation between the researcher and the participants is the most likely context to understanding the world of the subjects. The interviews were transcribed into text and then analyzed using content analysis. Content analysis is a method used to analyze texts for the frequency and presence of themes, concepts, or meaning (Tonkiss, 2004). The strength of the approach is the clear and systematic way it can be used in the analysis of textual information. The explicit nature of the framework of analysis allows for comparison between different researchers, allowing for a greater degree of validity and reliability (Tonkiss). There was a need for validity and reliability in the current study. Firstly, it is a professional necessity in research and is required in the research design, and secondly, this research domain is new and there are few other studies to validate the analysis of the interviews. The use of other researchers in the refining and clarifying of categories created during the analysis is a helpful and productive activity.

The coding scheme used for the content analysis can incorporate feedback during the course of the research. It is not pre-determined at the beginning and unable to accommodate findings that become apparent during the course of the research (Seale, 2004). This approach allowed the coding scheme to evolve and refine each time the researcher returned to the source material. This approach was consistent with the use of a case study methodology. One criterion of case studies is the ability to re-visit the phenomenon as a result of discoveries made during the data collection (Yin, 2009). The exploratory nature of the research would have been limited if there was no ability to incorporate findings that arose during the course of the research.

4.2.5 Rationale for Research Schedule

The design of the mixed methods research design also has specific sequencing and timing elements. Understanding the sequencing of different methods provides additional rationale for using both quantitative and qualitative methods (Barbour, 2008). The quantitative survey was administered first to gather information that would serve as a framework for the questions in the interviews. The survey was also be used to gather information that could be used identify interviewees for the second half of the study. In this case it allowed for the selection of participants who played games and provided a basic context for the types of games they preferred and a summary of their game playing behaviour.

4.3 Research Questions

1. What differences can be detected in perspectives about knowledge and knowing between different types of video game players using current academic research instruments?

2. How can the paradigms of epistemological belief structure research, which are used to explore conceptions towards knowledge and knowing in a formal educational setting, be used to explore similar conceptions in video games?

3. What is the video game player's perspective on learning how to solve challenges in a video game environment?

4. How do video game players develop the knowledge they perceive as necessary to succeed in a video game?

5. How does a video game player's perspective towards knowledge and knowing differ from perspectives towards knowledge and knowing in post-secondary setting?

6. How are the video game player's perspectives towards knowledge and knowing in a video game utilized outside of that context?

The research questions were designed to gain the most complete possible view of learning in both video games and an undergraduate university context. The questions were open so that new information and perspectives could be included in the answers provided by the research participants. The rationale for exploring a student's outlooks towards learning in both contexts was a desire to compare those perspectives. The use of "what" in some of the questions was focused on exploratory inquiry in areas where there was little information existing in current research. The use of "how" in the other questions were focused on the creation of a description of the phenomenon being studied.

4.4 The Research sample

The study used a purposeful sampling approach to select participants for the study because they illustrate something that interests the research. In order to obtain as much information as possible, purposeful sampling is often used in case study methodology (Silverman, 2005). The unit of analysis, or case, was defined by an individual who both played video games and was enrolled in an undergraduate university program. The research questions were specifically targeted towards this unit of analysis.

4.4.1 Survey Sample

An anonymous survey instrument was administered online using Survey Monkey software. The rationale for the use of an online survey instrument was based on ethics requirements that data could only be gathered from undergraduates outside of a classroom context. The use of an online survey allowed students to voluntarily undertake the survey whenever they had free time. The criterion for selection of participants for the online survey was that all participants were enrolled in an undergraduate program.

The research sample for the survey included 50 individuals. These individuals were all in an undergraduate program.

Although all participants were undergraduate students there were differences amongst them along the following parameters: discipline of study, gender, and age.

4.4.2 Interview Sample

A follow-up interview was requested from a small group of participants who participated in the online survey. The criterion for selection of participants was that all participants were video game players.

The research sample for the interview included 10 individuals. These individuals were all video game players.

Although all participants were undergraduate students there were differences among them along the following parameters: discipline of study, gender, and age.

4.5 Study Instruments

4.5.1 Survey Instrument

The online survey instrument was designed as both an exploratory tool and a measure of personal epistemological beliefs. The survey was broken into two sections. The first section gathered demographic information on the participants and a survey of their video game playing behaviour. The information related to the participants included their undergraduate program, year of study, age, gender, and video game play preferences. This helped to establish the context for the cases being used in the study. The second part of the online survey used the Epistemological Beliefs Survey (EBS) (Appendix A). The EBS is a 34 item questionnaire designed to detect individual differences in epistemological disposition (Colbeck, 2007).

The results from the survey were used to (a) establish a baseline of personal epistemological beliefs for comparison between demographic and contextual measures, (b) differentiate between year of study, (c) differentiate between game genre preferences, and (d) as a source of data used in descriptive and exploratory statistical analysis. The survey results were also used to examine the validity and reliability of the EBS instrument during the analysis portion of the study.

4.5.2 Interviews

Semi-structured interviews were conducted both face-to-face and online with participants who had been identified as video game players. The interview was designed to be an open, yet focused, conversation that wasn't constrained by a pre-determined number of questions (Kvale & Brinkman, 2009). It was conducted according to a guide that focused on certain themes and included a few questions. The themes were created from the epistemological belief structure literature. These themes became the basis for the initial rubric, created by the researcher, which was designed to analyze the interviews based on categories that were relevant to the study of personal epistemological belief structures. Themes were identified in the literature review looking for issues that related to personal epistemological beliefs and motivations to learn. Questions were asked to determine participant perceptions towards the experience of learning how to play video games. These conversations were designed to be open in order that the participants could describe how and why they would learn to play a video game and what motivated them to learn. The final Interview Content Analysis Rubric is included as Appendix B.

The purpose of the interviews was to gather in-depth and context specific information about personal epistemological beliefs in a video game context. This was necessary as there is no existing quantitative instrument for the measurement of epistemological belief structures in a video game context. As a new area, it is necessary to begin the research with an interview strategy in the same way that research into formal, academic epistemological belief structures began several decades ago.

4.6 Data Collection Methods

The data collection sequence and methods are summarized in a research workflow (see Figure 4). After the online survey was completed and the participants submitted an interest in being interviewed, their surveys were checked for completion.

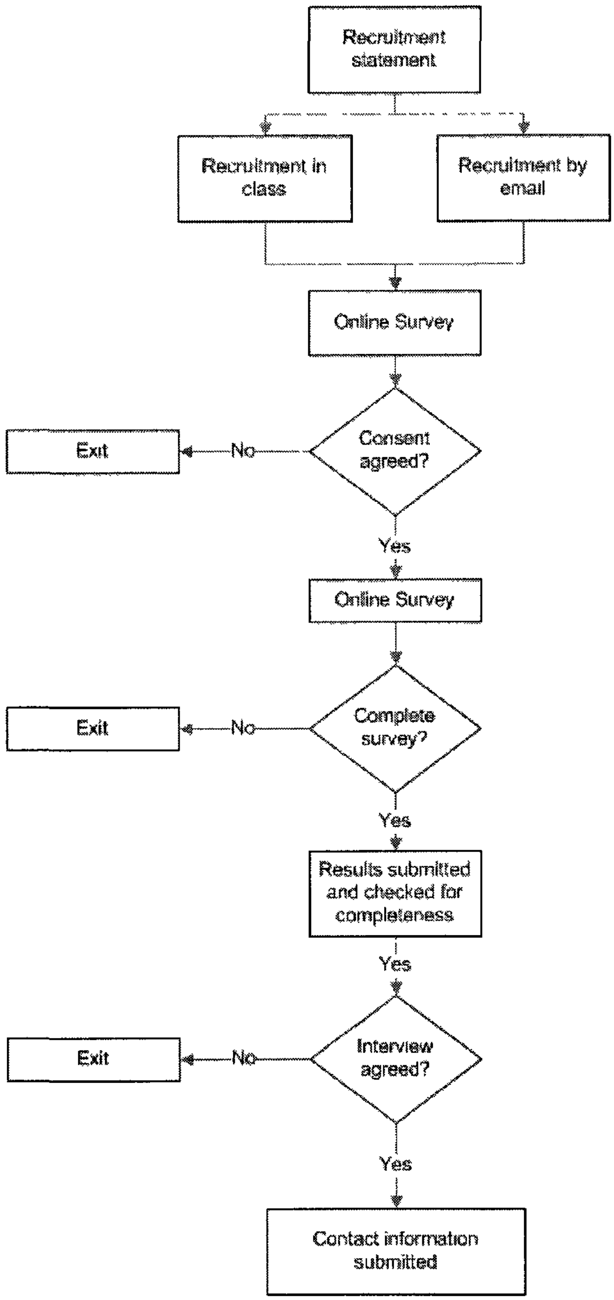


Figure 4. **Research workflow**

4.6.1 Web-based Survey Study

Recruitment for the survey was accomplished using a variety of means. The researcher obtained permission from faculty members to do a five minute summary of the study to their classes. There were 25 faculty members contacted to see if they would allow a recruitment speech to take place at the beginning of their class. Two faculty members responded and an in-person request was made to approximately 75 undergraduate students. Ten other faculty members agree to send out an email with study information and a URL link to their undergraduate students. The students in the class were advised that they could fill out the survey using an online survey instrument. They were given a sheet of paper with the online web address. The students who received a URL were provided with a web page that outlined the purpose of the research and provided them with the opportunity to become part of the survey.

4.6.2 Web-based survey considerations and administration

Informed consent was obtained using the design of the web-based survey. The opening web page was an explanation of the survey with a statement explicitly outlining that the participant was implicitly agreeing to be part of the study by accepting the terms of the study and clicking to enter into the survey. It was also made clear that that participant could exit the survey at any point by exiting the survey site or closing the browser.

Anonymous participation was a commitment on the part of the research study so no identifying information was gathered during the survey. The survey software, Survey Monkey, captured the IP address of the participant by default but this information was not used in the analysis of the results. Those participants who volunteered to take part in the interview were asked to provide contact information, allowing for the identification of those specific surveys.

4.6.3 Interview Procedure

Participants were invited to participate in an interview by a question posed at the end of the online survey instrument. Self-identified game players were asked if they wished to be interviewed about their game playing experiences. There was an online statement that informed the participants that the interview would be no longer than an hour. The interview location was identified as a public location on campus that was convenient for them. They had the financial compensation of $15 for their time explained to them as well. They were provided details about how a pseudonym would be used when their interviews were included in the research study and that access to the identity of that pseudonym would only be provided to the researcher. They were also informed that the recording of the interviews would be archived for a period of time by the dissertation supervisor of the researcher and then destroyed.

Each person who agreed to participate took part in one of the 10 semi-structured interviews for the study. The interviews took between 20 and 60 minutes each. Each interview began with the same kind of open request to describe how the subject approached learning in a video game context. The goal of the open question was to allow the subject to give an answer that would take the form of a story. The remaining questions asked for clarification of the story.

4.6.4 Face to face interviews

A face-to-face interview allowed the researcher and participant to meet at the same time and place. The advantage of a face-to-face meeting between the subject and the interviewer is the availability of social cues such as tone of voice and body language. These can provide additional information beyond the verbal answers provided by the interviewee (Opdenakker, 2006). These interviews were recorded for later transcription.

4.6.5 Skype

For convenience, online interviews through a computer-mediated software package called Skype, were offered as an option during the study. Skype is an online video and audio communication tool. These Skype interviews offered similar advantages as a face-to-face meeting. There is an additional benefit of an increase in access to potential participants in the study. Some of the participants were not easily available for a face-to-face meeting and this provided an alternative (Opdenakker, 2006). These interviews were also recorded and the participants were always made aware that the call was being recorded by a verbal warning from the recording software itself.

One of the disadvantages to the approach was a reduction in observable social cues. Although a voice cues were still available, body language was absent. Another disadvantage was that there was no way to discern the physical situation of the interviewee.

4.6.6 Transcribing Techniques

Due to the interactive nature of the research it was important that no detail be removed from the interviews. This required that the transcripts be done verbatim without any omissions. It was also necessary to decide whether or not the analysis would be concerned with only the manifest content or the latent content as well (Elo & Kyngäs 2008). In analyzing the latent content, gestures, pauses, laughter and other actions are noted and analyzed. If latent content was observed that might affect the meaning of words, it was noted during the interview. This could be an issue if sarcasm was being used to make a point, the intended meaning might be different than just the transcribed words. Nonverbal features of the interactions were also noted in the post-interview comments written by the researcher. The goal here was to capture how things were being said in the interview using notes without distracting the interviewee. The goal of transcription is to record a level of detail that is sufficient for the aims of the research project (Bailey 2008). In the case of this study, the transcribed interviews provided sufficient detail for content analysis. The transcripts provided not only details about the nature of the video game experience but additional information that enriched and expanded the understanding of the phenomenon.

4.7 Data Analysis and Synthesis

The research presented a typical challenge of reducing large volumes of information in a meaningful way. The goal of this process was the identification of significant patterns and the construction of a framework that could be used to communicate the essence of the data.

The process of data analysis can be divided into two sections, quantitative and qualitative. These approaches needed a different analysis technique to make sense of the information gathered during the study.

4.7.1 Quantitative

The first step was validating the data obtained from the online survey. The data were assembled into a spreadsheet and any survey participants that had not completed all the questions or defined the demographics of age, gender, program year or program discipline were identified and these surveys were discarded. This resulted in the initial 107 surveys being narrowed down to a sample of 50.

The data was then sorted and organized in different groups based on demographic information and game playing behaviour. The group's scores were broken down into EBS score subsets. Descriptive and exploratory statistics were used to examine the normality of the samples. The various datasets were then analyzed using inferential statistics to see if there were any positive or negative relationships between the groups.

4.7.2 Qualitative

The analysis of the interview data began with the creation of a rubric based on the categories and descriptors from the epistemological belief structure conceptual framework (Appendix B). Once this Interview Content Analysis Rubric was established the researcher went through the transcripts and highlighted transcript sections with colours that corresponded to the rubric elements. As the process of coding progressed, new themes were identified and added to the rubric. These new themes were used in the subsequent reading and re-reading of the transcripts.

The creation of the rubric initially used a deductive approach based on existing epistemological belief structure theories and models. The goal was to work from the general rubric to find specific examples, using the content analysis, which would validate the rubric. Deductive content analysis is typical when the structure of the analysis is based on previous knowledge (Elo & Kyngäsh, 2008).

Although a deductive approach was used to develop the initial rubric, an unconstrained matrix was developed that allowed for different categories to be created within its bounds. Rather than following a single researcher's perspectives on epistemological belief structure, the literature was widely reviewed in order to identify as many relevant elements as possible for the matrix. As new themes were identified within the interviews, the development of the rubric expanded beyond personal epistemological belief structures to include research into social epistemology and the motivational factors behind video game play. After all the interviews were initially reviewed a final version of the rubric was finalized. The final version of the rubric was utilized for a final re-read and re-coding of all of the interview data. Only elements from this rubric could be used to categorize the interview data (Elo & Kyngäs 2008).

The researcher shared samples of the colour-coded interviews with three other colleagues. One had a graduate research background in content analysis while the other two had a graduate background in video game research. These colleagues were asked to critique both the rubric and the classification of statements within the interviews. There was a general agreement on the rubric as well as the content analysis. The areas of discussion were focused on those statements that the validators considered ambiguous enough that they might have been considered to be in different rubric categories. The discussion that followed was about the relative strengths of the statement in terms of its fit into the different categories.

4.9 Ethical considerations

Ethical issues related to the protection of the participants were of critical concern. It was important to consider both procedural issues and the principle of informed consent (Ali & Kelly, 2004). It is important in the research process that participants are enlisted voluntarily and that they have informed consent about the purpose of the research and their obligations towards it (Bloomberg & Volpe, 2008). The procedure used to apply for ethics included a number of safeguards to ensure that participants were properly informed of the purpose of the study and their rights were protected throughout the study.

Informed consent was obtained for each phase of the study. Participants were able to read a summary of the study and ask any additional questions if they were unclear about the study. They were also provided with multiple opportunities to withdraw from the study without consequence. Although some personally identifiable information was kept by the researcher when contacting interview subjects, measures were taken to protect the information and ensure that it would be destroyed in a timely manner.

4.10 Limitations and Biases

The use of a standard psychometric instrument to detect differences in personal epistemological beliefs in different environments is problematic. Its ability to detect differences in various domains has limitations. The context of the measurement may only provide a level of reliability when the participant is actively engaged in the context for which the instrument was designed.

There are additional concerns related to the measuring of self-regulated learning using survey instruments. In self-reporting inventories that are provided with response formats defined by the researcher, reliability is almost always reported as a coefficient of internal consistency (Winne & Jamieson-Noel, 2002). Although the internal consistency of the EBS has been addressed in previous research it is important to recognize that the research field of survey instruments that measure personal epistemology is constantly evolving and subject to updates.

There is also a personal bias possible in the researcher himself. Having been an advocate for educational games and simulations for a number of years, the researcher may be focused on finding positive effects in the research. The analysis of the research lies in the hands of the researcher and may therefore be subjectively influenced.

Recognizing these limitations, the researcher added the following measure to the research. First, he used descriptive and exploratory statistics to analyze the patterns in the survey data. He made no attempt to provide definitive causal relationships from those statistics. In the interview portion of the research he clearly stated his research agenda and explicitly stated any assumptions he had made. The coding scheme for the content analysis was derived from existing research and vetted by colleagues. The coded results were reviewed and confirmed by colleagues.

The restricted sample size provides another potential limitation. The ability to generalize the results to other groups or context might be limited. The study tried to gather rich interviews that could provide enough information that transferability between contexts could be appropriately assessed.

4.11 Summary

In summary, this chapter has provided a detailed description of the research study's methodology. A mixed methods approach was utilized to examine the personal epistemological belief structures of individuals in a post-secondary and a video game playing context. Looking at a similar framework in two contexts illustrated how perspectives towards each context differed and allowed for an examination of experiences related to personal epistemological beliefs in a game play environment. The quantitative portion of the study gathered data using a survey instrument. The qualitative portion of the study gathered data using semi-structured interviews. The quantitative study sample size was 50 that were part of a purposeful sample of undergraduate students while the qualitative study used 11 purposefully selected video game players. The quantitative data was organized and analyzed using an existing questionnaire called the Epistemological Beliefs Sampler (EBS). That data was analyzed using descriptive and inferential statistics. Descriptive statistics summarized the data. Inferential statistics were used to explore if any relationships could be determined between the different categories of data. The semi-structured interviews were transcribed and became the qualitative dataset. This data was organized and analyzed using content analysis. The rubric used an open matrix that was based on existing literature.

Chapter 5 Results and Findings

5.1 Introduction

The purpose of this study was to investigate and explore the epistemological beliefs of undergraduate students in a video game context. This chapter is organized in terms of the research questions stated in Chapter 1. It first examines the ability of an EBS instrument to detect any differences between different types of video game players. It then examines the ability of the same epistemological belief structure framework to investigate and explore personal epistemology, in respect to knowing and knowledge, in a video game context. Finally, it compares student's perspectives towards knowledge and knowing in a post-secondary and a video game environment.

The iterative nature of the methodology meant that the data was not simply analyzed only once using a linear and structured process. Instead, the data began to feed back into the instruments that were being used to analyze that data. This process was less structured and more flexible. Figure 5 provides a summary of the process used to analyze and report the findings from the research material.

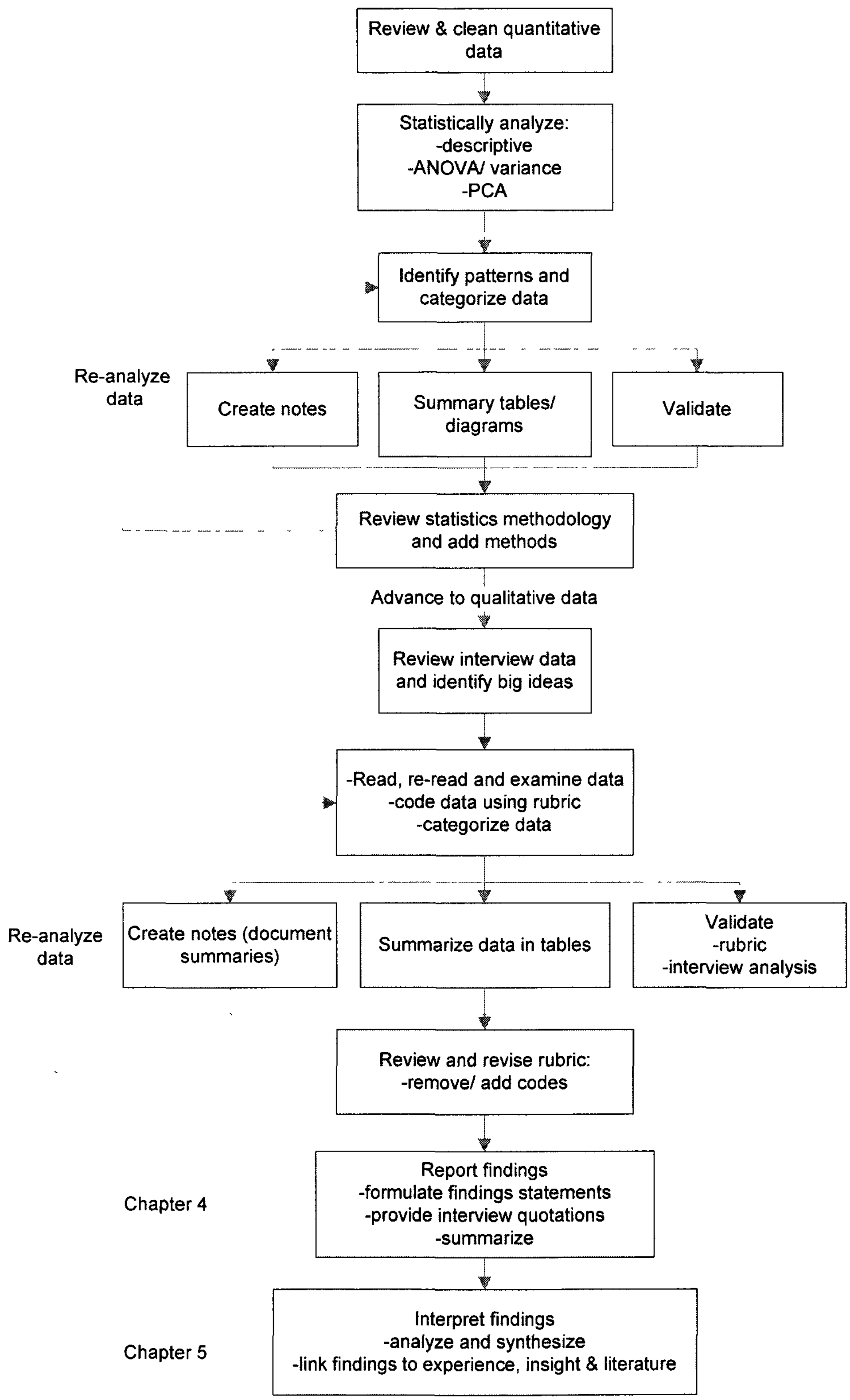


Figure 5. **Analysis, results, and findings workflow**

This chapter represents the key findings from 50 surveys and 10 interviews. Several major findings emerged from the quantitative portion of the work included:

1. The EBS instrument did not detect any difference, at the EBS subset or EBS question level, between years of study at the undergraduate level.
2. The EBS instrument did not detect any difference at the EBS subset or EBS question level, between different types of video game players in terms of game genre.

The qualitative portion of the work also yielded a number of findings that included:

1. The majority (67%) of the participants indicated that they had a mature perspective towards Certainty of Knowledge during their video game play. Although the similar number of participants (63%) indicated a naïve perspective towards Certainty of Knowledge, the majority (50%) indicated that those perspectives were forced on them by the game design itself.
2. The majority (78%) of the participants indicated that they had a mature perspective towards Simplicity of Knowledge during their video game play.
3. The majority (78%) of the participants indicated that they had a mature perspective towards Quick Learning during their video game play.
4. The majority (89%) of the participants indicated that they had a mature perspective towards Fixed Ability during their video game play.
5. The majority (67%) of the participants indicated that they had a mature perspective towards Source of Knowledge during their video game play.
6. A majority (56%) of the participants indicated that Affect was part of the learning experience during their video game play.

7. Less than half (44%) of the participants indicated that Socialization was their motivation for playing video games.
8. Less than half (44%) of the participants indicated that Relaxation was their motivation for playing video games.
9. More than half (56%) of the participants indicated that Personal Growth was their motivation for playing video games.
10. The majority (67%) of the participants were aware of dissonance between their personal beliefs and the beliefs presented in the video game experience.
11. A small number (22%) of the participants took this dissonance and addressed it as a potential growth experience.
12. The majority (67%) of the participants felt that the worldview they had created to address the game world would transfer to other game contexts. A small number (11%) felt that this would transfer to the real world.
13. More than half (56%) of the participants believed that the epistemological beliefs developed during game play were socially constructed and maintained.

Following the summary of the findings there are discussions on each of those findings. They are divided between quantitative and qualitative sections and are organized sequentially, in an order that followed the temporal sequence of the research.

5.2 Discussion of Survey Findings

The survey was voluntary and therefore it does not represent a completely random sample of undergraduates.

5.2.1 Participant Demographic summary

The participant data can be broken down into further categories based on the survey results. The profile categories were explained to the participants so that they could self-identify their own profile information.

5.2.1.1 Gaming Profile

The gaming profile of the players was defined as hardcore, midcore, dormant, and non-gamer. A hardcore gamer is a player who spends much of his or her leisure time playing video games. A casual gamer enjoys playing games with simple rules or games which do not require a large amount of time to play. A midcore gamer is somewhere between a hardcore gamer and a casual gamer. They don't spend a lot of time playing video games. Dormant gamers like playing video games but don't have time because of family, work, or school. Non-gamers don't play any video games. The results of the survey are included in Table 3.

Table 3

Game player profiles

Game Player Type	**Totals**
Hardcore	18
Casual	0
Midcore	20
Dormant	11
Non-gamer	1
Total	**50**

5.2.1.2 Game genre preference

Participants were asked to identify which types of video games they played. The results of the survey are included in Table 4.

Table 4

Game genre preference

Game Genre	Totals
Action-Adventure	35
First/ Third person shooter	28
Construction & Management	25
RPG	36
Strategy	38
Vehicle Sim	16
Music	25
Other	10

5.2.1.3 Faculty Profile

Participants were asked to identify which faculty or program they were currently enrolled in at university. The results of the survey are presented in Table 5.3.

Table 5

Faculty profile

Faculty	Number
Computer Science	22
Engineering	4
Business	3
Healthcare	2
Physics	2
Math	1
Multidisciplinary	1
Journalism	1
Communications	2
English	4
Fine Arts	3
Philosophy	1
Political Science	1
Other	3
Total	**50**

5.2.1.4 Year of Study Profile

Participants were asked to indicate their year of study in the program they were currently enrolled in a university. The results of the survey are presented in Table 6.

Table 6

Year of study profile

Year of Study	**Number**
1	11
2	12
3	15
4	8
5	4
Total	**50**

5.3 Descriptive Statistics

5.3.1 Introduction

Descriptive analysis of the survey data provided summary information about the data collected. In this research study, there were three distinct types of data: interval, ordinal, and categorical.

Interval or scale

Interval or scale data takes the form of a range of numbers that have no categories but only numerical values (Connolly, 2007). The data ranges from low to high with equal intervals (Greasley, 2008). The scale being used in this study is based on the numbers from the Likert scale within the EBS survey. The range is from 1 to 5 and is a measure of epistemological maturity. A higher score on a question would indicate a more naïve individual; a lower score would indicate a more mature individual. Some of the questions had a negative valence that would need to be recoded before it could be analyzed. The purpose of the negative valence was to ensure that matching questions could be used that would ensure an individual would respond positively to one question and negatively to another complementary question. This purposeful design approach needed to be corrected before the data could be plotted.

Ordinal

Data that can be organized into an ordered sequence is ordinal. This approach to data allows categories to be ranked in an order which is meaningful (Connolly, 2007). In this research the data is ranked by undergraduate year, from 1^{st} to 5^{th} year. The separation of the ranks is one academic year.

Categorical

This type of data is defined by category rather than scale (Greasley, 2008). There are several categories used to define the data in this research. The EBS questions organize questionnaire answers based on each individual answer to those questions. The EBS subsets take the average of the scores on those EBS questions that load to a particular EBS subset. There are also a number of demographic and video game play activity categories that are used to organize that data. For example, there are categories for the frequency of video game play, such as hardcore and dormant.

5.3.2 Summary of all results

A summary of the valence corrected scores on the questions for the entire survey groups are located in Table 7. A description of the questions is available in Appendix A, Table 2. The complete statistical analysis is available in Appendix C. The range is from 1 to 5 and is a measure of epistemological maturity. A higher score on a question would indicate a more epistemologically naïve individual.

Table 7

Descriptive Statistics summary of EBS questionnaire

Question No.	Mean	Standard Error	Median	Mode	Standard Deviation	Sample Variance	Kurtosis	Skewness	Range	Minimum	Maximum
1	3.67	0.12	4.00	4.00	0.89	0.79	-0.33	-0.53	3.00	2.00	5.00
2	2.18	0.15	2.00	2.00	1.09	1.19	-0.26	0.79	4.00	1.00	5.00
3	2.22	0.13	2.00	2.00	0.94	0.89	0.65	0.88	4.00	1.00	5.00
4	2.84	0.16	3.00	2.00	1.16	1.33	-1.15	0.16	4.00	1.00	5.00
5	2.39	0.15	2.00	2.00	1.04	1.08	-0.56	0.35	4.00	1.00	5.00
6	3.37	0.14	4.00	4.00	1.00	1.00	-1.12	-0.07	3.00	2.00	5.00
7	1.82	0.11	2.00	2.00	0.82	0.67	4.71	d	4.00	1.00	5.00
8	3.16	0.14	3.00	4.00	1.03	1.05	-1.06	-0.33	4.00	1.00	5.00
9	2.33	0.12	2.00	2.00	0.89	0.79	-0.48	0.35	3.00	1.00	4.00
10	2.16	0.14	2.00	2.00	1.01	1.01	-0.03	0.65	4.00	1.00	5.00
11	1.94	0.12	2.00	2.00	0.83	0.70	0.93	0.97	3.00	1.00	4.00
12	2.04	0.13	2.00	2.00	0.96	0.92	2.28	1.34	4.00	1.00	5.00
13	2.20	0.13	2.00	2.00	0.89	0.80	2.34	1.16	4.00	1.00	5.00
14	2.55	0.17	2.00	2.00	1.19	1.41	-0.55	0.59	4.00	1.00	5.00
15	2.29	0.16	2.00	2.00	1.17	1.37	-0.10	0.87	4.00	1.00	5.00
16	2.41	0.16	2.00	2.00	1.13	1.29	-0.93	0.48	4.00	1.00	5.00
17	4.57	0.09	5.00	5.00	0.64	0.41	3.84	-1.69	3.00	2.00	5.00
18	2.86	0.16	3.00	2.00	1.17	1.36	-0.84	0.28	4.00	1.00	5.00
19	2.90	0.15	3.00	2.00	1.04	1.09	-0.94	0.31	4.00	1.00	5.00
20	3.10	0.14	3.00	4.00	0.98	0.97	-1.08	-0.33	4.00	1.00	5.00
21	1.71	0.10	2.00	2.00	0.73	0.53	0.59	0.85	3.00	1.00	4.00
22	2.69	0.14	3.00	2.00	0.99	0.98	-1.15	0.04	3.00	1.00	4.00
23	1.67	0.11	2.00	1.00	0.79	0.63	1.24	1.18	3.00	1.00	4.00
24	2.49	0.09	2.00	2.00	0.67	0.45	2.59	1.46	3.00	2.00	5.00
25	2.84	0.17	3.00	4.00	1.24	1.53	-1.22	-0.08	4.00	1.00	5.00
26	4.10	0.11	4.00	4.00	0.76	0.57	1.79	-1.04	3.00	2.00	5.00
27	3.76	0.11	4.00	4.00	0.79	0.62	2.73	-1.32	4.00	1.00	5.00
28	2.61	0.14	2.00	2.00	0.98	0.96	-0.65	0.48	4.00	1.00	5.00
29	3.76	0.10	4.00	4.00	0.68	0.46	5.73	-2.04	4.00	1.00	5.00
30	4.12	0.11	4.00	4.00	0.79	0.63	4.29	-1.48	4.00	1.00	5.00
31	1.73	0.08	2.00	2.00	0.60	0.36	-0.50	0.19	2.00	1.00	3.00
32	3.47	0.14	4.00	4.00	1.01	1.01	-0.57	-0.47	4.00	1.00	5.00
33	3.80	0.12	4.00	4.00	0.85	0.72	2.07	-1.24	4.00	1.00	5.00
34	1.71	0.09	2.00	2.00	0.64	0.41	1.90	0.82	3.00	1.00	4.00

5.3.3 Comparison of EBS question scores by Undergraduate Year

Initial descrıptive statistıcs were done to see if there were any obvious trends in personal epistemological belief structures by undergraduate year of enrollment. A plot of the Mean of questionnaire answers (valence corrected) to the EBS questions by undergraduate year ın presented ın Figure 6.

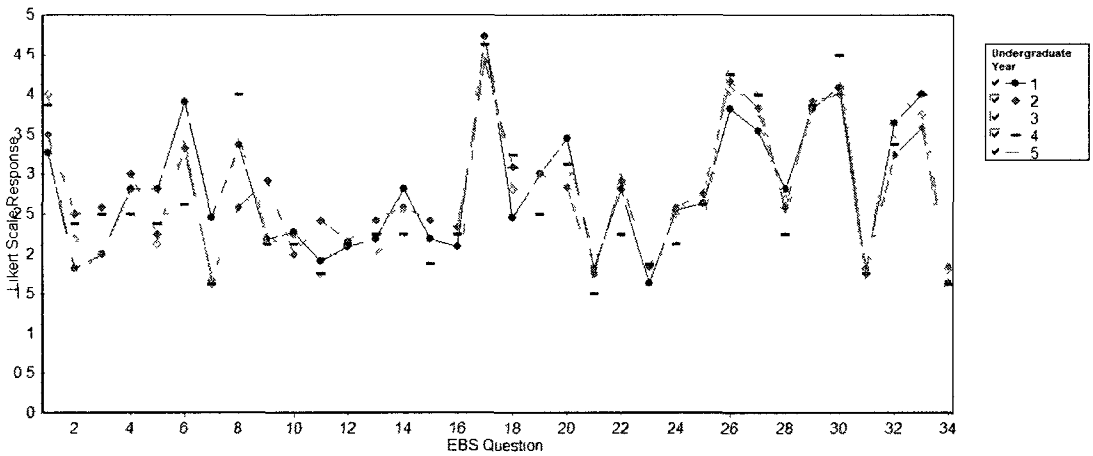


Figure 6. **Plot of Mean for EBS Questions against undergraduate year of study**

5.3.4 Comparison of EBS Subsets

The EBS subsets are an organizational framework used in other EBS studies to organize the EBS statements. The basis of the grouping was a factor analysis of the answers to the EBS statements. The summary of this groupıng is in Table 7. The statements that correspond to the numbers are avaılable in Appendix A.

Table 8

EBS Statement Subsets extracted to ten components. (Colbeck, 2009)

Subset	Definition	Statements
1	Seeks sıngle answers	1,2,3,4,5,6
2	Avoıd ıntegratıon	7,8,9,10
3	Avoıd ambıguıty	11,12,13,14
4	Knowledge ıs certaın	15,16,17,18

5	Depend on authority	19,20
6	Don't criticize authority	21,22,23,24
7	Ability to learn is innate	25
8	Learn the first time	26
9	Learning is quick	27,28,29
10	Success is unrelated to hard work	31,31,32,33,34

These subsets were further grouped into four factors based on an additional factor analysis (see Table 8). The data was organized so that comparison could occur with other studies that had used this organizational framework. A more detailed analysis of this approach is contained in the section on factor analysis and principal component analysis located within this chapter.

Table 9

EBS Subsets extracted to four components (Colbeck, 2009)

Factor 1: Simple Knowledge	
EBS Statement Subset	Definition
1	Seek single answers
2	Avoid integration
3	Avoid ambiguity
4	Knowledge is certain
6	Don't criticize authority
Factor 2: Omniscient Authority	
EBS Statement Subset	
5	Depend on authority
Factor 3: Fixed Ability	
EBS Statement Subset	
7	Success is unrelated to hard work
8	Ability to learn is innate
9	Learn the first time
Factor 4: Quick Learning	
EBS Statement Subset	
10	Learning is quick

In the initial work on the EBS instrument, the four extracted components comprised a total of 61% of the data analysed. (Colbeck, 2009). The factor analysis used to generate these four components was based on the original 10 factors used to group the original Schommer (1990) subsets.

This organizational framework was used in this study to provide another perspective for the descriptive statistics created for the data. In the first set of descriptive statistics all the survey results are treated as a homogenous sample (see Table 9).

Table 10

Descriptive Statistics of EBS Subsets

Subset	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Mean	2.79	2.37	2.20	3.03	2.98	2.15	2.88	3.48	3.37	1.70
Standard Error	0.06	0.06	0.08	0.07	0.10	0.07	0.16	0.05	0.06	0.09
Median	2.78	2.25	2.17	3.00	3.00	2.00	3.00	3.33	3.43	2.00
Mode	2.67	2.25	1.75	3.25	3.00	2.00	4.00	3.33	3.60	2.00
Standard Deviation	0.43	0.45	0.58	0.54	0.69	0.48	1.18	0.38	0.40	0.63
Sample Variance	0.18	0.20	0.34	0.29	0.48	0.23	1.40	0.15	0.16	0.39
Kurtosis	-0.01	-0.29	-0.23	1.14	-0.62	-0.06	-1.01	1.62	6.25	2.29
Skewness	-0.06	0.11	0.56	0.36	0.32	0.55	-0.11	0.24	-1.83	0.93
Range	2.00	2.00	2.50	2.75	2.50	2.00	4.00	2.00	2.40	3.00
Minimum	1.67	1.25	1.25	2.00	2.00	1.25	1.00	2.67	1.60	1.00
Maximum	3.67	3.25	3.75	4.75	4.50	3.25	5.00	4.67	4.00	4.00
Sum	144.88	123.44	114.51	157.80	154.74	111.62	149.57	180.90	175.01	88.16
Count	52.00	52.00	52.00	52.00	52.00	52.00	52.00	52.00	52.00	52.00
Confidence Level(95.0%)	0.12	0.12	0.16	0.15	0.19	0.13	0.33	0.11	0.11	0.17

The Means of the 10 subsets were also used with the study's categorical data. The first comparison was the EBS subsets Means by undergraduate year of study (see Figure 7).

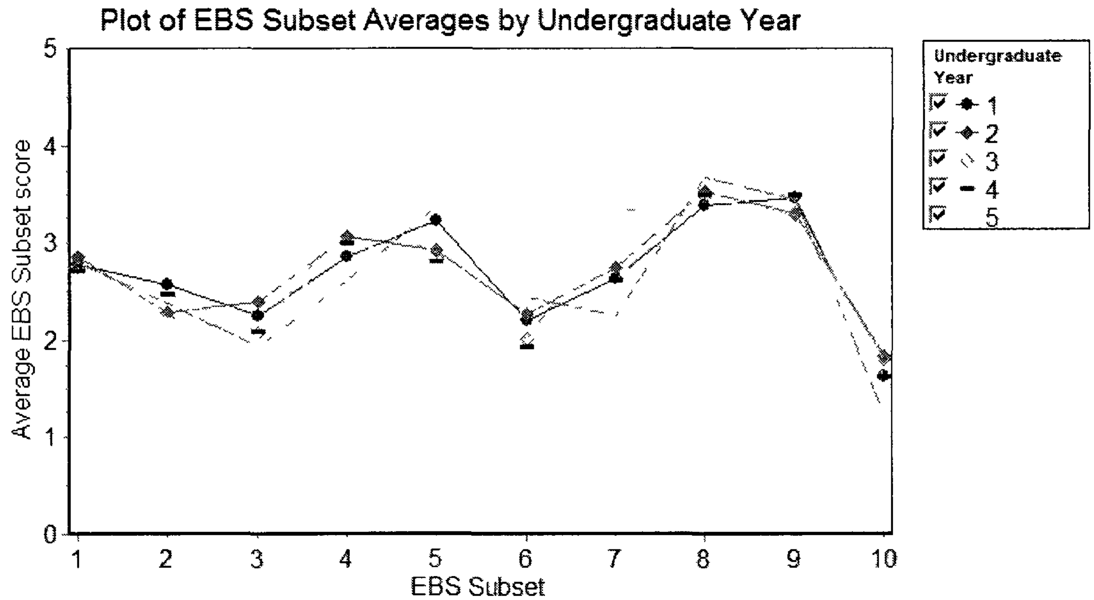


Figure 7. **Plot of 10 EBS subsets by year**

A similar comparison of the EBS subset averages by game genre was created and plotted in Figure 8.

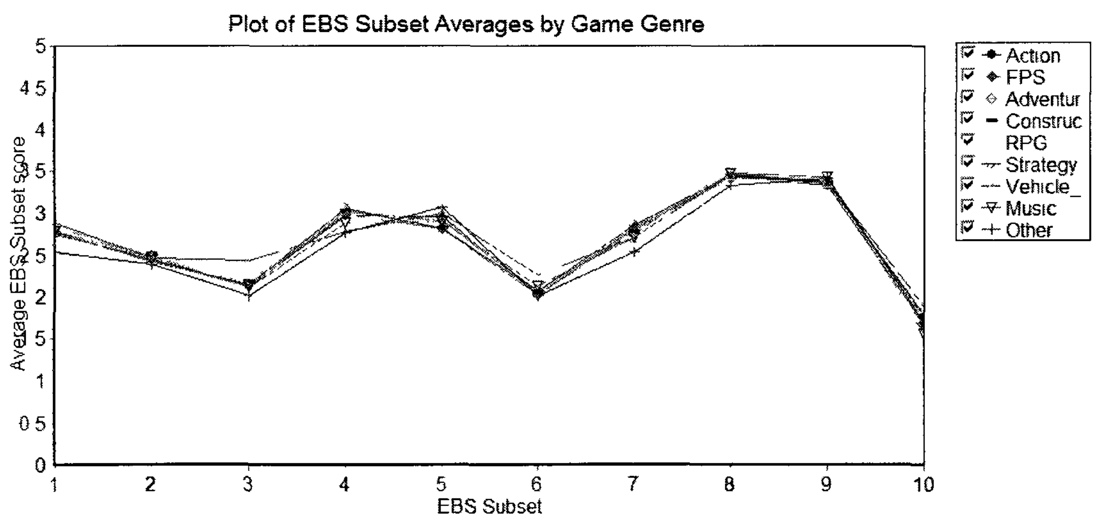


Figure 8. **Comparison of EBS scores by Game Genre**

5.4 Descriptive Statistics Discussion

5.4.1 Descriptive statistics of EBS questions

The overall trend of the questions was towards a higher Mean. The overall mean for EBS questions was 2.75. This would indicate a population trend towards a less mature and more naïve epistemology.

5.4.2 Descriptive statistics of EBS subsets

Overall, the undergraduate population seemed to trend towards a less-mature epistemological perspective. Of the 10 subsets, the highest, and most epistemologically naïve scores were for subset 8: Ability to learn is innate (Mean=3.48), subset 9: Learn the first time (Mean=3.37), subset 4: Knowledge is certain (Mean=3.03) and subset 5: Depend on authority (Mean=2.98). The lowest, and most epistemologically mature scores were for subset 5: Don't criticize authority (Mean=2.15) and subset 10: Learning is quick (Mean=1.70).

Subset 1 (Seek single answers) was composed of questions that allow students to indicate their perspective on the simplicity of knowledge. A more immature epistemological perspective would believe that there was one, single answer for every question posed about the world. The Mean of this subset was 2.79.

Subset 2 (Avoid integration) were questions designed to indicate a student's perspective towards the simplicity of knowledge. It is based on the idea that components of knowledge are separate and unconnected to one another. The Mean of this subset was 2.37.

Subset 3 (Avoid ambiguity) was made up of questions that were designed to indicate a student's perspective towards the composition or structure of knowledge. A more immature epistemology would believe that knowledge was black and white in nature and lacked any degree of variation. The Mean of this subset was 2.20.

Subset 4 (Knowledge is certain) was composed of questions that were designed to indicate a student's perspective towards the certainty of knowledge. A more immature epistemology would believe that knowledge is certain and knowable rather than tentative in nature. The Mean of this subset was 3.03.

Subset 5 (Depend on authority) provided questions designed to indicate a student's perspective towards authority as a source of knowledge. More immature epistemological believe that reliance on authority is linked to success in school. The Mean of this subset was 2.98.

Subset 6 (Don't criticize authority) provided questions designed to indicate a student's perspective about questioning authority. More immature epistemological believe that unwillingness to question authority is linked to success in school. The Mean of this subset was 2.15.

Subset 7 (Success is unrelated to hard work) questions were designed to allow students to indicate their perspectives about whether or not the ability to learn is related to how hard an individual works at learning. More immature epistemological beliefs would include a belief that success in a subject area is due to a special gift that student possesses rather than how hard they work. The Mean of this subset was 2.88.

Subset 8 (Ability to learn is innate) questions were designed to allow students to indicate their perspectives about whether or it is possible to work beyond any predispositions towards learning. More immature perspectives would include a belief that smart students don't have to work hard to do well in school. The Mean of this subset was 3.48.

Subset 9 (Learning the first time) questions were designed to allow students to indicate their perspectives how many attempts are required to learn material. More immature epistemological beliefs would include a belief that one should be able to learn everything the first time one encounters a knowledge source, such as a book. The Mean of this subset was 3.37.

Subset 10 (Learning is quick) questions were designed to allow students to indicate their perspectives about the speed at which learning takes place. More immature epistemological beliefs would include a belief that successful students will learn things quickly. The Mean of this subset was 1.70.

5.5 Analytical Statistics

5.5.1 Introduction

Although descriptive statistics are useful when summarizing data, analytical statistics are used when attempting to judge the acceptability of a proposed hypothesis about the data (McPherson, 2001). The study used analytical statistics in order to test the hypotheses about whether or not the EBS instrument could detect the difference between video game players based on game genre. The hypothesis that there was a difference in scores across undergraduate years was also tested. Similar research studies had not found any difference between undergraduate years but it was considered prudent to evaluate that assumption before the data was treated as a common, homogenous body (K. R. Muis, personal communication, January 2, 2009). Evaluations made using analytical statistics may be subjective and therefore the criterion for making research decisions is based on explicit decisions that have been stated and based on previous work in the area of research. The subjective nature of statistics is the result of judgment being used to identify an appropriate statistical method. Although the decisions can be justified they can be the result of assessing a number of different factors in the dataset that will be analyzed.

5.5.2 Analysis of Variance of EBS Subsets by year of study

It was necessary to compare the university years to see if the scores on the EBS subsets were homogenous enough that the entire sample could be treated as one large sample. In order to do this, the null hypothesis was created that states there is no difference in the EBS subset scores in undergraduate years 1,2,3,4, and 5. This would indicate that the means of the subset scores are not significantly different for all groups.

When comparing more than two means simultaneously the analysis of variance (ANOVA) is used. The goal of the ANOVA is to detect any differences between means that is greater than would be expected by pure chance (McPherson, 2001). The ANOVA examines the ratio of between-group variance/within-group variance and provides an F-score. The survey results were grouped according to the EBS subsets. The goal was to determine if the average scores based on EBS subset grouping indicated any significant variance.

5.5.2.1 Finding 1

The results of the analysis indicated that there is no significant difference between the undergraduate years when the results were clustered using the EBS subsets.

Based on this finding, the research population can be analyzed and discussed as a whole.

5.5.3 Analysis of Variance of EBS questions by year of Study

The survey results were also separated based on the EBS questions themselves. The goal was to determine if the average scores based on EBS questions indicated any significant variance. In order to do this, the null hypothesis was created that states there is no difference in the EBS questions scores in undergraduate years 1,2,3,4, and 5. The strategy of comparing subset to questions was an attempt to be thorough and determine if there were any patterns in the data at a finer level of detail in the EBS survey. An ANOVA was again used to analyze the variance of the survey results.

5.5.3.1 Finding 2

On an EBS question basis there was a significant difference detected in question 7 between years 1 and 2 and years 1 and 3. In this question, years 2 and 3 were significantly lower (1 mean=2.45, 2,3 mean=1.667 & 1.625). In question 6 there was a significant difference between years 1 and 4. (1 mean =3.909, 4 mean=2.625). In this question, year 4 was significantly lower than year 1. There were no other significant differences between all the question means and years of study in the survey data.

5.5.4 Analysis of Variance of EBS subset and EBS questions by game genre

One of the research questions related to the ability of the EBS survey instrument to detect any differences between the answers provided based on video game genre preferences of video game players. The survey results were compared between game genres using the analysis of variance (ANOVA) method.

The survey results were grouped according to the EBS subsets as well as each question in the EBS instrument. The goal was to determine if the average scores based on the EBS subsets or questions indicated any significant variance.

5.5.4.1 Finding 3

The results of the analysis indicated that there is no significant difference between the game genre preferences when the results are clustered by subset or broken into individual EBS questions.

5.5.5 Analysis of Variance Discussion

The variance within and between groups who had taken the EBS survey was an attempt to determine if any patterns existing within the data that could be explained by a categorical description.

The analysis of the variance between the categories of undergraduate year resulted in no detection of significant variance at the subset level. When the undergraduate years are compared on a question by question basis there are some significant differences in two of the questions. There is no general trend obvious in the differences though. In one case, the more advanced undergraduate group has a more mature perspective on that particular question. In the other case the more advanced class had a less mature perspective on a particular question than the undergraduate class from a lower year.

The analysis of the variance between the categories of game genre resulted in no detection of a significant difference. The same level of analysis was done with the game genre categories. The categories were compared when the EBS results were clustered in subset and using each individual question of the EBS survey. The results indicate that the EBS survey was not able to detect any difference between in personal epistemological belief structure scores between game players by game genre.

5.7 Discussion of Interview Findings

The following section is a discussion of the findings from the interview portion of the study. Each of the findings has details from the interviews as well as an explanation of the findings. The discussion uses "thick descriptions" (Denzin, 2001, p. 116). that attempt to represent the meanings a particular experience has to the research participants Quotations are taken from interview transcripts in an attempt to capture the range of research participant perspectives and the complexity of the subject matter. This work provides the basis for the interpretations generated by the researcher.

5.7.1.1 Finding 1

The majority (67%) of the participants indicated that they had a mature perspective towards Certainty of Knowledge during their video game play. Although a similar number of participants (63%) indicated a naïve perspective towards Certainty of Knowledge, the majority (50%) indicated that those perspectives were forced on them by the game design itself.

A common finding in this study is evidence of mature personal epistemological beliefs exhibited by research participants in their descriptions of video game play. In the finding related to certainty of knowledge, most of the participants were comfortable with the challenges in a video game environment constantly changing. They also believed that there were many ways to solve problems presented in the video game and there was no one "right" answer. This is in contrast to an average EBS subset score of 3.03 out of 5 when asked about certainty of knowledge in a post-secondary setting. The EBS score would seem to indicate that the participants are more likely to believe knowledge is certain in a post-secondary setting. The group had an average EBS subset score of 2.20 when asked if they avoided ambiguity. This is about average indicating that the group had an almost even mix of naïve and mature perspectives towards the ambiguity of knowledge in a post-secondary setting.

Although most of the participants had a mature perspective towards certainty of knowledge in a video game environment, some players did express a preference towards predictability and certainty:

> I hate having to sit there and worry that there's four different ways that people can get money, or technology or knowledge or whatever else. I don't like them. I like something that's much more straightforward, give me a gun I can kill it and I'm gone. (Kr)

> I think in raiding (in *World of Warcraft*) maybe there's more of that kind of "up-in-the-air" sort of thing but again I haven't really got into that aspect of the game and I'm not sure if it'll be an aspect I like. (Ln)

> I always try to be good. I am the "Go and save the princess" kind of person so those alternate endings don't appeal to me much because for some reason I always take the same route. (Ln)

Some players explained this preference by their attraction to the inherent certainty in some games. They know that games will always present them with challenges that they can recognize and there will be always solutions to those challenges.

> Whatever you're doing there is more to do, whatever task you complete, there is always something next and in our real-life world that's rarely as obvious and so for a lot of people, it's, they may flounder, and "this doesn't interest me." (Chr)

There were also a number of participants that seemed to express a contradictory position of having both naïve and mature perspectives about the certainty of knowledge in a video game environment. Most of the participants explained this as a limitation of the type of game they were playing. Some games didn't present any uncertainty or ambiguity in terms of how the game was played or how problems could be solved. The contradiction is a part of the complexity of video game play and the variety of game designs. Some game designs are predictable and the Artificial Intelligence (AI) that controls how the game player interacts with that game design is often simplistic. Eventually the game play became predictable, not because the player prefers it that way, but it was a constraint of the game design and programming. The player recognizes, and is forced to use a single, unambiguous, and correct way of solving challenges in the game. Participants expressed this concept and its contradiction with the following statements:

> Well, I wouldn't say bored, *Halo 3* was very impressive for the A.I., I wouldn't say bored but I could definitely handle it. Of course, there would be quirks and because of the environment changing, the in-game characters would behave differently but it wasn't something that I didn't have trouble overcoming. (Ch)

> Usually in a game, I recently played the *Prince of Persia*, there is not a lot of learning, I learned the combos and whatnot but I kind of looked them up once in a while and just keep practicing until they become… and there's so much chance to practice. You're not really thinking about it, I guess there is a goal of learning because you're learning the next combo but it's done in a very unobtrusive way whereas in something like *Civilization*, you can't go anywhere until you learn. (Dnl)

> As I've gone along, it takes a shorter span of time for a game to lose interest. Like *World of Warcraft*, I can play that for maybe less than an hour and then it's just like an accumulator. You get a whole bunch of items and your level increases but actually you're playing the exact same game with items that are just higher power. (Mx)

Some of the players recognized that the definition of the "correct" way of solving a problem or challenge in the game comes from the game designers themselves. In areas where some of the challenges are ethical in nature there should be a considerable amount of uncertainty about a single truth or answer. Despite the capacity for video games to explore these gray areas, it is up to the game designer to allow for that kind of game play. The game designer would need to build a great deal of complexity into the game to accommodate multiple ethical perspectives. Usually there is not enough time and money in a budget to allow for multiple "right" answers in a video game.

> The ethical ones (video games), on the other hand, I think you could do a pretty good job with, the issue is that the ethical bias of the (video game) creator would affect the game because if you have to have some kind of reward or punishment system for your choices and so if I am the game designer and you are the player and we both have different ethical viewpoints and they could both be legitimate but that could…you could do something that you think is the right thing and because I thought it was the

> wrong thing you get punished, which doesn't work that well. (Ja)

Often the player will recognize that the game design patterns are the same and look for shortcuts to avoid having to repeat the same patterns over and over again in order to solve the game. There is a recognition that the redundant nature of the design doesn't present a challenge to the player's skills and so they look for shortcuts to save time.

> When I play games on my computer I will usually look for cheats just to quickly gain levels because I don't see how it's any different than mindlessly fighting the same thing over and over again whereas cheating gets myself five more levels ahead to get on with the story. (Dnl)

Only one game was mentioned that had a built-in back-story that reflected multiple truths within the game. The game design and AI were created to reflect a different worldview depending on which faction the player decided to play within the game. This was the most interesting example of a more mature epistemological perspective being integrated into a game experience. In this case, the truth was portrayed as relative and contextual. It is important to note that acknowledging the different worldviews is part of the richness of the back-story that was developed by the game designer. It is still possible to play the game and succeed without having to address or accommodate the different perspectives.

> In *Dawn of War*, it's that strategy game based off of that old figure game that is still around. I've played it and what I noticed is that the creator has, either purposefully or accidentally, made all the different factions and groups evil in their own extent. Like what is supposed to represent humanity is fascist and Nazi-like. The alien Orcs are brutish anarchist tribespeople, killing everything that's different from them, and then there's some other kind of... they basically covered every kind of evil villain or evil

> group or society you could come up with... You start seeing an evil underbelly running through the whole thing and so that's an interesting simulation of the different perspectives of evil but each different group of people saw themselves as right... Humans are fighting for humanity, we are the only good intelligent life form out here, we should exterminate everybody else. Everybody is good in their own eyes but being the player and looking at all them, they are all evil in their own way. (Ch)

Multiplayer games placed the participants in opposition with other game players in a game environment. It was during these game play experiences that certainty would start to disappear. Under these game play conditions players discussed their acceptance of ambiguity and chaos in the game environment. Most of them believed that it represented the most challenging aspect of game play by constantly confronting their perspectives on knowledge in the game environment. What the player may have considered "correct" knowledge at one point would facilitate success one day and could lead to failure the next as other players adapted to that strategy and created counteracting strategies.

> And it could also tie into the way the characters are, because in multiplayer everyone is made equal and it comes down to the player's skill. Whereas with a storyline (single player), the characters have their strengths and weaknesses. (Ch)

> Stress we tend to think of when you're forced to adapt to change, stress is that sort of transitory side effect, having to adapt to change means stress. Having competitive games, especially where it's you against the other person and the game is like a medium that you're fighting through, means constantly adapting to new changes, which means, at the very least, a certain steady amount of stress with occasional peaks when you screw up and they have you pinned or whatever. (Pa)

> It's the players that really test the constraints of the system. (Pa)

> I picked the game up fairly quickly but nothing I did against the AI really prepared me for what humans beings would do, and not only because they didn't necessarily follow patterns. I mean you're looking for opportunities; sometimes they make mistakes that throw you off right? There is a certain amount of artificial stupidity in there that an AI can't match. (Pa)

Many of the games discussed by the participants seemed to present opportunities to engage in uncertain and ambiguous game environments. This was most consistently present in multiplayer environments. There was always a choice to engage in this type of video games. Video games have enough freedom and flexibility in their design that players can avoid those types of situations if they prefer. This meant that a player who preferred certain and unambiguous games would stop playing a video game entirely if that option was not available to them in the video game environment.

5.7.1.2 Finding 2

The majority (78%) of the participants indicated that they had a mature perspective towards Simplicity of Knowledge during their video game play.

The finding related to simplicity of knowledge shows a high level of mature epistemological perspectives. This finding relates to the survey data in two subsets. In "Seeks single answers" the Mean score was 2.79 indicating a trend towards a naïve epistemology. The other subset, "Avoid integration" had a Mean of 2.37 indicating a trend towards a more mature epistemology. Both of these score are close to a middle score of 2.5 so neither of them represents a strong tendency either way.

The finding indicates that the participants believe video game players will succeed in a video game environment by understanding how all the components in the game interact with each other and understanding the integration of those components will influence the kind of solution they create to solve challenges in the game. It is not a matter of identifying discrete pieces of knowledge in the video, such as movements or actions, memorizing them and then repeating the over and over again throughout the game. The previous finding identified that for simpler video games, such as platformers, this may have been the only option available for players. Most respondents did not talk about these games when discussing the simplicity of knowledge in video games. Instead they focused on complex games, often socio-economic simulations, where successful game play was the result of integrating many different concepts within that game. That integrated knowledge would allow them a range of options that could be developed during game play. Some players engaged in a more in-depth analysis of the game, not only looking at how different components integrated but attempting to discern the underlying algorithms that controlled them. This approach worked at uncovering the complex systems that would determine how the game would react to the game player's behaviour.

> This was actually the first game (*Secret of Mana*) where I was forced to sit and read to understand what I was supposed to do because most games like Mario, there's a pit you jump it, if you fall into it you die. Very simple concepts that you pick up quite quickly but these games you had to read. So that forced me to start putting vocabulary to use. Trying to put into my head, you know, what all this meant. (Pa)

> (Discussing data collection in *World of Warcraft*) collect this data and thereby ascertain what the different parameters that affect things… and how to maximize things. (Chr)

> When I played *Everquest*, I played that for number of years as well, I remember that my apartment is littered with all these different printouts I had of different things about the game and locations of stuff, and maps of this, and list of equipment and stuff, with recipes and trade skills and sort of other different things. (Chr)

> With *Dawn of War* and *Warhammer* you are guiding armies and they have their own doctrines and their own ways of running their societies and so you're more like an observer looking over the map and watching the world work rather than being one of the pieces. (Ch)

Some players understood that analyzing and understanding the underlying mechanics of the game would also allow them to exploit that game. This is often an unintentional side effect of poor game design and AI programming. Exploiting these simple game systems will give the game player an advantage.

> It's interesting because when you're playing against a certain type of bad guy you get to understand how they work, you get to know, very well, exactly how close you can get before they turn around towards you and you can take advantage of that. (Dnl)

> I've got friends that like to describe videogames as just a math problem. It is just that we don't get to see the work, we're left to guess and through our own various types of testing, what is actually the math is behind the curtain and so there are people who do that. (Chr)

Some games are predictable and limit the range of options available to a game player. The ideas that underlie the game are simplistic themselves, leaving little opportunity for the game player to discern any complex relationship between components within the game.

> That is one thing I haven't seen games do well. They tend to be very black and white in their choices. You can be the

> ultimate good hero who's everyone's best friend or if they give you the option to be evil it's the evilest, worst thing. It's always "murder everyone and take their stuff" or "save everyone". They don't do a good job in gray areas. (Ja)

The complexity of the video game can be increased in a multiplayer game environment. Much like other players increase the level of uncertainty in a video game environment, they also increase the complexity of game play. The game player needs to learn about a new level of human complexity and develop strategies for dealing with other players.

> You can beat the AI and that's completely not there in player versus player. The first time I went into a PVP (Player versus Player) city, it's like... dead..... dead, dead, dead. And there's nothing you can do, you just have to learn the tricks and how to stay alive. (Dnl)

> Unless you have very brilliant AI programmers in the games with... I don't know what they'd have to do but, I mean after a while you just learn what the AI does and you play the game, you know what to expect from them and you... it doesn't take long to figure out. With other players it gets a lot more interesting because if you do something they actually change their strategy, right? (Mx)

5.7.1.3 Finding 3

The majority (78%) of the participants indicated that they had a mature perspective towards Quick Learning during their video game play.

Given the time required to learn to play and succeed in complex video games it is not surprising that the majority of the research participants viewed learning in video games as gradual and time consuming. This finding relates to the survey data in one subset. The subset "Learning is Quick" had a Mean of 1.70, which seems to indicate a more mature perspective towards learning.

In describing video game play, most participants recognized that learning to play a video game takes time. Any initial frustrations encountered in learning a new game could be overcome by continued persistence in playing the game.

> It's just a learning curve; it's just a pure learning curve. (Kr)

Similar to the other findings, there is a recognition that all games come with a different expectation about the amount of time required to learn how to play them. Many games are simple and are quick to learn.

> Most games like Mario, there's a pit, you jump it, if you fall into it, you die. Very simple concepts that you pick up quite quickly. (Pa)

Other games are recognized as being much more complex and require a considerable investment of time in order to learn how to play them. The commitment to investing this time can be substantial.

> I guess *Civilization III*, I played that just last year and that's quite a steep learning curve there are lots of trees and whatnot that you need to learn before you can effectively build your cities and evolve your society. (Dnl)

> I sat there for two weeks straight, didn't shower, didn't go out of the house and just played *Sims 2.* (Kr)

A game player's previous experience with video games will help to manage his or her expectations on the amount of time required to learn a video game. He or she will usually begin a video game with a good idea of the amount of learning effort that will be required.

> It does take some learning because those games have a huge learning curve. There's a game called *Civilization IV*, I was a huge fan of the game but it takes three months to learn the game. It's because it's so complex. That was a bit of a learning curve. Because I've been so experienced with games it wasn't that daunting for me to learn. (Da)

The awareness of the amount of time required to learn these games will often influence the types of games that a game player will undertake.

> In the more recent the years, the more time I'm in school, the less and less time I've had to play video games in general so it's kind of on my list of games I'd like to try to get into but...(Cha)

Some game players recognize that learning in video games is not just a long process of accumulating a large amount of knowledge. It is a repetitive process that requires them to implement their knowledge over and over again.

> ...with facts, it's like you're told them and then you take a test, then you usually forget them. With video games, you're doing it over and over and over and over again. (Da)

More complex games provide an easy entry point for game players. These games can often resemble simpler games at the beginning but are designed to give the player enough mastery in the game that they are encouraged to continue with the more complex and time consuming aspects of the game.

> Getting people hooked into the game means making it really approachable at least at first, maybe always, ideally always. Where they can...it's the shortest transition between when you have to pick up and learn a game and when it becomes an expression of self. If you can shorten that transition as much as possible, then for me that's really great because you get to that point where it's just you expressing yourself through the game, relating to other people whether you're working together or working against

> them and that opens up the doors for learning a lot more. (Pa)

The participants were also aware that learning in the game never really ended, it was a continual process that results in continuous rewards, although the size of those rewards will eventually decrease.

> It's an endless learning curve, it's steep and so there's always the appeal to get better but the reward for getting better and better as a result is really more and more minor as far as the skill you have developed, just that they have a greater emphasis, that extra little bit does count for a lot but it is only a little extra bit. (Pa)

The speed of learning also depends on type of opponent or challenges being presented to the game players. When a player is asked about how long it takes to learn how to defeat the game AI he or she replied:

> Fairly fast because eventually you get used to what the computer strategies are, you know what types of units they are going to bring into the battle, and you can almost always prepare for that. (Da)

Almost all of the participants recognized that more complex games take a considerable amount of time to learn and they do not believe that they will quickly learn everything they need to succeed in the game. The complexity of the game and its underlying systems provides one challenge; other players interacting with that same system provide an additional challenge. It isn't surprising that some players avoid games that require a large amount of time to learn. This may seem like the player is avoiding these game because they believe that learning is quick. It is possible that some players have that epistemological stance but some of the participants indicated that they didn't play games that took a long time to play because of the time constraints of school, jobs and family.

5.7.1.4 Finding 4

The majority (89%) of the participants indicated that they had a mature perspective towards Fixed Ability during their video game play.

Fixed ability is not necessarily about competence or being born with a certain ability to perform a task. It is more about how an individual reacts to failure. A naïve individual will equate his or her failure to low intelligence and personal inadequacy. His or her first experience with failure will often demoralize the individual and any subsequent attempts to address a challenge will be less and less effective. The individual does not believe that he or she has the inherent skills to address the problem. The findings relate to the EBS data, "Success is unrelated to hard work" which had a Mean of 2.88, "Ability to learn is innate" which had a Mean of 3.48, and "Learn the first time" which had a Mean of 3.37. This indicates a trend towards a naïve perspective about innate ability in a post-secondary environment. In contrast to this, the participant's perspectives towards fixed ability in a video game environment seemed quite different. Most of the video game players interviewed seemed to have a mature perspective towards fixed ability. Their experience with video games had taught them that if they failed once, they needed to approach the problem again, often with a different strategy. Eventually their perseverance would allow them to find a solution to the problem. The participants described their perspectives towards failure in the following ways:

> A lot of trial and error. They'll be like if you get X, Y and Z it makes a good combination and get that so I'll try it out and see how it works for me, stuff like that. (Ja)

> Yeah, it was just trial and error… it's just the learning curve, it's just a pure learning curve. (Kr)

> I guess it depends, if you have the *Prince of Persia*, in which learning is just trial and error, you repeat, repeat, repeat. That's different than opening up your (technology) trees in *Civilization* to figure out how you're going to evolve your society because it's a lot more like regular homework where you sit and open a book and read through it, and it's a lot more boring than trial and error of… I guess you could trial and error through *Civilization* but that would be a lot of trial and error. (Dnl)

Many players would actively seek out difficult and challenging video games as an opportunity to improve their competency at video games. They always believe that their ability to play the game will improve and are strongly motivated to achieve that improvement.

> It's beating my highest score and beating other people's high score. For me it's the competitive side. I've always been very, very competitive be it downhill skiing, be it karate, be it video games I don't like to lose, I like to win. That's definitely what keeps me going with those, I want to be someone. (Kr)

5.7.1.5 Finding 5

The majority (67%) of the participants indicated that they had a mature perspective towards Source of Knowledge during their video game play.

Most of the research participants indicated that the knowledge they used to succeed in the video game world was created by the participants themselves. This seems similar to the mature perspective towards source of knowledge in personal epistemological belief structure research. In that perspective an individual creates their own knowledge rather than receiving it from some external authority. This finding relates to the survey data "Depend on authority" with a Mean score of 2.98. This seems to trend towards a naïve epistemological perspective in a post-secondary context. In that context, students look to outside or authoritative sources of information to inform them about knowledge in a particular domain. In contrast to this belief participants saw themselves as the constructors of knowledge in the context of video games. The video game player learns through the process of trial and error and creates his or her own strategies that allow the player to succeed in the video game environment.

Some games facilitated experimentation by creating a very open environment. This allows the game player generate a wide range of strategies and that can then be tested and judged on their success or failure.

> I've never really gone to seek help when I'm stuck on a level. I usually figure it out eventually. (Ch)

> Once you get thrown out on your own it's up to you where you want to go, they won't force you to go anywhere so you have to be able to keep track of the plot, to know where you're supposed to go next or what's going to advance the storyline and it isn't very often that they are going to push you directly into that. (Pa)

The feedback that allows the video game player to learn is built into the game design itself. Some players feel that they are only accountable to learn up until the point that the learning is no longer fun.

> Accountability for your learning is basically to the point where learning becomes much more work and it is no longer fun to play the game, so that is where getting the learning to be behind the scenes or not interfering with the game is good. (Ja)

Some players contrast their approach to building knowledge in a video game with similar experiences in the post-secondary environment.

> ...institutional learning, it's kind of imposed upon you and you're told what to think and how to think rather than video games where you learn yourself so you are developing knowledge from experience rather than being told. (Da)

There is also an element of learning from the feedback of other players in the game environment. He or she doesn't use an external source of knowledge to initially learn how to play the game. Once the player begins the game though, he or she receives feedback from other players that he or she isn't performing well at the game. Through a dialogue with other players the player co-creates knowledge that is then applied in the game environment.

> The best way to learn that game is to compete against another person, to do something, for me. So if someone says "Hey, I'm doing a terrible job in this role" I'll ask them "okay what would you have done better?" (Pa)

> You find people, specifically in *World of Warcraft* say, you look for people the same level or skill or whatever with you and then you partner up in a way that helps you work together to learn it. (Ln)

Not all video game players feel confident enough to learn on their own, some of them recognize that they need to go through some kind of education or training in the game. These are often in the form of tutorials but they may come in the form of online resources as well. They still take responsibility for making that learning their own. They will make sense of the educational material and put the knowledge into action in the video game in their own way.

> But in most real-time strategy games I always play the tutorials because I'm a really bad intuitive learner with those types of games. (Dnl)

> What I do with a lot of them is go online and look at what other people have done, look at their strategies, try to incorporate that into what I'm doing. A lot of trial and error. They'll be like, "If you get X, Y, and Z it makes a good combination" and so I'll try it out and see how it works for me, stuff like that. (Ja)

There are others that take little responsibility for developing their own knowledge in the video game. This is a more naïve perspective and the video game player will rely on an external authority as their source of knowledge rather than creating it themselves.

> I have one friend who, I told him about it (*City of Heroes*). He started playing and became an Uber-player and one of those people who sits down with charts and analyzes the best build to get the powers. I don't do that but I guess if I ever said "what powers should I get next?" I call up my friend and he says "Oh you've got to do this and then do this". He's really into it. (Dnl)

This external authority is rarely formal but there are many places, including online forums, blogs, and video clips where video game players can go and get answers.

> Yeah, but I don't really have the patience to dig deep into them. I'll wait a week and then look, there's always people who have done the work for you, who have made up these great big charts so you basically just look at the punch line. That's what I do.
>
> I don't really ever have something to say because I never really do the research in the video games, I just take advantage of others. (Dnl)

> I went online and was looking for information about that and found a blog, I found several different blogs where the different talents that were coordinated with the math behind it all was explained. (Cha)

> I am very lazy person so I like to...I'm willing to help but I'm generally far more willing to go to the assessments and go from the shopping list they have. (Cha)

5.7.1.6 Finding 6

A majority (56%) of the participants indicated that Affect was part of the learning experience during video game play.

Personal epistemological belief structure research does not address the role of affect or emotion on how people approach knowledge and learning. This category does not have any equivalent measure in the EBS instrument. In this study, more than half of the participants were able to articulate that affect was part of their experience in learning and experiencing a video game.

A positive emotional state is often an incentive for the amount of learning required in some video games.

> It gives me a sense of accomplishment; it lets me go beyond what I'm physically capable of. It allows me to give myself a sense of being a hero in some ways, to stand out.
>
> Or through a team mission and we're successful or I contribute in a noticeable way. It's a real boom in self-esteem I guess, real satisfaction. (Ch)

> It gives you are really escapist feeling. I don't know, during high school I used to really enjoy that escapist feeling. (Da)

> If you have a really good game going then you sort of, maybe identify with the character more and you sort of get absorbed into the game even though it is just like a book. (Mx)

When compared to a post-secondary learning environment, the gratification from learned is perceived much differently.

> Chances are, reading about recursive parsers, you're not going to be too interested right off the bat but thinking "Okay, I'm going to learn PVP (Player versus player)" in a videogame, you're willing to put in some time there. The homework is hard and there's no real gratification in some of the classes, I mean, some of the classes you take because you have to you know, or you're pretty sure, this is not something you're really going to use, like compilers or assembler. You're not going to use these in the real world but you still have to take it. There is no gratification there. (Dnl)

Often, the emotional state of the game player will affect their disposition and result in different choices for game play. Different video game contexts will, in turn, affect the kinds of approaches they will need to take towards learning.

> If I'm having lots of slow days where I'm just bored out of my mind and I start to feel that detachment I know I need something to get connected to, to be engaged in. Strategy games are the best thing for me, because they will bring me back to reality but in other circumstances where I'm loaded, adding to that load is not necessarily a good thing so it depends on the disposition that I'm in. (Pa)

> It's a combination of the friends I usually play with, or players I meet through the game, so it depends on the mood. Sometimes, when I'm playing on my own, it's out of preference. They all have their moments. (Ch)

In some cases, the video game player is aware that the game itself is trying to manipulate their mood or emotional state.

> A lot of them (game cinematics) it is just for dramatic effect, although some of them would be for setting the mood of the game. Especially if they are trying to make a dark game where you suppose to feel like you don't have any hope and things like that. (Ja)

Not all of the emotional states discussed in regards to video game play were positive. Sometimes the impact of a negative experience in a game could result in extreme responses.

> This one guy had a character in a campaign where a dragon got a lucky strike against him or something like that and it killed the character. The guy cut himself badly, blood on the kitchen on the wall, really mutilated himself as an emotional expression for the loss of that character an expression of the bond that he had with the character that he had built. (Pa)

> It's a time thing, it's also addictive. You know if you have a slightly addictive personality you can just get sucked in and it's just like, I wanna, I wanna, I wanna. (Kr)

> I seem to go for the highly addictive games and prior to *Everquest* I was a MUDer, back before the games were so much more videogames and when I played Multi-use Dungeons (MUDs) there was less research to do and I did MUDs for number of years. I agree they're horribly addictive and it's one of the reasons I dropped a school on the other hand I wasn't having fun in school either. (Cha)

5.7.1.7 Finding 7

Less than half (44%) of the participants indicated that Socialization was their motivation for playing video games.

In trying to understand the complexity of the experience there were a number of questions focused on trying to understand the motivation players had for learning how to play video games. Much like affect, it was possible that these motivations could affect the video game preferences and how the game player would view learning within the game environment. In this research group, less than half of the participants indicated that socialization was their motivation for playing video games. Although it was not recognized as dominant in the participants, it still represents an important motivation for those participants to engage in learning how to play a video game. Socialization would be a group activity undertaken with friends and colleagues, either online or in person. These kinds of experiences were described with the following passages:

> There is always… the best items are being spammed in trade channels and stuff like that, so you're driven to desire that stuff that is considered socially acceptable in that world and then when you get it you feel a sense of belonging and ubiquity but I do think that the larger trend takes place in games where if that happens to be a primary motivator for game players 18-24 well now you're going to have this issue that that's going to be the primary motivator in a lot of these games. (Pa)

The motivation to socialize is not limited to the context of video games. Some players are finding that the rewards of socializing in games wanes as they find other opportunities to socialize.

> My friends still play video games and when I play video games with them it just bores me. I never experienced that until I had a more active social life. (Da)

5.7.1.8 Finding 8

Less than half (44%) of the participants indicated that Relaxation was their motivation for playing video games.

Relaxation or stress relief as often seen as a reason to engage in video game play. This kind of motivation often had to do with dealing with high stress situations in other aspects of the game player's life. The participants would often describe video games as an escape from their real lives, a place where they could enjoy themselves and forget about the stress of their lives for a period of time. These kinds of experiences in relation to video games were described in various ways:

> Having competitive games, especially where it's you against the other person and the game is like a medium that you're fighting through, means constantly adapting to new changes, which means, at the very least, a certain steady amount of stress with occasional peaks when you screw up and they have you pinned or whatever and that doesn't do well for me if I have to focus a lot on school because then I already stress out about finance, school and homework and time constraints. I can fit the strategy games in but I'll be even more burned out rather than relaxed at the end of them. (Pa)

> I still play *World of Warcraft*, I tend the budget it for an hour or two a night when everything else is done. I lose my prime time at 6 or 7 PM I stopped being able to focus well and that's sort of my brain lazy time, my off time when I do whatever feels good. (Pa)

> Video gaming in general is a stress relief for me and it's something you can escape into which is why *World of Warcraft* is really something that you can escape into. (Kr)

> I play a lot of strategy games but probably, actually the RPG games because there is a more immersive, right? It gives you are really escapist feeling. I don't know, during high school I used to really enjoy that escapist feeling of it but I don't feel the need to escape more, I'm a lot happier now. (Da)

5.7.1.9 Finding 9

More than half (56%) of the participants indicated that personal growth was their motivation for playing video games.

Video game players were often looking for something that they believed would challenge them intellectually. Some games were seen as being challenging to the participants and this would lead to a preference in the genre of game they played.

When they compared the video game experience to the potential for growth in a post-secondary environment there were some instances where they found the video games as more likely to provide personal growth opportunities. This would depend on type of learning happening in both of those contexts.

> If it's a class I really enjoy, like Chinese history or Japanese, those courses are really awesome. I get more intellectual stimulation than I would from most videogames but unless, of course, I really like. I would say that RTS's give me more intellectual stimulation, slightly, because if I'm reading those boring fact-filled textbooks I tend to zone out. (Da)

This understanding, that not all games can provide an opportunity for any kind of intellectual growth, was common among players who were actively seeking out some kind of stimulation. When asked about most console-based games, one respondent didn't have a high opinion of the kind of growth that can occur.

> Definitely, for entertainment value if I want to play with a friend or something it's fun but if you're interested in intellectual sort of…you get nothing out of them after 10 minutes or so, yet pretty bad. (Da)

These challenges didn't always come from the explicit design of the games themselves. Many participants were looking for ways to "game the system" as a challenge to themselves. "Gaming the system" is a process of discovering a weakness in the game and then exploiting it in a way that no other player has succeeded in doing. The respondents see this as a real challenge to their intellect.

> Lately I've been focusing more on just exploring the world and going out and uncovering every little nook and cranny and being like, "Hey guys I made it into this zone I'm not supposed to be in, check it out let's see how long it takes before I get banned." (Pa)

> So basically I am trying to go down the dungeon as quickly as possible without doing any of things, which is sort of "gaming the system" so that it you can get down (into the dungeon) pretty far and then you have a whole bunch of different interactions because you are lot lower on the level or, so that's something. If you figure it out, instead of slowly progressing in it (the game), you can do this and then make the game more interesting. (Mx)

In other situations, games are seen as the only opportunity for challenge and growth as the regular day-to-day life of the game players provides little or none.

> As far as the learning aspect goes in building sets of competencies, it pretty much has to be there because that forms the basis of accomplishment like when you get a sense of mastery that's very, very rewarding and promotes further learning and so that becomes the baseline for basically all the games I play if I'm not receiving that reward elsewhere. (Pa)

> It's one of those things that you look at people and okay, I see that in your life you are not living up to your intellectual capabilities but in… it's something that I've seen in, and I would say to be quite honest, it is true of myself that I will much more gleefully completely dive into a research project and I will doggedly pursue it in ways that I would never be tempted to put as much effort into for work. (Cha)

> What I've seen is that other people, they may do the same thing but their work is well beneath their… like I had a friend who, he doesn't play the game anymore he's playing something else so I don't see him or hear from him anymore but he worked as a security guard and while he did get to meet people and chat with people and have a public interaction his job asked nothing of him intellectually and yet he was one of the most number-crunchingest guys I've met who would doggedly pursue whatever problem he was working at. I mean I've got several friends who really are excellent players and they really research stuff and they really crunch the numbers and

> they don't apply that same sort tenacity to their work and/or schooling. (Cha)

> I totally confess that if something catches my focus, I'm all over it and I don't want to give it up. If it's other stuff… it's well… and personally I'm on Adderall, and I take it for work and for school, I don't need it for playing the game. (Cha)

5.7.1.10 Finding 10

The majority (67%) of the participants were aware of dissonance between their personal beliefs and the beliefs presented in the video game experience.

In addressing personal epistemological belief structures, it is important to be able to recognize or be aware of, a situation where an individual's perspective on knowledge and learning don't correlate with something they are experiencing. Faced with this dissonance between what they are experiencing and what they believe to be true, the dissonance must be examined, explained, and integrated into a new personal epistemology. This is not always the case though as one option when faced with dissonance is to ignore it or come up with an alternate explanation that won't conflict with their self-identified perspectives. Most of the participants in the study recognized that this dissonance occurred in video game play although this recognition did not guarantee that they would address it.

Some recognized the dissonance from their own perspectives, the most obvious being in the realm of morality. Some games presented opportunities to explore conceptions of good and evil but in some cases the activities didn't seem authentic.

> I always play good, I tried playing evil once but I grew tired of doing all the little activities such as attacking

> random people and stuff like that. It didn't really appeal to me. (Ch)

> Some of them (games) tend to put you in situations where you only have bad choices...Either one is a bad choice or you're trying to pick between the lesser of two evils.
>
> For a lot of them it is just for dramatic effect, although some of them would be for setting the mood of the game. Especially if they are trying to make a dark game where you're supposed to feel like you don't have any hope in things. That's where situations are more useful. And some people are like "Hey, this is cool" but they don't really understand the implications. (Ja)

Recognizing the dissonance does not mean that they altered their own perspectives, merely that they were aware of it.

> Like for characters that were in the first game I really enjoyed them even though they were the opposite of the way I usually play. Such as the HK 47 assassin droid, I really liked him even though he was the evilest of the characters. So I used a lot of the characters that, I don't know, really didn't align with my preferences. The way that character developed sort of had a different perspective or more contrast, or stood out. (Ch)

> The learning is a lot more engaging in virtual reality because it's part of the activity. Whereas learning through university and learning in real life, it's gaining a tool or a skill set that you then have to wait for the right time to make use of. (Ch)

Some recognized that their success was linked to recognizing and accommodating the epistemological stance of the game designer, not necessarily their own. They recognized the break from their own worldview and seemed comfortable with temporarily changing their own stance in order to succeed.

> The ethical ones (video games) on the other hand I think you could do a pretty good job with, the issue is that the ethical bias of the (video game) creator would affect the game because if you have to have some kind of reward or punishment system for your choices and so if I am the game designer and you are the player and we both have different ethical viewpoints and they could both be legitimate but that could...you could do something that you think is the right thing and because I thought it was the wrong thing you get punished, which doesn't work that well. (Ja)

In many cases the game player doesn’t even consider how dissonance may result in the processes of learning. They see it as an intuitive process that doesn’t require any awareness.

> I don't know, it just sort of comes naturally to me, right? Like I've been playing video games for a while, pretty much from when I was six. So yeah, I don't really think about the actual experience of beginning to learn that it just comes to me. Often it depends what kind game it is. (Da)

> No, you don't think, I mean you're learning, say in the shooter you're learning not only the map are also learning response time for weapons spawn as well is where enemies spawn. I don't know, what would make you stick with it? I just enjoy it, I've never thought of it quite like that. I definitely stuck with *Halo* because of the competitive nature. (Kr)

A small number were even surprised when they discussed the genres and subject matter of games the routinely played. They realized that they would never try to play a different kind of game that might conflict with their preferences.

> I'm kind of surprised at myself to discover that I don't vary from that method very much but yeah I guess so. (Li)

5.7.1.11 Finding 11

A small number (22%) of the participants took this dissonance and addressed it as a potential growth experience.

Some of the respondents welcomed challenges to their intellect, actively seeking out those experiences that would force them to think about the world in different ways.

> I actually probably like strategy games the most out of everything. Just that doing the strategy and keeping your mind active on all the different possibilities like if it's a micromanagement intense game and stuff like that can be very taxing on the brain it's not necessarily a good complement to a school or a student lifestyle, so they aren't the types of games I play most often but I do find them the most engaging. (Pa)

This perspective seemed most common when the context of the real world provided little or no challenge to them. They seek out experiences that push them and find them in the digital world.

> I would definitely say it was beneficial to me. Just even using my brain way more than I otherwise would be doing sports or watching TV especially with complicated games like *Civilization.* (Ja)

Many of the participants recognize the challenge presented by more complex games but aren't seeking that kind of experience in a video game. They avoid the kinds of experiences that don't focus on immediate gratification.

> Like Sid Meier's *Civilization IV.* I played one round of *Civ IV* and said "Cool, I'm done." I don't care to play this on hard, I don't care to play the other factions, I'm done. I don't like having to sit there and watch my guys and having to build over here and then wait for this thing to spawn over here.... I like to hit the ground running, I don't like to sit there and have to build up. (Kr)

5.7.1.12 Finding 12

The majority (67%) of the participants felt that the worldview they had created to address the game world would transfer and be meaningful in other video game contexts. Only 22% felt that this would transfer successfully to the real world.

Most of the participants in the study didn't have a problem with the idea that the epistemological perspectives they developed in one video game would assist them in playing another video game. The perspective came from a recognition that game genres and a general lack of creativity in the gaming industry has resulted in the re-use of design patterns between games.

> Once you play one strategy game you've got the blueprint for how to play lots of others. (Da)

> I suppose there is probably a problem-solving skill set that you develop that kind of transfers over. It is a different gaming type of course, the community thing versus you figure it out yourself kind of thing, which happens in console games but there must be some process I guess that happens when you give me individual gaming that transfers over to most other games, problem-solving specifically. (Li)

> I think it's the same for everything else, you don't really consciously think ... here is my skill set from *Halo* and going over to *Counterstrike* and here's what applies and what doesn't apply and I will just print out a map and measure the distance and whatever. I mean that you just try it out because it's a lot more interesting. (Mx)

Some were openly concerned that any of the lessons learned would actually be considered for transfer to a real world context.

> I actually think it's just a game. I don't know it kind of scares me to draw any parallels with the real world because

> it's blurring the lines between video games and real life. I don't know it's kind of a daunting thing to do. (Da)

The perspective may be supported by the reinforcement from the game itself, as many of the features of game play are based on the unreal.

> You punch somebody and they fly across the room. I mean I guess if you're a super strength superhero then you would expect that but for a regular guy to do a punch and you'd knock them back it's a little weird. It's surrealistic I guess. (Dnl)

Some participants had an understanding that their success in a game had to do with the agreement, even temporarily, with the epistemological stance of the designer of that experience. Their own epistemology would be contextual to that single game experience and wouldn't necessarily be consistent across other contexts.

> So if I am the game designer and you are the player and we both have different ethical viewpoints and they could both be legitimate but that could…you could do something that you think is the right thing and because I thought it was the wrong thing you get punished, which doesn't work that well. (Ja)

Only 22% thought that video games provided anything that might transfer successfully to the real world. This may well be a reflection of the risk-free environment of the games that allows an extension into epistemological perspectives that align with the certainty that there is likely an answer to each problem in the game and cost of failure while solving a problem is low.

Time management skills are one thing that players have seen transfer out of the gaming context into the real world.

> He's learning to compress more things and multitask more because in that game you're required to be attacking and using abilities and watching for multiple other targets or threats at the same time and he's turned this into this is how I can maximize my time for brief periods. It does a few things I can do it once let's try to do all three or four of them. Sometimes it's overloading, it's like Mr. Bean, but he did pick that up from the game, the game does teach certain amount of time management because you invest so much time into it that you have an inherent interest in trying to make the most of it. (Pa)

Another was teamwork, which some players felt would help them in teamwork situations in the real world.

5.7.1.13 Finding 13

More than half (56%) of the participants believed that the epistemological beliefs developed during game play were socially constructed and maintained.

The concept of social epistemology is related to personal epistemology. It understands human knowledge as a collective agreement. In a video game environment game players the engage in a multiplayer environment as often limited in their actions by the concepts of fair play and accepted practices for how to address challenges in the game environment.

> So I don't see the stress being reduced by having a reflection downtime after the fact so much as it is having other people that can actually, strangely enough, challenge me to move through that by offering potential solutions. I still have to take their advice and apply it and see if it works but if they're there to offer it I can take it. I can cut a huge swath of time trying to figure out if taking a strategy either does or does not work. (Pa)

Understanding comes through mutual consent.

> You can take a shortcut path to go around everyone and everything and get to their base without destroying any towers. It's called "back-dooring." If you did that, you could win in a second but no one does it because there is an online ethical code not to do that and you just get shunned if you do it. (Da)

These systems can come through informal agreement but often they are defined within the game design and features are in place to facilitate it.

> *Halo* has quite a few measures to keep things fair. They have a very active monitoring system for cheating and bad behavior and also reporting systems. And then also there is an in-game feature for booting team killers. (Ch)

Consensus on game play can also happen outside of the game play environment itself.

> All the people I play with I know in real life so we always talk about the game and stuff. Usually before we play a game we know what to do because we strategized outside. (Da)

5.8 Chapter Summary

This chapter presented the three findings from the quantitative portion of the research and the 13 findings from the qualitative portion of the research. Data from the EBS questionnaire were used for the quantitative results while data from the individual interview were analyzed for the qualitative results. The combination of the two sets of results revealed the personal epistemological beliefs of the research participants in both a post-secondary and video game context. The quantitative data underwent a number of statistical descriptive and analytical methods that yielded a number of results. The qualitative data provided extensive quotes from the participants that were included in the chapter. The use of actual quotes from the participants was part of a strategy to represent an accurate picture of the reality of the participants in the context of video game play.

Chapter 6 Analysis and Interpretation of Findings

6.1 Introduction

The purpose of this survey-based and multi-case study was to explore conceptions of personal epistemology in relation to video game play. It was hoped that by better understanding how personal epistemology influences learning in video games that we will have:

1. A real-world example of personal epistemology in action
2. A better understanding of the implications of the thousands of hours of video game play undertaken by video game players
3. A perspective on the kinds of context necessary to encourage and support growth and development of personal epistemology

The six research questions were largely satisfied by the findings presented in the previous chapter. The overall finding was that personal epistemology plays a role in how the participants learn to play video games and which games they choose to play. There was also a difference between the ways the participants perceived learning in a post-secondary environment versus a video game environment.

This chapter analyzes, interprets, and synthesizes the findings. It is organized around the following analytic categories:

1. The EBS instrument did not detect significant differences between the participant's year of study or video game genre preferences. (Research question 1)
2. The video game player's perceptions of what they need to learn to succeed in a game and how they acquire that knowledge. (Research questions 2, 3, and 4)

3. Video game player's perspectives on learning transfer from video games to other contexts. (Research questions 5 and 6)
4. The supports and barriers to the growth of real-world personal epistemological beliefs during video game play. (Research questions 2 and 6)

The analytic categories are aligned to the research questions used for the study. The categories were used to organize and present the findings from the previous chapter. The goal of the categories was the identification of connecting patterns within the categories as well as connections between the categories. Relevant theory and research is tied into the analysis in order to compare and contrast issues that have been raised in the existing literature.

The purpose of this chapter is to organize all of the data from both the quantitative and qualitative sources into categories that create a readable account of the research. The interpretation of the findings is designed to provide insights into the subject matter and bring together all the findings into a holistic perspective.

The discussion takes into consideration the literature on epistemological belief structures, metacognition, game design, and self-regulated learning. The implications of the findings are intended to provide new insights into learning in a video game environment and how epistemological beliefs are a part of that experience. The chapter concludes with a re-examination of the researcher's assumptions, which were identified in the first chapter and a summary that discusses the possible researcher bias in interpretation of the findings.

6.2 Analytic Categories

6.2.1 Analytic category 1: EBS Instrument

The EBS instrument did not detect differences between the participant's year of study or video game playing preferences.

The first research question sought to determine a baseline of personal epistemological beliefs in a post-secondary setting using the EBS, a survey instrument that was designed for that purpose. By creating a baseline of an individual's personal epistemology it was hoped that it could be correlated to other variables such as year of study or preferences for certain genres of games. The results of the analysis seem indicates two things:

1. There is no statistically significant difference in the average EBS scores between undergraduate year of study,
2. There is no statistically significant difference in the average EBS scores between video game genre.

In comparing undergraduate year of study and game genre, the EBS results were compared at the subset and the question level. It seemed that the clustering of the questions into subsets would provide one set of numbers for comparison and the actual results from the questions themselves would provide an additional set of numbers for analysis.

The lack of any significant difference between years of study in the results was not entirely unexpected. Other researchers had found no differences across years of study at other post-secondary institutions (K. R. Muis, personal communication, January 2, 2009). The failure to detect any differences is not completely based on the ability of the

EBS instrument to detect differences between populations. Although the complete sample size was 107, once the data was cleaned and validated the overall sample size for this study was low, at 50 participants, and the largest number of participants in a single group was in year three of undergraduate study with a total of 16 participants. A low sample size makes the statistical detection of any patterns challenging.

The lack of any significant difference in scores between video game genres has two main issues. The first relates to the underlying assumption about measures of personal epistemology in an undergraduate context generalizing to other contexts. The second is the way video game players described their video game genre preferences.

The first issue relates to the fact that the EBS instrument was designed for understanding a student's global perspectives towards personal epistemology in a post-secondary context. The idea is based on the belief that personal epistemology generalizes across other domains from a post-secondary environment. This is not a point of common agreement in the academic community (Hofer, 2005). For example, in the domain of mathematics it was found that a student's academic performance could be predicted by his or her score on a personal epistemological beliefs instrument. These same beliefs were not credible in predicting successful performance in a less-structured context (Liu, 2010).

The second issue relates to the way that the participants identified their preferences in video game genres. There was no single genre that they identified as a preferred type of game. Many of them identified several different types of games that they enjoyed playing. This limits the ability to identify discrete groups and link them to EBS survey results. The reasons for video game players engaging in multiple genres of video games seems linked to preferences and motivations when they are deciding to play a game. This means game genre preferences are unlikely going to be a sole indicator of epistemology. This will be discussed in more detail later in the interview analysis. It is unlikely that any patterns would emerge when the data was analyzed and this was confirmed in the statistical analysis.

Although there was no definitive difference detected between years of study and video game genre preferences it is still conceivable that a substantially larger data set might provide some indication of statistically significant variance between groups. The EBS instrument is still under development as well. Continued work on the instrument may provide the ability to detect more fine grained differences in groups who take the survey.

6.2.2 Analytic category 2: Perception of learning

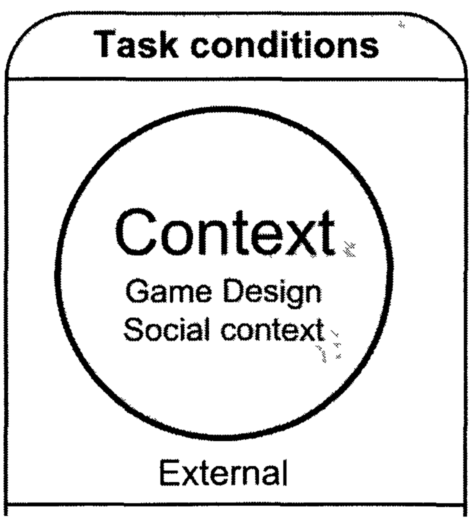
Perceptions about what video game players need to learn to succeed and how they acquire the knowledge.

The participants recognized that they needed to develop knowledge that would allow them to succeed in playing a video game. Their perspectives of what they needed to learn and how they learned it seemed to describe a wide range of epistemological stances. To add to the complexity, many of the participants described having both naïve and mature epistemological stances towards knowledge and knowing during learning. This apparent contradiction of an individual having multiple stances is an indication of the complexity of the learning experience in video games. The findings seem to indicate that there is a multi-faceted mix of factors that contribute to the participant's perspectives. These are in addition to the perspectives that are guided by their personal epistemology.

Some of these factors include the type of video game they were playing, the context in which they were playing it, and their motivation for playing.

In order to organize and make sense of this complexity, one of the goals of the research was to understand if and where personal epistemological belief research fits into the entire process of learning how to play a video game. What follows is an interpretation of the study results within the framework identified in Chapter 3. In this discussion what the participants needed to know to play a video game and how they learned it were examined. In the course of the discussion both external and internal contexts were taken into account. Both of these contexts affected the way the participants perceived the learning tasks presented in the video game as well as how they developed strategies to learn and monitor their success.

6.2.1.1 Task conditions



External context

There are two external task conditions that were noted in the planning process of the participants. These were the game design of the game itself and the social context in which that video game is played (see Figure 9).

Game design

Game design is imposed on the video game player as an external constraint to their approach in learning to play a video game. Many of the participants in the study recognized that their strategies were defined by the game design itself. In formal educational settings the instructor and assessment, or test, provide the student with expectations on their approach to learning. Video games lack either of these types of external constraints. Successful learning is defined within the game design itself as it provides the constraints on behaviour and feedback that the player will need to determine if they are successfully learning. The mechanics, constraints, and measures for success and failure are all contained within the enclosed context of the video game environment. Much of the information the game player needs is implicitly communicated by the game genre and how the game presents itself through marketing. Complete identification of the game design does usually not occur until the player actual begins to play through the game itself. Once this happens, the game player will usually understand the expectations of the game designer. The player's success in the game depends on their ability to match the expectations and perspectives of the game designer. The study participants were aware of this condition as one of the components they needed to know before they could be successful in the game:

> The issue is that the ethical bias of the (video game) creator would affect the game because if you have to have some kind of reward or punishment system for your choices and so if I am the game designer and you are the player and we both have different ethical viewpoints and they could both be legitimate but that could…you could do something that you think is the right thing and because they thought it was the wrong thing you get punished, which doesn't work that well. (Dnl)

Most video game designers rely on personal experience and an intuitive sense of what game players are looking for in a game (Sotamaa, 2007). There is no evidence in the literature that game designers have an awareness of their own epistemology and how it influences their design decisions. This creates an unconscious bias and the video game player must spend some effort understanding how the designer's personal epistemology has influenced the environment they have created. It is not surprising that the participants recognized the necessity of understanding and conforming to another's epistemology in order to play the game.

The findings seem to confirm a phenomenon that has been noted in several academic articles about our ability to modify our perspectives on knowledge to match the expectations of the learning environment (Bromme et al., 2010). The perspective that our personal epistemology is adaptable means that we can temporarily suspend our beliefs about knowledge to adopt another set of beliefs that will ensure our success. This was one of the reasons Muis (2004, p. 323) began using the term "availing" to describe personal epistemology instead of mature or naïve. Mature and naïve come with an inherent value judgment while the term "availing" indicates that an individual was using a belief structure that they believed was most likely to lead to a successful learning outcome. In an academic or learning environment this meant that a learner would match his or her epistemology defined by the objectives of learning defined in the curriculum or the epistemology of his or her professor.

Hofer (2004) also noted that although students will filter knowledge presented in class through their own epistemological filter, those perceptions are malleable. An example would be their reliance on rote memorization of terms when they believed that knowledge was actually contextual and relative. If the professor believed the memorized knowledge was an indication of competence and their exams were created to reflect this, a learner will adopt what they perceive as a more naïve epistemology in order to succeed in that class. They would identify knowledge and plan for the memorization of that knowledge accordingly. This kind of student adaptation to instructor epistemology has been observed in mathematics education at the elementary, secondary, and post-secondary levels (Muis, 2004). Muis (2007) called this the consistency hypothesis and it explained how epistemological beliefs could predict success in the domain of mathematics during academic learning. In this hypothesis, the learner identifies the expectation for performance from a problem presented to them. They would choose to use an epistemological stance that might differ from their own in order to succeed. An outside observer would only see the learner exhibiting that temporary epistemological stance during the course of learning.

Similar phenomena have been observed in the study of history where a successful student needed either a similar epistemological stance about history as the professor or a clear understanding of the tasks in the course (Nist & Holschuh, 2005). In a longitudinal study it was found that the personal epistemologies of a student would show evidence of correlating with an instructor's after just one semester of study (Clancy, Fazey, & Lawson, 2007).

The personal epistemological stance of the game player will need to be reconciled with the tasks programmed into the video game. There will be other tasks defined during the identification of tasks and planning that will also need to be addressed. This means that game players were more than capable of regressing back to a more naïve epistemology when they wished to engage in a simpler game. In games, there is no other option but to interact with knowledge in the game in the way it is defined in the game design. Simpler games, such as casual, puzzle games, or platformers provide very limited options for play, no matter what the wishes of the game player.

> Most games, like Mario, there's a pit, you jump it, if you fall into it, you die. Very simple concepts that you pick up quite quickly. (Dn)

Many of the game players recognize that their prior knowledge of game design from previous game play experience will create most of their expectations about what they will need to learn. Often they identify that it will be the same learning over and over again. The repetitiveness of the game design actually inhibits their range of behaviour to the point where they have started to become bored with the games.

> I don't know what these companies' problems are but I'd rather play a bad game that at least attempted to be innovative than play a mediocre game that uses the same aggressive video game design over and over again. (Mx)

In some cases the identification of a simpler game design is part of the overall decision to play the game. If the motivation of the game player is stress relief or pure socialization, the game player might actively seek out games that required a less sophisticated epistemology while avoiding any game that would require a mature perspective towards knowledge creation.

Failure to understand the expectations of the game design, or a disagreement with them, will usually result in the game player failing in the game itself. When the player can't move forward, he or she usually experiences the kind of stress and frustration that means they stop playing.

Social context

Although personal epistemology would, by its name alone, seem to indicate a solitary process there are some who consider the development to be socially constructed

(Brownlee & Berthelsen, 2006). Changes in personal epistemology are contextually bound in the learning experiences of the individual and if a community of practice is part of that learning experience it supports the concept that they are part of the epistemology that develops (Hofer & Pintrich, 1997. In a multiplayer gaming environment this means that peers play an active role in developing and maintaining personal epistemology. Despite the considerable amount of work being done on social learning theory there has not been a great deal done in relating it to personal epistemological belief structures. Most teaching environments still emphasize the instructor as the guide for the individual developing knowledge. Even in constructivist environments where the individual must make sense of the subject matter on their own terms, the instructor is there to facilitate the process for the individual.

The social context in video games is defined by the individuals playing together in a game environment. These game players use commonly agreed upon rules to define how a game will be played. This was a common theme among the participants and it is due to an increasing number of games having a multiplayer component. There were many examples of the participants explaining understanding of the game context in relation to their peers.

> Through the games I've played we've never really had a sole leader it's more of a group agreement. (Ch)

The external context of a peer group can have the strongest influence to a game player who is motivated heavily by extrinsic factors to succeed at the game. The game player will be careful not to identify a standard during the planning stage that will make them lose respect and prestige among the community. In this way, the community not only defines the worldview for the game players but they are part of the motivation to learn and maintain that worldview.

For those game players that do not feel they are constrained by the socially constructed epistemology of the video game there are usually built-in mechanisms to identify them and provide feedback on their inappropriate actions. This usually means the player is removed from the game by the community.

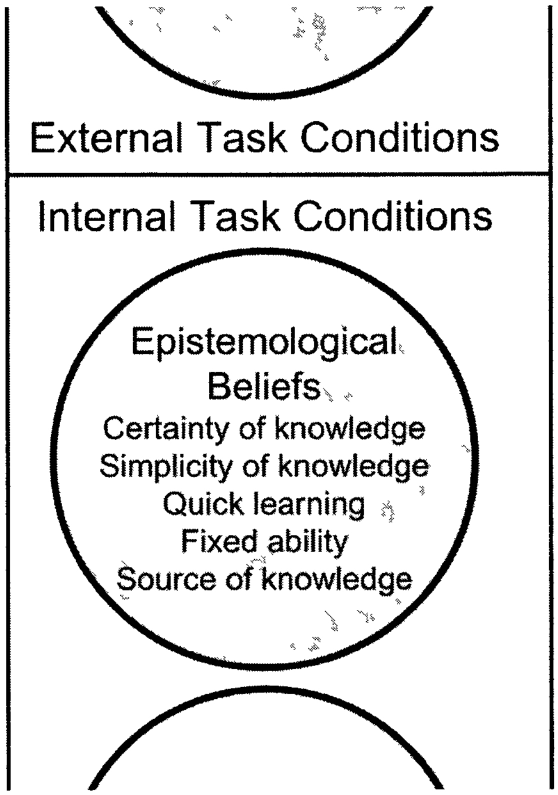
The participants only discussed the constraints of a social context when they were describing multiplayer games. Some of them did not have a preference for multiplayer games and therefore socially constructed epistemology was not part of their described experience.

6.2.1.2 Internal conditions

Internal conditions are a collection of influences on learning that reside inside the individual. For the purposes of this study there were three internal task conditions identified. They include personal epistemological beliefs, motivation, and affective, or emotional, as the internal elements. These factors influence that planning that is undertaken by the learner when the set out to learn how to play a video game.

6.2.1.3 Epistemological beliefs

Epistemological beliefs influence a game player's strategies on what to learn in a video game environment. In following with the framework that personal epistemology is comprised of several different components rather than a single construct, these beliefs were examined individually. The personal epistemological components used to interpret the study results include certainty of knowledge, simplicity of knowledge, quick learning, fixed ability and source of knowledge (see Figure 10).



.: Personal

During the identification of task conditions, epistemological beliefs are used by the game player to assess the kind of learning that will be necessary in order to play the game. They are part of a number of other influences, both internal and external, that will be taken into account so the game player can create the most viable strategy for learning in the game.

In many games, this process seems to involve the game player planning to use epistemological beliefs that are most consistent with the game design. This approach will result in the highest chance of success in learning and succeeding in the game. For example, a game player might believe that knowledge is uncertain and complex. This would allow for multiple different approaches to a problem. Each potential solution would need to be attempted and then evaluated. In a first person shooter style of game the player's solutions are limited to shooting the opponent to solve a problem. In the real world there are many other solutions than violence but trying to create another solution in the game will result in failing until the player accepts that there is only one way to solve the problem. Often the only choice the player has is the gun he or she will use during the action.

This approach was observed in the current study as the participants exhibited a high degree of flexibility in deciding how they were going to interpret the epistemological standards for a learning task. This led to some interesting observations about how people learn in a video game environment. Contradictions seemed to appear when the same participant would describe both mature and naïve epistemologies when they discussed learning to play different types of games. They would be able to adapt to the situation presented in the game and align with epistemological assumptions that are defined within the game design.

The openness of the game designs appeared to facilitate many different epistemological standards to be in use at the same time. The flexibility of the design allowed the game players to be successful in the same game no matter which standard they chose to play the game. The best example was the Massive multiplayer online role-playing game (MMORPG) World of Warcraft. There appears to be enough flexibility in the way the game can be successfully played that the players are not restricted to a single epistemological standard. The game players appear to do this by being selective in their game play experiences and carefully choosing online companions that align with their epistemological stances. Creating a game design that can engage so many different perspectives isn't surprising. The video game industry is driven by marketability that will try to maximize the number of players who enjoy the game. In these types of open environments, this flexibility makes it possible for players to enjoy a game without completely accepting every epistemological premise of the game. The flexibility provided the most obvious observation that epistemology appeared to be reflected in game play behaviour. Several examples will be discussed in the sections that follow.

Certainty of knowledge

Most of the participants (67%) in the study were able to deal with ambiguity and still learn successfully in a video game environment. Although most participants could deal with ambiguity this was not necessarily their preference. Their willingness to deal with ambiguity and uncertainty was a reflection of the motivations they had for playing at that particular time. The uncertainty present in the video game environment was a combination of influences. These included the game design, the game AI and other players in a multiplayer environment.

Uncertainty in games doesn't mean inconsistency. A video game that does not consistently provide feedback will frustrate most videogame players. Video games have an internal consistency that is designed to provide feedback within a certain range. This consistency is described by game designers as a process of balancing. The goal is to create a system with a dynamic equilibrium (Rollins & Adams, 2003). Most games follow this design pattern.

Some game players still had a preference for certainty that became apparent in the way they described their game play. It wasn't that they would never play a game that had a degree of uncertainty but they preferred to play games that had a greater degree of predictability.

This is consistent with the idea that game play preferences are defined by personal epistemology. Even if a game is capable of supporting a more mature epistemological stance, it does not mean the player will be motivated to explore that form of game play.

This preference is also expressed in the consistency of the identities the player chooses when playing games.

Rather than exploring multiple viewpoints, they follow one single, repeatable path. This doesn't come with any negative feedback as most games are designed with the freedom to choose. A game player can undertake any game play style they wish if it meets their needs.

This approach to game design was recognized by the participants. The underlying motivation of the game company is to create the largest number of entry points for potential players. Allowing different epistemological perspectives to comfortably play the game is in their best interests.

> Getting people hooked into the game means making it really approachable, at least at first maybe, ideally always, where they can…it's the shortest transition between when you have to pick up and learn a game and when it becomes an expression of self. (Pa)

Some players were able to recognize certainty in the game and were bored by it. This seems to indicate a more mature epistemological stance towards certainty. Recognizing a more naïve perspective designed in the game makes the game less appealing.

> It's (*World of Warcraft*) not a very intellectually demanding game. Even on the website they have what they call the routines or the cycles which are what you do with a certain character, a certain build. This is roughly how you approach combat every single time so it's very monotonous, like *Diablo 2*, you'll do the same thing over and over again. (Pa)

> As I've gone along, it takes a shorter span of time for a game to lose interest. Like *World of Warcraft*, I can play

> that for like, for maybe less than an hour and then it's just like an accumulator. You get a whole bunch of items and your level increases but actually you're playing the exact same game with items that are just higher power. And you can go back and slaughter stuff but essentially you have the same interactions with monsters at every single level. (Ma)

The game design is one aspect of the overall game play experience but the game AI controls how the system reacts and adapts to the game player. Based on the feedback of the participants it appears that the game AI tends to become more predictable the longer they play the game. It seems that real uncertainty occurs when other human players become part of the game play experience.

> The AI's were good for basic things. They teach you about the upside and the downsides of different types of creatures, or units, or whatever you have, so you get to know the details of the game but how to use them in cruel and unusual ways is only ever really done by a player, that stroke of genius does not come from an AI. (Dnl)

> With other players it gets a lot more interesting because if you do something they actually change their strategy. (Ma)

When other players become involved in the game play experience they seem to actually become the game itself. The challenges other players present are far more unpredictable and adaptable than anything else described by the participants. The consequence of this is a game that will constantly provide challenges for the players. These kinds of dynamics are most visible in all multiplayer environments but seem most obvious in the large persistent worlds of Massive multiplayer online role-playing games such as World of Warcraft.

> There is one aspect of certainty that all game players accept. It is the certainty that there will always be more challenges in the game and they will be able to find them.

> The challenges in the game have been made explicit by the game designer and the game player is certain that good game design has created a game based on a system or systems that are decipherable. Unlike the real world, there is never any doubt that a game player can find something new to challenge them in their existing game or simply find a new one. Identifying and addressing meaningful challenges in the real world can often be much more difficult. An interesting observation from one participant noted: Whatever you're doing there is more to do, whatever task you complete, there is always something next and in our real-life world that's rarely as obvious and so for a lot of people, it's, they may flounder, and "this doesn't interest me." (Chr)

This is an important distinction as the virtual world is essentially an artificial construct and there is never any doubt that what the participants are experiencing is a reflection of human perspectives not necessarily a real-world experience.

Simplicity of knowledge

Simplicity of knowledge is perhaps one concept from personal epistemological belief research that does not necessarily translate well to video games. Although 78% of the participants indicated that they had a mature perspective towards epistemology this may be due to an underlying assumption behind game design. One of the basic rules behind game design is that a game is based on an underlying system or systems (Rollings & Adams, 2003). It is made up of a number of elements that interact with one another dynamically. The game makes the underlying AI or system opaque, leaving it up to the game player to try to create their own models so that they can make sense of and understand the game. Although these models may start out simplistically they continue to evolve as the underlying system is rarely simplistic. There is due to a concept in game design that dictates that dominant strategies should be avoided (Rollings & Adams).

Dominant strategies are strategies that will ensure success in the game. Such a strategy would be arrived at through a mathematical calculation of the idealized behaviour. This works in consistently predictable environments but game environments are often comprised of many different variables with constantly changing values. This creates an ongoing degree of ambiguity in terms of the correct strategy to use while learning how to play the game. So instead of creating a simple model with predictable components, a successful game player will try to understand the system in a way that will provide a greater advantage in playing the game. In a study of how game players develop mental models, Graham, Zheng, and Gonzalez(2006) found that naïve game players, who had never played a real-time strategy game before, would organize the units in the game by their visual appearance. This model didn't give the players any insight into the underlying AI or systems that controlled the units. After several days of play some of the players developed a functional model of the units based on the functional relationship of the underlying AI with other units. Most of the participants in the current study were experienced game players who had not only come to think of games as systems with numerous functional relationships, they had actually developed strategies to systematically analysis and dissect the game mechanic.

It is not surprising, therefore, that an overwhelming number of the participants (78%) expressed a mature perspective towards simplicity of knowledge in learning in video games. It is part of an implicit acceptance of the games themselves. There is no memorization of terms and no single answer to a definition. An answer to a challenge can change constantly and is affected by a number of changing variables interacting with one another.

> You just, you do it a lot and then you see the patterns or you develop the skills or you come up with the concept, a concept, to cover a common interaction. Something like that so, that's what makes something like logic interesting and something like *Nethack* interesting as opposed to any other game that's low on the skill curve. (Ma)

Given that almost all games come with an underlying system controlling them, there is a great degree of variation in the complexity of those systems and how game players use them to learn how to play the game. Some players didn't discuss their strategies for discovering this complexity as an explicit part of their approach to learning how to play the game. Others had an ambitious approach to understanding the underlying system of the video game.

> We will try, we will set up, we will stage a testing example where we can go ahead and repeatedly take a consistence amount of damage and then we will either record that damage or most likely other stuff we are looking at, like the amount of damage you are able to heal or mitigate. (Ln)

> *Warcraft 3* was a game I actually tried to study when I was working as a shorthand accountant for my family. I was budgeting their books, cleaning their office, selling their product. I worked and then I came home and I studied for *Warcraft 3*. I had the *Tao of Jeet Kune Do* by Bruce Lee. I was taking all of his combat principles about speed and dynamism and how to adapt to different situations and why and trying to apply them to the game. (Dnl)

This approach describes participants who would undertake detailed studies of the game in order to understand the parameters behind the game play. They represent the participants who were most willing to accept considerable complexity in a video game environment.

The amount of effort an individual put into this analysis was a reflection of their personal epistemology as well as their motivation for success. This kind of work would eventually pay off with much more successful strategies than the unprepared player. The approach has been described as a “scientific state of mind” towards video games (Steinkuehler & Chmiel, 2006, pg. 724). It has been observed in other game players who undertake a research study in order to understand the game system and provide themselves with a maximum advantage in the game (Steinkuehler & Chmiel).

In some cases, this understanding of the underlying dynamics was part of a strategy to exploit weaknesses that could be uncovered in the underlying game design. This allowed game players to create an unfair advantage for themselves within the game. It is also a way to create complexity in a game that they perceived as being overly simplistic.

> There are some games where it's almost interesting to find loopholes but if you're playing a game and then you sort of, you know, beat it through these loopholes two or three times what's the point of even looking for more? It doesn't become a very interesting; it's not a very interesting game after you're able to beat it in one way. (Mx)

Game genres can build expectations for a game player about the level of complexity they will experience when they are going to play a game. Real-time strategy games and simulations usually present the most complex types of games that require a considerable amount of effort in order to learn how to play them. Some of these games included complex simulation of social, political and business models.

> It would have to be *Civilization IV* because it's like you basically have to learn… it's really complex. It's based on

> realistic history, you take on a historical character someone like Napoleon and you have to rebuild an empire from scratch and you have to learn how to balance trade and diplomacy and all that. (Pa)

The participants usually took cues from the game genre and the initial levels of play in order to understand the complexity required of them. The games genres that were most likely to be complex were real-time strategy, simulation, and MMORP games. Players who have a lower level of tolerance for complex games will most likely just avoid them in the first place. Whatever motivates them to play games is not found in the considerable time depth required to master these complex games.

Although some games have developed an impressive amount of complexity, it is real human players provide the greatest degree of complexity within a game environment. Although the variation in behaviour and strategy is ultimately limited by the game design itself, another player can add a level of complexity that isn't possible in a single player game.

> Unless you have very brilliant AI programmers in the games with... I don't know what they'd have to do but, I mean after a while you just learn what the AI does and you play the game, you know what to expect from them and you... it doesn't take long to figure out. With other players it gets a lot more interesting because if you do something they actually change their strategy. (Pa)

This willingness to deal with increased complexity in a multiplayer environment is consistent with the participant's perspectives towards certainty of knowledge and multiplayer games. In that situation they also have a high tolerance for the ambiguity and chaos created by other players.

Quick learning

A large majority (89%) of the participants had a mature epistemological stance towards quick learning. Most of them acknowledged that their learning process was a long period of repeated trial and error that often took place over a considerable period of time. None of them discussed a belief that if they didn't pick up the game the first time or in very little time, they didn't believe that they would ever learn how to play it. They understood that they were on a learning curve and that they would have to put in considerable effort in order to understand how to play the game. As the participants described learning in a game:

> It's just the learning curve; it's just a pure learning curve. (Kr)

There were differences in the perceptions towards the amount of time it would take to learn how to play a game. These were again linked to the game player's perceptions of the game design and their own preferences. In explaining how video game design affected their expectations they seemed to mainly correlate the game genre with their expectations. Simple games, such as platformers would take much less time to learn.

> It depends on the game of course, how complicated it is and all that. You get some platformer games where you basically have the shoot button, the jump button and then it is just trial and error. (Ja)

Other game designs would build expectations in the participants of a much longer time period of learning in order to succeed in the game. These kinds of games were usually described as being in the real-time strategy or simulation genre.

> It depends on the game. How complicated it is and all that... Different, more complicated games, like *Civilization*

> or whatever. When I fired up *Civilization IV*, I just went through the tutorials just to understand the control scheme and then started playing at the easier levels, and working my way up. (Dnl)

Player preferences around learning time was mostly linked to the amount of free time or cognitive effort they had to spend on the games, not a lack of willingness to spend long periods of time learning how to play games. Twenty-two percent of the participants had identified themselves as dormant gamers, meaning that they simply didn't have time anymore to play video games. Most of them described how their video game play had dropped dramatically when they had entered into a post-secondary setting.

> In the more recent years the more time I'm in school, the less and less time I've had to play video games in general. (Ch)

> If I have to focus a lot on school because…then I already stress out about finance, school, and homework and time constraints. I can fit the strategy games in but I'll be even more burned out rather than relaxed at the end of them. (Pa)

The participants were willing to spend long periods of time learning how to play the game because they were always motivated to do so. There were a range of different motivations that would induce the participants to accept long learning curves in video games. Given the range of needs that are met by video games it is not possible to determine which motivation is most effective in encouraging persistent learning but a mature epistemological stance towards fixed ability allowed them to choose motivations that would prevail over long periods of learning. The relation of a mature epistemological stance has been linked to motivation in other contexts as well. Buehl & Alexander (2006) noted that the maturity of student's perspective towards integration of knowledge and the amount of effort required to learn a subject were positively correlated to a student's "goals, efficacy, and interest" (p. 36).

Given a choice, the participants would engage in extended durations of video game play in order to learn what they needed to know in a game and how they needed to apply that knowledge. Limitations in their willingness to spend large amounts of time learning how to play a game were noted. These related to the amount of free time they had and stress levels they were experiencing from other aspects in their lives. When they were not limited by these factors, the majority of the participants had a mature perspective towards quick learning.

Fixed ability

Fixed ability is one of the most interesting aspects of personal epistemology in relation to learning how to play a video game. It influences both expectations on how to learn the video game and the evaluation of the products or results from game play. In the study the majority of participants (89%) indicated a mature personal epistemological perspective. The participants discussed two relevant aspects to fixed ability that are linked to the maturity of their perspective. One aspect is the way the participants reacted to failure in a video game. Individuals with a more naïve epistemological perspective tend to believe that failure is linked to their own intelligence, which is fixed and unchangeable. Based on this belief, they will not react well to failure as they don't believe any further effort will change the outcome. They tend to perform less and less effectively before they finally quit due to their perceived lack of ability (Dweck & Legget, 1988). Individuals with a more mature epistemological stance viewed failure as a learning experience and would persist in a challenge despite failure.

The other aspect is how individuals evaluated rewards from learning. Those individuals with a naïve epistemological perspective towards fixed ability tend to focus on performance goals that are evaluated by external sources. They believed that they were successful when they had achieved something that would be validated by others. In a formal educational setting this would be an instructor, in the video game environment it would usually be their peers. A mature epistemological perspective tended to be motivated by intrinsic rewards that were defined by the individual themselves.

The majority of the participants indicated a mature epistemological stance towards fixed ability. This was mostly based on their perspectives towards failure as they were all very tolerant of failure. They saw learning how to play as game as mostly trial and error. Based on this belief they could eventually overcome any challenge in the game. Often they would undertake a research-like approach to learning. As noted in the discussion on simplicity of knowledge, the participants would engage in lengthy projects to research the parameters of the video game. An example would be the participants who set up experiments in World or Warcraft in order to discover the underlying mechanics of the game. Similar behaviours were noted in schoolchildren and adults who had a mature perspective towards fixed ability. They would tend to see unsolved problems as challenges that could be overcome with effort. They would engage in hypothesis testing strategies and monitor the results (Dweck & Legget, 1988). This likely speaks to at least one overlapping influence of the personal epistemology components of fixed ability and simplicity of knowledge.

Understanding their motivation to learn how to play creates a complication to understanding the participant's epistemological stance on fixed ability. In earlier research on fixed ability it was observed that those who thought that their intelligence was fixed were often concerned with extrinsic goals. These would include performance goals, such as the favourable judgment of their competence from others (Dweck & Legget 1988). There appears to be validation to this kind of behaviour in video game research that focuses on understanding the personality and motivations behind video game play. Extrinsic motivation seems to align with Bartle's (1996) description of the video game player personality "Achievers". A similar personality was discovered in video game players by Yee (2002). Yee's group has a perspective to their game playing personality that is primarily motivated by high scores and gaining prestige within the game. In performance-based learners in school, these kinds of learners are seeking approval from their teacher as a reward for their performance. Another consequence of having a focus on performance-based results is a learner that will actively avoid situations where they cannot easily do well (Dweck, 2006). It may be that tolerance towards failure is not the best measure of epistemological maturity in video games as those players who are extrinsically motivated may actually be choosing the types of games where they know they won't fail. This would be seen in their preference for games.

> It's beating my highest score and beating other people's high score. For me, it's the competitive side, I've always been very, very competitive be it downhill skiing, be it karate, be it video games I don't like to lose, I like to win. That's definitely what keeps me going with those is I want to beat someone. (Kr)

The voluntary nature of video game play means the participants always have the option to limit the games they played although the reason for the preference was not always obvious.

Those players who were intrinsically motivated to play video games defined a rewarding gaming experience themselves. Intrinsically motivated learners decide on the criterion for success and they are the only ones who can judge their performance (Dweck & Legget, 1988). This group is similar to the game playing personality called "Explorers" (Yee, 2002). This group is mostly motivated by intrinsic factors such as curiosity and learning. Futher discussion about the nature of intrinsically motivated players is contained in the motivation section of the analysis.

It becomes difficult to really gauge if fixed ability, as understood in the personal epistemology literature, is a good assessment of the sophistication of game players' beliefs. This study focused on the traditional definitions and based on that, the feedback from the participants seems to indicate a mature epistemological stance. It seems that there is also an underlying issue that can be drawn from the participant's statements about their choice of video games and how they viewed success in that game. Fixed ability appears to be a much more complicated construct that is influenced by a number of different factors. This includes time constraints, which may influence the participant's willingness to continue playing a video game rather than an immature perspective towards failure. There are also differences in how the participants perceived rewards for their tolerance of failure. Although both intrinsically and extrinsically motivated game players both need to be able to tolerate failure, it seems that extrinsically motivated players are also very good at only choosing games where they can predominantly succeed.

Source of knowledge

The maturation of source of knowledge in personal epistemology denotes a transition from an individual looking to an authoritative, external source of information to an understanding that knowledge is internally created and understood by the individual. In an educational setting this denotes a shift from an instructivist perspective, where a teacher or authority figure transmits an objective view of the world to the student, to a constructivist perspective of the world where an instructor provides the material and facilitates the student making their own meaning. As the student matures, they look to themselves as the source of knowledge.

The participants in the study discussed both perspectives in their approach to learning. Most of the participants (67%) had a mature perspective and saw themselves as the source of knowledge when it came to learning how to play video games. There were certainly aids to learning in the form of tutorials and manuals that came with the game but they recognized they were autonomous learners that needed to identify learning tasks and create plans to address those tasks. Many games did not enforce any specific course of action and it was the responsibility of the player to build their own approach.

> Once you get thrown out on your own it's up to you where you want to go. They won't force you to go anywhere so you have to be able to keep track of the plot to know where you're supposed to go next or what's going to advance the storyline and it isn't very often that they are going to push you directly into that. (Pa)

There were also participants who looked externally for an authoritative figure who could tell them what to do in the game. The participants identified two motivations for seeking answers from an external authority. They either considered themselves too lazy and unmotivated to learn it themselves or they had time constraints on the amount of time they had for learning so they sought to shortcut the process in order to learn how to play the game.

> I am very lazy person so I like to...I'm willing to help but I'm generally far more willing to go to the assessments and go from the shopping list they have. (Cha)

Those participants who saw themselves as the source of knowledge were often the same group who believed that learning could be a long and complicated process. They were able to maintain long hours of game play and they had expectations that they would be able to build their own knowledge of the game in that time. Their motivation for this could be intrinsic or extrinsic but both motivations seemed linked to a positive sense of image about their game playing ability. Although the participants viewed themselves as the source of their own knowledge they would seek outside assistance when they had reached a difficult challenge in a game that they were unable to solve. They would usually stop playing or begin to look for answers elsewhere. Some players would go online and look for solutions that had been created by other players. Depending on the complexity of the game, they would either use an identical solution or modify it to their own context and try to duplicate the success. MMORP games were one example where a successful solution could be viewed from another player, either as a video or a written description. Due to the large variety of character types they could not use an identical solution but would instead have to adapt it to their own character.

> There are lots of people who will do videos and they will talk to you through the video, explaining that you need to go over here and then this person needs to do this, this person needs to watch out for this. They will explain in

> great detail but even watching that, then comes the trick of translating that into your skill set, translating it into the game, translating that into a real-time encounter where you have so many more demands on your time and there's big flashy lights and you can't see what it is you're supposed to watching out for because there is a dragon in the way. It just really escalates in terms of how much they're asking you to be able to process. (Ch)

A commonly described failure point was when the participants began playing against other human players. Most of them were able to successfully learn the parameters of a game AI and successfully exploit it but weren't able to deal with the complexity and uncertainty of dealing with other players. This was another common point where the participants began to go to external sources to look for a solution.

> You can beat the AI and that's completely not there in Player versus Player (PVP). The first time I went into a PVP city, it's like… dead….. dead, dead, dead. And there's nothing you can do, you just have to learn the tricks and how to stay alive. (Dnl)

> I stopped playing PVP (Player versus Player) for a long time until my buddy who came in after me was much better than me. He started doing PVP and so I let him at it for a month or so and then I called them and said "do you want to show me how to do this? "And then he came in and showed me his strategies. It was way complicated so I didn't do it very often but it made it a lot easier to have someone show me. (Dnl)

Those game players who took shortcuts due to time constraints believed that they would eventually find a solution but they didn't have the time or patience to come to it on their own. They sought shortcuts because their main motivations weren't in solving those particular challenges in the game. Their objective was often beyond that challenge. In one case the narrative was what mattered to the player, not necessarily all of the challenges in the game.

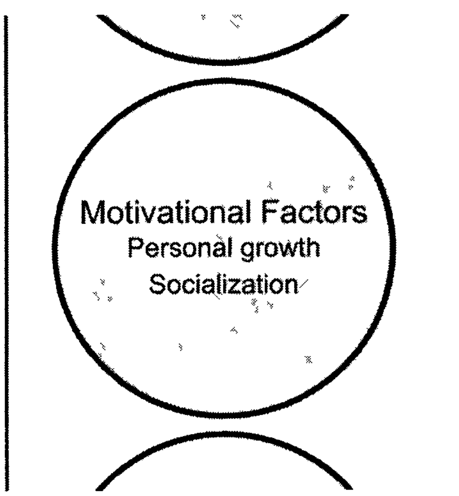
> Fighting just to level... when I play games on my computer I will usually look for cheats just to quickly gain levels because I don't see how it's any different than mindlessly fighting the same thing over and over again. Whereas cheating to get myself five more levels so I can get on with the story. (Da)

Most game players seemed to see themselves as the ultimate solution to any problem. They had developed this perspective from years of video game play where they had successfully completed challenging games. They seem to have a sense of pride over their ability to deal with complex and challenging games. These participants seemed to exhibit a mature epistemological stance towards source of knowledge. Despite this there were still instances when some game players didn't believe that they could solve the problem and saw an external source as an easy solution. The description of their reaction to failure seems to indicate that they did not believe that they could ever overcome the problem on their own. At this point their personal strategy had no alternatives but to look for outside solutions. These participants seemed to be the closest to the description of a naïve epistemological stance related to the source of knowledge.

Summary of Personal Epistemology

Most of the participants exhibited a mature epistemological stance towards knowledge and knowing in a video game context. Their willingness to engage in ambiguous and complex environments was typical. Most of the participants seemed comfortable with the underlying systems used in video games although the degree of complexity they were willing to address varied considerably. The participant's perspectives towards failure were mostly mature although their willingness to address all failure seems to be linked to what type of reward they were seeking. Those motivated by intrinsic rewards were willing to engage in many different types of failures as long as the experiences represented learning or growth. Those motivated by extrinsic rewards seemed most interested in choosing experiences that would minimize their failure and maximize their achievements. Most of the participants had a mature perspective towards source of knowledge. Some would look to outside sources of authority when they didn't feel motivated to find a solution themselves or didn't have the time available to address challenges themselves. Overall, the construct of personal epistemological beliefs was able to describe much of the learning activity that occurred during learning in video games. There were limitations to the construct but it was originally developed to describe learning in a formal academic setting so it can be expected that there would be differences.

6.2.1.4 Motivational factors



ions:

Understanding the motivation the participants had for learning how to play games related directly to how they would create tasks to undertake that learning as well as how they would evaluate the products of those tasks once they were enacted. Their perspectives about motivation had a large impact in their choice of epistemological stance as well as the emphasis given to epistemological standards when identifying learning tasks. Personal growth and socialization were two motivations for learning identified in the study (see Figure 11). Affect was related to motivation but it is being dealt with as a separate item due to the complexity of affect and motivation.

Personal growth

Personal Growth was a motivation for game play in about half of the participants (56%). Only 22% recognized that dissonance as a possible source of personal growth in video games. The motivation for personal growth and intellectual stimulation seemed most apparent when the participants discussed their time outside of a formal educational environment.

> I'd go to work and I wouldn't use my brain at all I would come home I'd really put it to work playing games. (Pa)

The idea that games promote personal growth has been one of the most discussed topics when the proponents of video games list the positive aspects of video game play. Investigating these perspectives was one of the major impetuses for initiating the current study so this topic was of particular interest.

The participants in the study identified video games as a chance to engage in challenges they couldn't find in their regular life. It is not simple escapism as the individual is looking for a type of intellectual challenge that they are not getting in their own life. One participant described one of their friends:

> He worked as a security guard and while he did get to meet people and chat with people and have a public interaction his job asked nothing of him intellectually and yet he was one of the most number-crunchingest guys I've met who

> would doggedly pursue whatever problem he was working at. I mean I've got several friends who really are excellent players and they really research stuff and they really crunch the numbers and they don't apply that same sort tenacity to their work and/or schooling. (Chr)

The participants saw video games as an outlet that would encourage their curiosity and allow them the opportunity to explore. The time the spent in the game world became an extension of their identity that wasn't being satisfied in the real world.

> There are lots of things, lots of reasons why people exercise their imagination, why we fantasize and sometimes we just create that artistic outlet and I could definitely see a virtual world that I could build especially if I can become fluent in it. Again, an extension-of-self kind of expression. (Pa)

There have been similar descriptions of this type of motivation from research on game design that has attempted to identify player type as a way of understanding player behaviour inside of a video game environment. One of the original works by Bartle (1996) defined player types in Multi-User Dungeons (MUDs). One of the four player types identified was "Explorers" who were intrinsically motivated by curiosity, learning and role play. Yee (2002) noted a similar factor in his analysis of player personality which he identified as the "discovery" factor. This group was driven to explore the game environment and understand the game mechanics. Jeng and Teng (2008) described this personality type as "openness" (p. 1057) and related it to the underlying personality traits of curiosity and motivations to explore the game environment.

There were also examples of this type of motivation from other learning contexts. Something similar has been described by Beswick (2007) where learners felt rewarded for carrying out a learning activity rather than the learning products from the activity.

Individuals in this study tended to pay more attention to complexities and inconsistencies within an environment. They also required time and freedom to explore, gather information, and come to an understanding of an integrated whole of that information. These individuals also tend to be more curious and will seek out and spend more time in uncertain situations (Beswick, 2007). A similar concept occurs in Csíkszentmihályi's (1990) description of flow. He called the construct an autotelic personality. These individuals have a greater preference for "high-action-opportunity, high-skills situations that stimulate them and encourage growth"(p. 117) than those without an autotelic personality. An autotelic activity is one that people will engage in for its own sake because the experience is the main goal, not any perceived destination (Csíkszentmihályi, 1990).

The individuals who undertake personal growth as a central motivation to their game play seems to be the most likely candidates for increasing the sophistication of their epistemological beliefs. It has been proposed that motivation and epistemic beliefs are linked if the motivation is acquiring new knowledge (Muis, 2007). The participants would often use the terms intellectual stimulation or growth when describing their motivation for playing video games rather than any terminology familiar to personal epistemological research. This was likely due to a lack of epistemic metacognition that would have provided them with the vocabulary to describe their perspective in any other way.

Some of the participants were able to identify some games that had a high level of complexity and subtext. These were the kinds of games they felt challenged them most at an intellectual level. Most of the games mentioned were older games from the late 1990s and most of the companies they mentioned are no longer in operation. One of the more interesting examples was a game called Xeno Saga.

> Narrative wise, a series called the *Xeno Saga*. The first one was *Xeno Gears* and then they had *Xeno Saga 1, 2,* and *3*. Each one had a German subtitle because they were based on the works of Friedrich Nietzsche. So if you are well versed in Nietzsche you would have thousands and thousands of metaphors from this guy's writing built all the way through the game. Characters whose names translated to Nietzschian concepts, the title of the second game was *Der Wille zur Macht* which was I think *Will to power* and that was a book written by Nietzsche. (Da)

There were two limiting factors in the ability of games to address their need for personal growth. One was an awareness of how stress and time constraints limited their ability to engage in challenging games.

> I actually like probably strategy games the most out of everything, just that doing the strategy and keeping your mind active on all the different possibilities. If it's a micromanagement-intense game and stuff like that can be very taxing on the brain. It's not necessarily a good complement to a school or a student lifestyle, so they aren't the types of games I play most often but I do find them the most engaging. (Pa)

> I already stress out about finance, school and homework and time constraints. I can fit the strategy games in but I'll be even more burned out rather than relaxed at the end of them. (Pa)

> And then some of them are those that I just play to kill time. Fun ones like a lot of the platformers. I've got a couple of hours to kill, now and then, I just feel like running around and shooting some stuff without having to worry about any kind of complicated strategy or that. (Ja)

The other factor noted in the participants was an increasing awareness that video games were providing fewer opportunities to fulfill that drive for personal growth. As they matured and began looking for more opportunities for personal growth they were also becoming more discriminating. Some were finding the opportunities they sought in a post-secondary environment but they were also looking for opportunities for growth in video games. This seemed to be motivated by a need for a continued involvement in video games, an interactive experience they had known for most of their lifetime.

> Like when you first start the game, they really put some effort into having a good atmosphere and everything but as it sort of progressed I almost lost interest because it's a really good game but if you look at the storyline in productions of movies, I mean *Bioshock* is a B-grade movie. It's interesting but it's kind of clichéd in some parts and you know not as gripping as you could certainly make games if... while I do not know what they have to do but, you know, it seems like there's a lot of potential there that's, I don't know. (Ma)

Some of the participants were starting to recognize the limited range of perspectives that were present in many of the video games they played. This realization also became apparent when they described the increasing predictability and boredom they were feeling when they were playing video games.

> I think that society as a whole has a very narrow perspective on what's important. I mean even advertising appeals to the same basic things. I was in a class for media studies 5,6, 8, 10 years ago it said the two primary motivators for advertising are the two strongest motivators for human beings and that is sex and fear... so it was sort of the same idea you have these games with a narrow view of things it is largely because, in a lot of ways it reflects cultural trends which is part of where the narrative comes into play because then you don't have to build something

> like that or completely design a different culture because you already have elements that the player can engage and relate with straight off. Now there are plenty of other ways to build such models for worlds but in Blizzard's case they already had *Diablo 2* and they realize that became the major motif for the game, get higher levels, get better items, have a tougher character and that worked very well for them so they had to do it again but in a larger scale.(Da)

> As I've gone along, it takes a shorter span of time for a game to lose interest. Like *World of Warcraft*, I can play that for like, for maybe less than an hour and then it's just like an accumulator. You get a whole bunch of items and your level increases but actually you're playing the exact same game with items that are just higher power. And you can go back and slaughter stuff but essentially you have the same interactions with monsters at every single level. (Ma)

In these cases the participants were well on their way to outgrowing games. They had not encountered a video game experience that met their need for growth. They might continue to play games but usually only as socialization activities.

> My friends still play video games and when I play video games with them it just bores me. (Pa)

> Definitely, for entertainment value if I want to play with a friend or something yeah it's fun but if you're interested in intellectual sort of, yeah you get nothing out of them after 10 minutes or so, yet pretty bad. (Ma)

> I don't know though I find myself playing less and less videogames in university. It's like… in high school I used to play video games all the time… as I come to university, I've got homework, I have girlfriends and I don't really have time. But I also don't miss them. (Da)

The players moved away from video games reluctantly. It did not seem to be an issue of nostalgia for losing an experience that had been part of their childhood and adolescence. They believed that games had the potential to grow with them. They identified the video game industry itself as the problem behind the dwindling number of games they considered to be intellectually stimulating.

> I think definitely they (the game industry) have lost their way because you know there's stuff that sells and I don't know how... also the people you've talked to are from the university right? I don't know what kind of tastes the average gamer has, maybe they're okay with a dazzling graphics, maybe with the dazzling graphics everyone is stuck with it without really wanting it but a) it's a crappy thing with graphics like this or crappy thing with graphics like that then you'll buy the one with better graphics right? They're both so crappy that it almost doesn't matter and that pushes, I don't know what pushes graphics in games but I don't like them. (Ma)

The awareness that the participants had about the limitations of video games to facilitate growth seems to indicate that as personal motivation becomes more focused on personal growth, video games seem less likely to be part of that participant's life. Most of the participants believed that games had the potential to facilitate growth; most of them mentioned intellectually challenging games that had existed in the late 1990s or early millennium. Although they didn't know exactly why current games were becoming more simplistic, some of them recognized that as university students, they might not necessarily be the demographic target for video game companies. Although it may be that video game players who are looking for personal growth experiences do not represent a large market share, there is recognition from the video game industry itself that game design has become increasingly predictable and boring. This perspective hasn't been lost in popular culture either. Games are being described a ghettoized form of media, one that is being taken less and less seriously as a medium for exploring meaningful topics (Fagone, 2008). The participants in the study echoed that sentiment.

Socialization

Socialization is a motivation for many video game players to learn how to play a video game. Less than half (44%) of the participants in this study indicated that socialization was their motivation to play games. Much like other motivations to play games, their preferences seem to be defined by the mood of the player. There was a similar impact noted when the participants discussed when choosing a game genre.

> I usually play with other players I meet through the game so it depends on the mood. Sometimes I'm playing on my own, it's out of preference. (Ch)

> I like the social aspect of it, the fact that it is a diversion, it is a diversion that has the opportunity to take up a lot of your time but it also is fun. (Chr)

The participants who did talk about socialization could be organized into more fine-grained categories. Yee (2006) had identified a number of motivational categories in online game players. There was a social component could be broken down into three categories: socializing, relationship, and teamwork. The participants in the study discussed all of these elements as their motivators to learn how to play games. Some of the participants described this motivation as related to coping with boredom while in the company of friends.

> It's like a fun pastime with friends and you're all bored and you're at somebody's house and you say well…(Da)

This seems to relate to the socializing component identified by Yee (2006). This component is comprised of game players who are most interested in chatting with other game players and making friends.

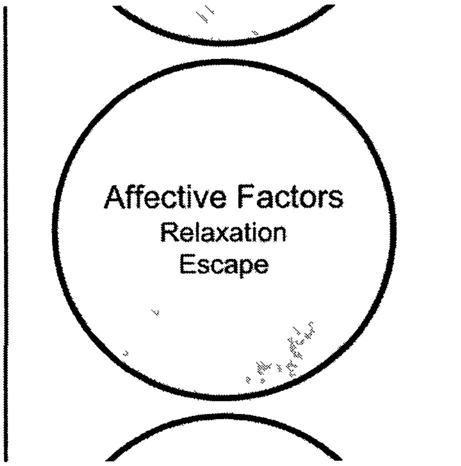
Most of the participants who described socialization described their desire to become part of a group in order to gain a sense of belonging or affiliation.

> There is always the best items are being spammed in trade channels and stuff like that so you're driven to desire that stuff as what is considered socially acceptable in that world and then when you get it you feel a sense of belonging and ubiquity but I do think that that larger trend takes place in games where if that happens to be a primary motivator for game players 18-24 well now you're going to have this issue that that's going to be the primary motivator in a lot of these games. (Dnl)

There was a teamwork component identified by Yee (2006) that seems to describe this motivation. These game players were interested in being part of a collaborative group and share in the accomplishments of the group. The majority of participants who discussed this as a motivation for learning how to learn how to play video games were attracted to multiplayer games. This includes MMORP games such as World of Warcraft.

Another aspect of socialization has been reported in the literature. This motivation was focused on developing personal relationships within the game environment. Yee (2006) described the relationship component of his model by game players who were motivated by a desire to create long-term and meaningful relationships with others. This has also been reported in the gaming community literature. As Alexander (2011) commented, “Sharing a love of a game is one perspective on a creating a foundation to build close relationships with other people” (p. 18)

6.2.1.5 Affective factors



ıs:

Motivation, based on affect, is one of the most influential factors in planning and evaluating video game play (see Figure 12). Most of the study participants (56%) indicated that affect had an influence on the way they learning how to play a video game. Gaming is considered a highly emotional activity and most game designers recognize, at least intuitively, that they need to appeal to the players at an emotional level. The effect of emotional engagement in a game can be profound. One participant, who was suffering from Attention Deficit Hyperactivity Disorder (ADHD), was able to engage in focused learning without the need for drugs.

> If something catches my focus, I'm all over it and I don't want to give it up. If it's other stuff… it's well… and personally I'm on Adderall, and I take it for work and for school, I don't need it for playing the game. (Chr)

Often the emotions experienced by the game player aren't complex, they may just be exhilaration and frustration, but they do affect the player (Rolling & Adams, 2003). The participants who were able to discuss their emotions recognized this as a large part of the reason that games attracted and retained players.

> Games like first person shooters happens with the "fight or flight" response, it happens based largely on fear. Right? You put yourself in that person's shoes and you're afraid of

> getting shot, so you get really locked in, you get fast twitch responses and stuff like that, you get nervous, stress levels go up, maybe your heart rate goes up. That's how it hooks people. (Pa)

> There's a particular moment but it gives me a sense of accomplishment, it lets me go beyond what I'm capable of…it's a real boost of self-esteem I guess, real satisfaction. (Ch)

Slower paced games, such as adventure games, have more time to create a mood for the player and a more complex set of emotional characters.

> There are other ways of doing it that involve building emotional attachments to characters like they do with role-playing games. In *Final Fantasy VII* they had a character that was like a healer for the party that everyone loves and a third of the way through, boom!, she got killed and that was the end of her there is no bringing her back. And everyone was like, "Oh my God." But it was one of those instances again where you knew people had gotten so into that game when they lost their character that actually made them feel really bad. (Pa)

> Some it's the environment and the mood and stuff like that. Like the *Silent Hill* games. It's great getting a bunch of people together even to watch someone go through, have all the lights off and the surround system on. Those ones are fun for the environment. (Ja)

Affect may be one of the strongest areas used in defining the task when the game player begins to plan out how to play a game. It will define the type of game played and how it is played. Emotional fulfillment was often used to indicate that a task has been successfully completed.

Not all games had an inherent affective component. Participants recognized that some games could be considered to be very logical and intellectual with few emotional components. Puzzle games are an example where the main reward is a sense of accomplishment. Many other games were much more focused on creating a certain emotional state.

> You'll find puzzle games that try to intellectually motivate people but a lot of games I actually think function in some form of emotivism, even if it's just a subconscious relation to the environment that you're in. A social contract or whatever that inspires a certain desire to do whatever is expected in that kind of position. (Pa)

The use of emotivism to describe games is an interesting perspective. It describes a tradition that believed that human actions and moral judgments are expressions of underlying emotion rather than logic (Stocker & Hegeman, 1996). This level of awareness was not typical in the participants but some of them did articulate that emotions during game play did affect their actions in that video game.

Positive affect is considered a strong motivational factor in persisting to try to learn in a difficult game challenge. This relates to the amount of positive emotion experienced by the player during game play. The game player tends to feel positive affect towards the game play experience as long as the gaming stays fun. If the game becomes more work than fun the game play usually stops. As one participant put it:

> With the single player games the accountability for your learning is basically to the point where learning becomes much more work and it is no longer fun to play the game. (Ja)

Affect complicates any observations of learning in a game environment. Unlike many studies about learning that focus on cold cognition, gaming is a very emotional context for learning and decision-making. This emotional state means that a learner may not choose the most appropriate beliefs in planning out their strategy. This includes their epistemological standards. The affective standards chosen and the kinds of emotions sought by the player influences which game is chosen and how the player decides to play it.

The impact of affect significantly modifies the way a game player plans to learn and how they undertake learning, more so than personal epistemology. The participants would impart meaning on the game experience that would depend on their emotional needs. Their emotion or mood would affect their choice of personal epistemological stance rather than personal epistemology exclusively influencing the choice of planning of how to learn.

Relaxation and Escape

Positive affect is just one of the motivations for game players. Relaxation, or coping with stress, was also a motivation for learning how to play a game in 44% of the participants. This motivation was interesting as the amount of stress a player was willing to endure to learn how to play a game could be quite low. The players weren't necessarily looking for a positive emotional as they may be looking for an escape from negative emotional state they were experiencing in their real lives. This is consistent with the current research on video game addiction. In a study of youth addicted to online video games it was found that escape from negative affect resulted in compulsive online play. The game playing was similar to that observed in video game addicts who were suffering from depression (Wan & Chiou, 2006). It wasn't possible to differentiate any signs of depression in the participants in relation to their game play motivation but it is an important consideration.

This kind of game play behaviour was identified as a factor called escapism (Yee 2006). The player motivation was defined by a need to relax or escape from real life. The participants in the study were well aware that games provided them with a way to get away.

> So, to read a book, play a video game is to escape. (Ch)

The escape seems to be almost completely related to stress reduction. Given the nature of the motivation, the participants who described this motivation seemed unlikely to tolerate the negative feelings and stress associated with dissonance with their personal epistemology. One participant did not specifically talk about using games for relaxation as much as knowing when to avoid certain types of games that they had identified as having stressful components.

> Having competitive games, especially where it's you against the other person…means constantly adapting to new changes which means a certain amount of stress with occasional peaks when you screw up…that doesn't do well for me if I have to focus a lot on school because I already stress out. (Pa)

Their escape didn't always influence their choice of game but it did affect the way that they played. They might engage in a game that has potential to be very challenging, they would just play them in such a way that they didn't create any additional stress to their lives. One participant describing their game play after a long day:

> I still play *World of Warcraft*, I tend to budget it for an hour or two a night when everything else is done. That's sort of my brain lazy time, my off time when I do whatever feels good. (Pa)

Similar perspectives have been noted in discussions in gaming culture literature. Many game players view video games as a temporary respite from the real world.

> The real world can sometimes be a disappointing or difficult place for people who think the way we do. I get heart wrenching letters from readers about the things gaming has meant to them – they describe a way to cope with stress, a place where they feel like they belong, a lifeline through hard times, or simply a way to ignore the mundane for a short while. (Alexander 2011, p. 18)

Stress caused by dissonance is a component in epistemological growth that has been recognized in the literature. However, individuals faced with stress do not always adapt to it and grow. When the participants are faced with unavoidable stress from many other parts of their lives, such as school or work, they do not seem to be motivated to voluntarily engage in any additional stress in video games. At this point, the ability of video games to provide the dissonance that might provide personal epistemological growth seems limited as the game player have little tolerance for the additional stress.

6.2.1.6 Enactment and Evaluation

Feedback from Artificial Intelligence

Video game players need feedback from the tactics and strategies they put into action in the game. The enactment of these tactics is based on the planning stage during learning and they are observable as the game play behaviours they perform in the video game. This is the point when they can assess their approach to learning how to play the game with the consequences of their actions in the game. If they have created strategies that were correct, they will be successful in their goal of learning how to play the game. If not, they will need to evaluate their failure and think about generating a new plan.

In many video games, there is external feedback provided to the game player that evaluates the plans to learn to play a video game. The game AI is one of those external feedback components. The AI is an extension of the game design as it follows with the overall construct put together by the game designer. In this way, the AI is a programmatic extension of the game designer's epistemology rather than an independent, learning entity. Most of the participants indicated that they could quickly learn the parameters of the decision-making ability of a game AI as learning the parameters of the AI was the first step towards becoming successful in the game.

This seems to indicate that game AI does not have a significant impact on challenging a player's personal epistemology when it relates to certainty of knowledge. Even with a degree of randomness, a game AI is simply too predictable. Their ability to manage and coordinate complex systems within the game does assist in the participants seeing knowledge as a complex system rather than simple, unconnected piece. This would help to facilitate a more mature epistemological stance towards simplicity of knowledge but most participants didn't believe that game AI had much else to offer.

> I mean after a while you just learn what the AI does and you play the game, you know what to expect from them and you… it doesn't take long to figure out. (Ma)

Some players focused a great deal of their effort towards deciphering the underlying rules and systems of the AI. A similar phenomena was noted by Yee (2006) who called the group "mechanics". This group was motivated by their interest to analyze the underlying system of a game. Some of the participants did have a similar motivation. They would approach the game as a functional system that could be analyzed, delineated, and eventually predicted.

This was the most intensive strategy observed among the participants for understanding the underlying complexity of a video game. They were motivated by the goal of dominating the game. It would also allow them to subvert that game and take advantage of the AI in order to gain an unfair advantage in the game. As noted above, this has also been termed "gaming the system."

Although most video games are based on complex systems that are coordinated by an AI, there seems to be a range of sophistication behind those systems. Most of the participants were very comfortable with viewing knowledge as complex and interrelated but they seemed to feel that the knowledge was ultimately knowable and certain. The reason behind this seems to be the simplicity of most game AI. At the moment the AI only acts as a tool to understand and enforce the parameters of game rules. It cannot really learn and adapt. Most participants had enough experience playing video games that they were able to learn the parameters of the game systems and AI and begin to predict how those systems would react to their game play. The impetus to understand the system was usually motivated by the player's desire to increase his or her success in the game. This represents another contradiction for understanding the role of AI in personal epistemological growth. Initially these systems require the player to adopt a mature epistemological stance towards certainty of knowledge and simplicity of knowledge. This stance does not seem to last as the AI is not able to adapt to the player and continue to present an uncertain and complex environment. Someday there might be a more robust AI constructed that will be able to adapt to video game player. This will happen when an AI is able to handle the level of complexity and unpredictability that is demonstrated by human players.

Feedback from other players

The participants in the study were almost unanimous in their perspective that other human players provided the most significant challenge to learning in a video game environment. Unlike the game AI, other video game players were most likely to create the complex and uncertain environment that would challenge the participant's personal epistemological standards around certainty and simplicity. They did this through unpredictable and constantly adapting their tactics in the game.

Some of the participants described this constantly changing environment where one successful strategy would be adopted by other players and then a new strategy would have to evolve. The community of players is constantly evolving their strategy within the game.

> They (game players) test the constraints of the system and do things themselves that the programmers didn't think to do or that are now possible to because of changes in the game that come after that. Player strategies tend to change it's more like culture trends where when you see that this becomes the predominant strategy you prepare for it and then you will get a few outliers who find a way to get around it and it's like an extended rock paper scissors. You play long enough you'll actually watch it cycle. (Pa)

Other players usually communicated feedback to the participants either implicitly through game play or explicitly through verbal feedback. Verbal feedback could be in either an online environment in the game or outside of the game.

> The best way to learn that game for me is to compete against another person. So if someone says hey, I'm doing a terrible job in this role I'll ask them,
>
> "Okay, what would you have done better?"

> "Use these and these skills instead of that one and you avoid using this one in the situations, and you help this guy take less damage."
>
> "Oh, I never thought of that."
>
> (Pa)

Feedback from players was not necessarily all based in adversarial conditions. In multiplayer games, where cooperation was the goal to succeeding there was considerable facilitation of learning occurring. Social interaction is seen as an important component is resolving the dissonance experienced during epistemic doubt when you question your own beliefs and their ability to help you succeed (Bendixen, 2002,). Positive feedback from peers in a cooperative context is also an important component in successfully learning from others.

> Other people can actually, strangely enough, challenge me to move through that by offering potential solutions. I still have to take their advice and apply it and see if it works but if they're there to offer it I can take it. I can cut a huge swath of time trying to figure out to taking a strategy that either does or does not work. (Pa)

Most of the participants believed that a multiplayer environment was going to always be uncertain and complex. The adaptability and creativity of other players meant that they needed to always have a mature epistemological stance about the certainty of knowledge and simplicity of knowledge.

Feedback from self

Metacognition is part of the ongoing evaluation of learning that the participants used while learning how to play a video game. Metacognition refers to metacognitive knowledge as well as metacognitive skills. Metacognitive knowledge is awareness of an individual's own strengths and weaknesses in how he or she learns (Bromme et al., 2010). Using this knowledge, game players were able to identify learning tasks at which they were both strong and weak when learning how to play a game. The participants did have a good level of awareness of their strengths on learning how to play a game. They were also conscious of how their own motivation levels influenced their approach.

> I am very lazy person so I like to...I'm willing to help but I'm generally far more willing to go to the assessments and go from the shopping list they have. (Cha)

> I suppose that depends how you learn, but for me I find it is better if I can get the most immediate feedback. Reflection doesn't work so well on me this is not always... they say hindsight is 20/20 but it really depends on how clear the decision process is. If it's not clear, reflection doesn't necessarily help it doesn't necessarily clarify anything but getting the instant feedback from other players who may have been in similar situations can get to work a lot faster. (Dnl)

All of the participants discussed some form of metacognitive skills during learning, at the very least in terms of monitoring the success of their learning. Metacognitive skills are the ability to not only have self-knowledge but understand how to use that to actively regulate cognition (Bromme et al., 2010). All participants were able to monitor their progress in learning. The nature of video game play required the participants to constantly monitor their success in the game. Their level of consciousness in discussing the process varied. Some claimed that they did not really think about it. Some of the players recognized an awareness of their approaches to learning, most saw it as an intuitive experience that didn't require much conscious thought or reflection. As these participants noted:

> It's hard to describe how I learned it (to play a video game). (Ch)

> Games are sort of, you almost can't tell you are progressing up the incline. (Ma)

These comments may be related to the way that the game player identified his or her goals when he or she begins to play a game. They may have identified an emotional state they wanted to achieve or status that they wanted to gain with their peers. They may not have been consciously thinking about the knowledge they needed to construct in order to play the game. It may seem more obvious in an academic setting. In that context metacognitive skills are used during learning to monitor a student's success and these skills are influenced by the student's epistemic stance (Muis & Franco, 2010). An academic context is more likely to focus a student's awareness on his or her perspectives towards knowledge. This can help a student become aware of how his or her personal epistemology plays a role in learning. Video games have many different domains where a video game player can focus their attention. Focusing a player's awareness of his or her personal epistemology is not guaranteed.

Much like in any learning context, the participants would need to adapt their strategies if they failed to learn how to play the video game. Their definition of failure is going to be extremely variable as well. If their motivation was relaxation or escape then failure is going to be focused on stress reduction. Their choice of standards would be more in the affective domain and they would use their metacognitive skills to monitor affective standards, not epistemological ones. If their affective goals were not being met, they would most likely stop playing the game and rationalize it as a preference, related to mood or a reaction to bad game design. Again, conscious or not, the underlying motivation affected the strategy for the monitoring of the learning products.

The participants who seemed most aware of their epistemological stance were those motivated by personal growth. They did not see other opportunities in their life to engage in challenges and looked to meet those challenges in a video game.

> I see that in your life you are not living up to your intellectual capabilities but in… it's something that I've seen in, and I would say to be quite honest, it is true of myself that I will much more gleefully completely dive into a research project and I will doggedly pursue it in ways that I would never be tempted to put as much effort into for work. (Chr)

The participants would use epistemological standards to actively regulate their approach to a game. When asked about how their motivation towards growth affected their evolving preferences towards video games, a typical response would be:

> Now it's more strategy games because, I don't know, the intellectual stimulation of it. (Da)

Their actual discussion of personal epistemology was limited by their vocabulary and understanding of the philosophical concepts behind epistemology. They would discuss the contexts they believed would facilitate growth. These were usually described as more complex games, such as real-time strategy, simulation, and multiplayer worlds. The recognized these games as more challenging to themselves but they didn't articulate the epistemological nature of that challenge.

Their justification for knowing came from their actions rather than discourse and presentation of evidence to support their argument. This provides a gap in awareness as they don't have to reflect on their actions and present a convincing summary of their approach. They can just demonstrate their argument through successful action alone. Although this doesn't represent a complete metacognitive knowledge of the participant's epistemological stance, it is an understanding of the kinds of approaches they took towards learning.

6.2.3 Analytic Category 3: Transfer

Transfer of personal epistemological beliefs from video games to other contexts

The majority of participants (67%) acknowledged that knowledge developed during video game play could transfer to other video game contexts. Few of the participants (11%) saw a possible connection between what they learned in a video game and other learning contexts.

> It's like, I don't know, the industry has been around so long that eventually all the games start to become the same, blend together so it would be impossible not to take away from one game to the next game. (Da)

> Once you play one strategy game you've got the blueprint for how to play lots of others. (Mx)

Transfer between games was almost a standard assumption of the participants. Their prior knowledge became a useful tool in understanding the expectations for learning in a video game.

Most of the participants didn't see the connection between the video game environment and the real world. This seems to be based on the value proposition that was held by the participants about learning in the video game environment. This value proposition seemed consistent with popular opinion about the lack any value in video game play beyond pure entertainment. This same perception seems to be held by the participants as well.

> I actually think it's just a game. I don't know, it kind of scares me to draw any parallels with the real world because it's blurring the lines between video games and real life. I don't know it's kind of a daunting thing to do. (Da)

There was some acknowledgement that skills developed during game play might be usable outside of the gameplay environment. Time management was one skill:

> The game does teach certain amount of time management because you invest so much time into it that you have an inherent interest in trying to make the most of it. (Dnl)

Teamwork skills were also noted:

> There are recurrent themes between all of video games and one of them is teamwork and that's a life skill so naturally that being drilled into you from video game to videogame I would expect those teamwork skills to stay with me. (Da)

Few of the participants offered any other examples of what they would have perceived as useful outside of the game. Some believed that their experiences in a multiplayer environment reflected human behaviour outside of the game environment. They believed that what they observed in the game world was going to be the same as what they were going to need to deal with in the real world as well. Despite the observation they didn't ever talk about the value of that observation.

The other interpretation of why transfer isn't occurring is that they don't recognize the type of learning as legitimate. All of the participants had a considerable amount of experience in a formal educational environment. Their understanding of legitimate learning is very different between the contexts of video games and formal education.

> ...institutional learning, it's kind of imposed upon you and you're told what to think and how to think rather than video games where you learn yourself so you are developing knowledge from experience rather than being told. (Da)

> Learning is a lot more engaging in virtual reality because it's part of the activity, whereas learning through university and learning in real life, it's gaining a tool or a skill set that you then have to wait for the right time to make use of. (Dnl)

The participant's experience in the post-secondary environment didn't emphasize the self-directed and self-motivated learning they had experienced in a video game environment. That learning was used to construct knowledge that was put into action immediately and was allowed to evolve with the personal motivation of the game player. The post-secondary experience of most of the participants was an imposed form of learning that didn't give them freedom to learn based on their personal motivations. Although their approach to learning in video games may seem useful, it was obvious that the participants didn't see those beliefs as contributing to their success in a post-secondary setting. Accordingly they didn't use these beliefs. This is consistent with the description of availing (Muis, 2004) beliefs; we use the epistemological stance that we've judged will most likely end in success.

This supports the conception that personal epistemology is contextual and the beliefs chosen in that context are identified by the learner's judgment that those beliefs will help them to succeed. Although the generalization of personal epistemology would seem intuitive, this study has identified barriers to that transfer of personal epistemology developed in video games from into a general domain.

6.2.4 Analytic Category 4: Support and Barriers

Supports and barriers to personal epistemological growth in video games

One of the main motivations for the study was an exploration of the potential of video games to facilitate the growth and maturation of personal epistemology. The research findings indicate that there are both supports and barriers to that growth.

This study was not only interested in examining the personal epistemology of video game players but understanding if that had any impact on their epistemological perspectives in the real world. Although the previous analytic category identified that there was no indication of transfer to the real world, this section includes a discussion on the supports and barriers to personal epistemology in a video game setting generalizing to other contexts.

6.2.4.1 Supports

Support for the maturation of personal epistemology in video games can be found in the interpretations of the study results. There were a number of observations that seemed to support the use, understanding, and growth of a mature epistemology in a video game environment. These include the identification of mature personal epistemological components in learning, epistemic metacognition, and transfer of epistemology between video game contexts. It is not a simple discussion, however, as some of the most interesting observations in the study were the wide range of epistemological stances used by the same participants to describe their approach to learning in video games. This would seem to indicate that they exhibit both naïve and mature epistemological perspectives when they engage in learning how to play a video game. The explanation of this observation is a complex mix of interpretations that relate to game design, motivation, and personal context.

Personal epistemological belief structures research

The evidence from this study indicates that academic frameworks used for discussion of personal epistemology in relation to formal learning can be used to organize and describe learning in a video game context. This finding means that a considerable depth of research and knowledge can potentially be used to support the understanding of personal epistemology in video game learning. The finding allows for more than just a descriptive framework for talking about learning in video games. There is a potential for insight into the mechanisms that could facilitate the maturation of personal epistemology in a video game environment. The finding does not only benefit video game researchers. Much of the research in personal epistemology has been viewed as academic and esoteric. Video games can allow educational researchers to view epistemological concepts in action. This is a unique opportunity as there are few opportunities to have a virtual sandbox where we can "play" with concepts of knowledge and knowing. Video games provide an unprecedented ability to explore our own epistemology by pushing up against the places where dissonance begins but the consequences for addressing that dissonance are only virtual. We can engage in a repeated cycle, exploring a knowledge concept over and over again until we see it from several different perspectives and in different contexts.

Learners can benefit from personal epistemological beliefs research as well as educational researchers. If learners are aware of the concepts and terminology of personal epistemological research they can use that framework to analyze and reflect on their game playing activities. Playing a video game then provides opportunities to explore mature conceptions of personal epistemology for the game player themselves. Although the participants in the study didn't describe their game play experience in epistemological terms, many of the participants in the study were able to accept uncertainty of knowledge and believed that knowledge was complex and interconnected in a video game environment. They believed that their intelligence was malleable so if they failed the first time they would be able to learn from that experience and try again until they succeeded. They also believed that learning how to play a video game could take a considerable amount of time and it wasn't likely that they would learn everything the first time they played it. Most importantly, they understood that all of these components were personally defined and that they were ultimately responsible for creating knowledge. There was no external authority telling them what to do. All of these experiences would have occurred many times through the thousands of hours of video game play they had already experienced. If the game player has an understanding of personal epistemological concepts it is possible for them reflect on the nature of those experiences.

As the game players become aware of their own perspectives they can compare their perceived expectations of learning in a video game with their own epistemological perspective. For example, awareness that they perceive knowledge as complex and ambiguous would likely make them avoid games that they perceived as simplistic. This would be most true when they were looking for intellectually stimulating games that need to have complex and mentally engaging challenges. The potential to gain their own awareness, or metacognition, of personal epistemology through their video game play is exciting. There is a potential for game players to begin to explore concepts of personal epistemology from a very young age.

Types of players

When defining types of players that would facilitate epistemological growth, it is important to explain that each individual can demonstrate a number of different player types. The choice of strategy in playing a game is heavily influenced by the task conditions defined by the player. This became evident in the study when the participants described very different approaches to games depending on the influences on them.

This meant that the type of player that could be observed playing a video game was a reflection of the motivation he or she had to play the game and the type of game he or she was playing. There was no simple type of player that would be most likely to support personal epistemological growth. It is more productive to think of a game player type as a reflection of the game playing behaviour that can be observed. If a game player is observed to engage in complex and ambiguous games, be tolerant of failure, look to themselves to solve game challenges, and persevere until they finish the game, then that game player is likely to have the mindset to that will use mature epistemological beliefs.

Types of motivation

There is nothing mandatory about playing video games. A game player chooses to spend weeks learning how to play video games. He or she will define his or her own motivation how those motivations are being satisfied. A great number of the participants indicated that they were motivated by positive affect or escape from the real world.

Although this creates a positive mood and is beneficial for the game player, it is less likely to support the maturation of personal epistemology. There was a small group identified in the study that had a motivation for personal growth. This was described as a need for "intellectual stimulation" and this group seemed to be the most likely experience epistemological maturation.

The participants who were motivated by personal growth were most likely to take the time to explore and reflect on their experiences in the video game environment. This time, and the willingness to explore a game environment from many different perspectives, set the stage for them coming to view knowledge as relative and contextual. Similar player characteristics were noted by Bartle (1996) as "explorers" and Yee (2002) as players motivated by immersion. The participants described similar types of motivations for video game play that related to exploration and role-play.

When the participants described the games they sought out for intellectual stimulation they commonly described an ambiguous, complex, and challenging environment. They didn't view these games as hard work however. They believed that a well-designed game would always keep the fun levels above the work levels so as long as they defined fun in terms of their intellectual growth, they would continue to have the volition to play in a challenging environment.

Although this group of participants saw video games as a place to grow, most of them did not explicitly identify how they experienced this growth. They could have described a video game experience in terms of how it made them re-think their perspectives about knowledge or the world but this did not happen. The reason for this is unclear. It may have to do with limited awareness of the vocabulary that would have allowed them to discuss the experience or it may be related to their lack of reflection on their game experiences that might have helped them make that experience explicit.

Types of games

Certain genres of games seemed more conducive to game play behaviour that reflected a more mature epistemology. The game genres included multiplayer, MMORPG, Real-time strategy, and adventure games. Each of these genres had their own characteristics that supported their inclusion in this category.

Multiplayer games can be a component of many different types of games. Other players provided the most uncertain and complex environments for the participants. These other players did so by providing a much more sophisticated environment than the programmed AI in video games. Game AI was there to control the multiple underlying systems in the game but many participants considered them basic and didn't take much time to be able to understand and manipulate them. Multiplayer games also allow for considerable social interaction and this is considered important by some for the development of personal epistemology (Bendixen. 2002). Although not a central component to personal epistemological research, social epistemology also has an opportunity to develop and evolve within the communities created online.

Massive multiplayer online role-playing games were often cited as the most challenging type of game. Although the context has been created by a game designer, much of the game-play deals with interacting with other human players. For reasons similar to the multiplayer games, these kinds of environments could present very unique challenges to a game player.

Both multiplayer and MMORP games are increasing in numbers. As more and more games are developed with multiplayer options, there are more opportunities for video game players to be exposed to a wide range of personalities and perspectives. This heterogeneous environment will be constantly changing and most supportive to the development of the more sophisticated epistemology needed to thrive in those environments.

Real-time strategy games provided the most complex environment and the longest time depth to achieve mastery. These games were often management simulations of cities, industries, or political organizations. These games would force the player to interact with an abstract version of reality that didn't completely resemble the real world. The worlds created were often open and flexible, allowing for a wide range of strategies for addressing the complexity in the game system.

Adventure games weren't exceptional in terms of their ambiguity or uncertainty. Their ability to facilitate a mature epistemology was mostly related to their slower pace and their ability to engage the participants in a thoughtful narrative. This pacing would allow the participants to spend a considerable amount of time reflecting on their experience and providing the time depth necessary to explore complex and challenging topics.

Time depth

Personal epistemological growth is not a quick process. It can take years to develop as an individual advances and retreats, constantly making sense of new experience and trying to make sense of it within their own worldview. Most of the participants described a time depth in playing games that was almost as long as their entire formal educational history. This means that a process that takes considerable time and reflection would have the opportunity to evolve in the time most of the participants has spent playing video games from an early age.

Summary

There are a number of factors identified in the study that provide opportunities for awareness and growth of personal epistemology. These include the compatibility of the personal epistemological belief structure framework for describing video games. The framework provides a considerable amount of research that could be utilized in the description and analysis of learning in video games. There were also certain player types, game play motivations, and game designs that would be more likely to facilitate personal epistemological growth and maturation.

6.2.4.2 Barriers

Although there were a number of promising elements supporting the hypothesis that video games could facilitate and grow mature personal epistemological beliefs, there were also a number of identified barriers. Personal epistemological belief structure research has developed out of formal education environments and is missing some key components to understanding how personal epistemology affects learning in video game environments. These include elements of affect, motivation and social epistemology. Other issues include evidence that personal epistemology is reflected in how video games are played. Observing video game play can be useful in terms of understanding how a participant viewed knowledge and knowing, but it didn't always provide evidence that games actually challenged them in a way that might facilitate growth. These observations made it obvious that an individual can enjoy playing video games but can choose to do so in a way that will never facilitate the growth of their personal epistemology. This seems to be primarily related to a lack of metacognition, societal perceptions, and the motivations the participants had to play video games. There was also evidence that any growth in personal epistemology was contextual and didn't generalize outside of the game environment.

Personal Epistemological Beliefs research

The process of developing the rubric used for content analysis of the research interviews (see Appendix B) identified a number of elements that were very important to the participants in their description of learning how to play video games. This resulted in the addition of a number of new elements to the rubric. The elements used to create the first iteration of the rubric were common with the EBS instrument and reflected the components of personal epistemology that had been identified as relevant to learning in a post-secondary environment. The new elements added a number of additional categories used in the final content analysis of the interviews. These included affect and motivational factors such as socialization, relaxation, and personal growth. Another new component was social epistemology that was both developed and maintained within a group environment during the process of learning how to play video games.

Although many of these aspects of personal epistemology have been discussed in the research, they have not been integrated into most research studies on personal epistemology in learning environments. This may be related to the lack of agreement on the number of components in personal epistemology and how they relate to one another. This level of complexity has already created an ongoing debate among researchers and created a narrow perspective as they attempt to come to consensus on how that small group of components relate. The narrow focus of traditional personal epistemological belief structure research is not a barrier to the growth of personal epistemology in a video game environment. It is a barrier to the research coming to a well-rounded understanding of the phenomena and is creating blinders in interpreting the data that may be gathered while investigating learning in video games.

Metacognition

Metacognition facilitates our ability to recognize how our reactions to a learning challenge are a reflection of our own perspectives on personal epistemology. A lack of metacognition may mean that any maturation of personal epistemology that occurs during learning how to play a video game may not be recognized by the individual. Awareness is necessary for an individual to compare and evaluate different conceptions of true knowledge. A lack of understanding or awareness of the learning process limits their ability to evaluate and make sense of any growth and integrate it into their existing perspectives.

Understanding how metacognition works in video games is problematic but there are similar challenges to this kind of research in educational settings. In those environments metacognitive control is discussed as being part of the fine-tuning of learning strategies that are related to personal epistemological beliefs (Bromme et al., 2010). Although this active monitoring during video game play was described by the participants, it happened very quickly and seemed to be intuitive rather than part of a conscious, reflective process. Based on these observations it doesn't seem that much monitoring is occurring at a metacognitive level during video game play. Slower-paced games seemed to be more likely to allow the time for players to reflect on their learning.

The other complication is that the monitoring of a game player's learning seems to be linked to his or her assessment of the epistemological stance required to succeed in the game. In games that have been assessed as more complex and uncertain it was likely that the monitoring of the game player is related to the deep level observations required to succeed. A player who adopted deep level observations would understand that they were facing a difficult challenge that would require that they detect as many clues as possible from the game in order to come up with a solution. It also requires the player to reflect on their own strategies and think about how their conceptions about how to play the game could be affecting his or her ability to find a solution.

The degree to which metacognition plays a role in learning how to play a game is also affected by the underlying motivation of the player. There were more complex games that would have benefited from deep monitoring but there was considerable evidence from the participants that they would ignore those cues. If they were constrained by time, felt lazy, or were motivated by some other factor that would have limited interest in deep monitoring. They would simply ignore the option of deep monitoring. As long as the game provided a way to succeed without deep monitoring they would continue to play. If the game required it to successfully play they would likely abandon the game in favour of some other game.

It seems most likely that there is a range of depth for metacognitive processing among the participants. This might require a different perspective of metacognition in a gaming environment. Monitoring in a fast-paced video game environment isn't going to allow the types of reflection that are typically described in metacognition (see Figure 13). The participant's description of "twitch" style games such as first-person shooters typically described a fast-paced playing style that was based on quick reaction rather than a well-though out response.

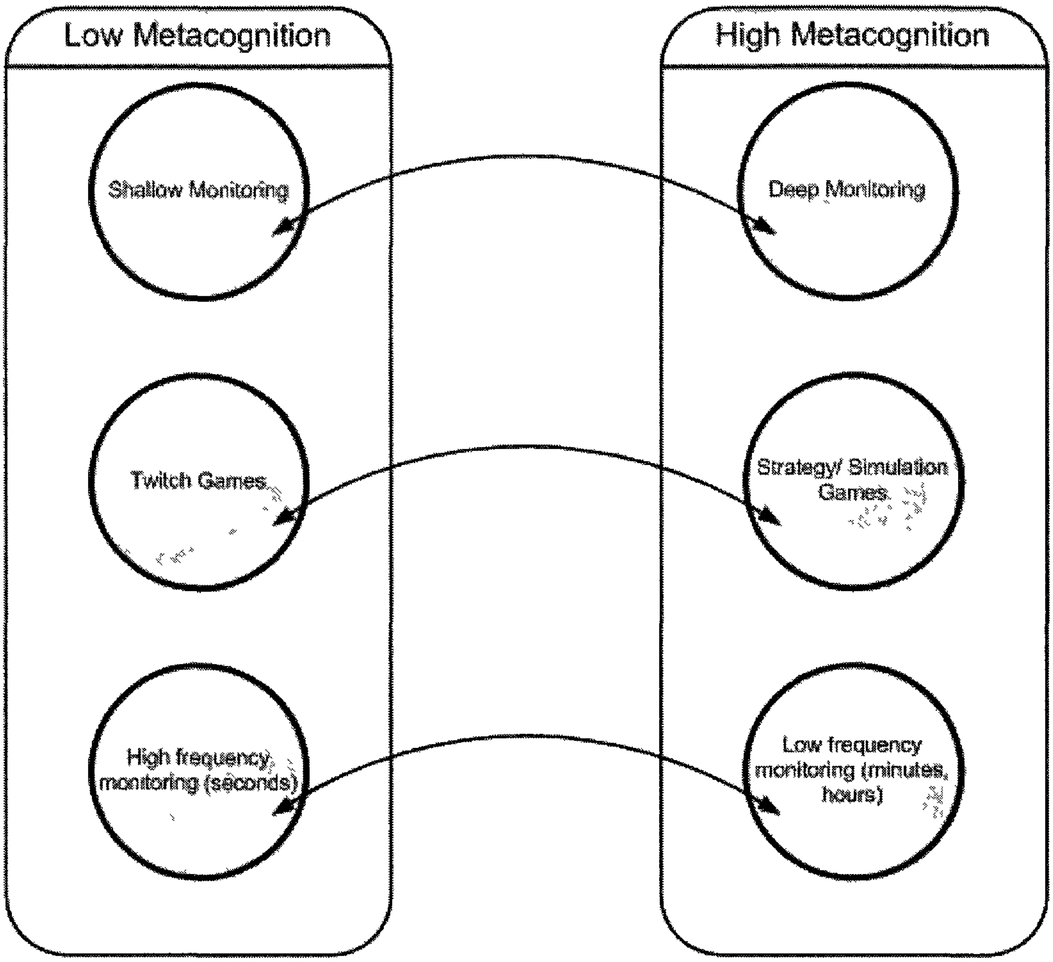


***Figure 13.* Metacognitive stances in different game types**

Different motivations for playing are also going to affect how metacognition plays a part in learning how to play a video game. In games where affective standards have been identified as having a priority it is likely that most monitoring will be focused on the affective domain. If the motivation to learn how to play is escape or relaxation, most of the participants had little interest in expending time or cognitive energy in learning how to play an intellectually challenging game. If they have identified personal growth as a motivation for playing they are more likely to ensure that they had the time depth and energy required to address complex and challenging game environments (Figure 14).

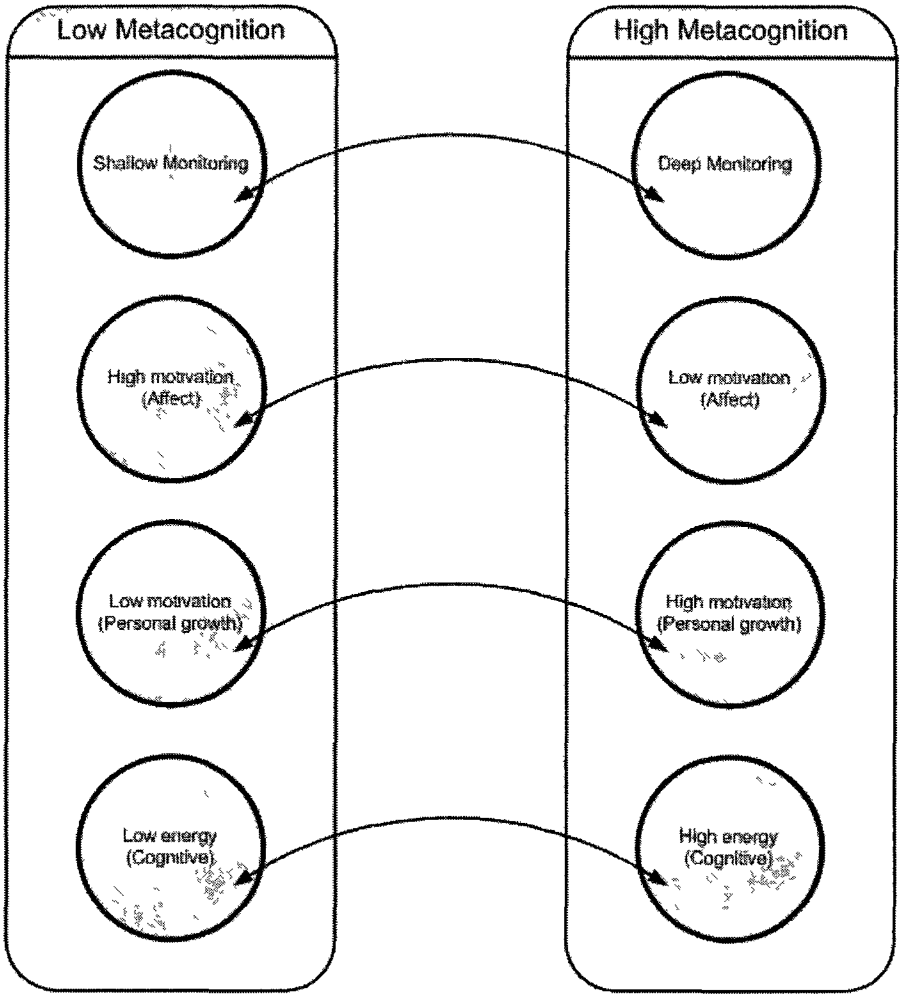


Figure 14. **Metacognitive stance in different motivational states**

There is one observation from the study that seemed to provide a limiting factor to the ability of video games to facilitate epistemic growth. The participants that seemed to be most aware of their own approaches to knowledge and knowing discussed a motivation to grow intellectually. They had begun to look to books and other media that could facilitate that growth. In the process they had also become more discerning in choosing that media. Although they continued to look to video games as one of the mediums that would grow with them they were becoming increasingly disappointed. Many of them were beginning to believe that they had outgrown video games and they were identifying fewer and fewer instances where video games challenged them intellectually.

A lack of metacognition will also impact the chances of transferring what they have learned to other contexts (Gourgey, 2001). The conscious transfer of an epistemological stance did not seem to come easily or intuitively to the participants. None of them discussed how their epistemological stance in learning how to play a video game would transfer to learning in the real world. This may be due to their relative lack of metacognition during their game play. It has been observed that although formal education has a role to facilitate metacognition, it has lost this focus due to a growing reliance on standardized exams that do not facilitate the development of metacognition (Kuhn & Dean, 2004). Educating students about metacognition is typically done through mentoring and providing a role model for using the skills of inquiry.

Societal Perceptions

Societal pressure is constantly reminding the game player that games are a "colossal waste of time" (Abanes, 2006, p. 11) at best and psychologically harmful at their worst (Abanes).The game context is not taken seriously as a place for growth while a post-secondary setting is considered legitimate. This seems to have led the participants to believe that any growth in the video game context is not generalized while growth in a post-secondary setting is expected to generalize to their lives and future careers.

In comparing the EBS scores that examined the participant's epistemic perspective of a post-secondary environment, and the interviews that examined the participant's epistemic perspective of a video game environment, the results seem to indicate a difference between the two contexts. The participants were more naïve in their perspectives of a post-secondary environment. This may only reflect their personal epistemology in that particular context. As learners choose the epistemological stance that is most likely to help them be successful in that context, it is not necessarily a reflection of what they really believe. The EBS questionnaire was essentially a series of questions about what the participants believed were the correct perspectives towards knowledge they needed in order to succeed in a post-secondary context. It would seem that they believed something different about learning in a video game environment.

When questioned about this concept, they always placed value on the knowledge they had developed in the post-secondary environment as opposed to a video game environment. They also understood that the learning in the post-secondary environment was imposed and the value came from being told by an authoritative source that their experience in a post-secondary environment had value. This seems to indicate that although the participants may have developed some more mature epistemological perspectives in video games they aren't likely to transfer them to learning in a post-secondary environment as they don't see the value in helping them to succeed. It also seems even less likely that they would consider transfer of their video game epistemological perspectives to their real general lives.

Games themselves are not helping their own perceived value. The game industry continues to release the same kind of game year after year. The lack of diversity in games had some of the participants reaching a point where they believed they were outgrowing games. When they actually looked at the experience of game play it did not seem evident to them that video games were going to provide them with the intellectual stimulation they had started to seek. This seems consistent with informal reports that the video game industry is becoming less and less creative and video games themselves are heading towards a "permanent cultural ghetto" (Remo, 2009). Video games are running the risk of becoming a trivial form of media.

Types of players

The ability to choose a relevant epistemological stance is commonly described by the participants. This is consistent with other research in an academic setting where students would match their epistemology to what they believe will help them succeed in that educational context (Hammer & Elby, 2003). The participants had a similar disposition except that their choice of epistemological stance was related to a range of motivational conditions that they considered meaningful. Their motivation could be socialization, building status through achievement, or escape. If these were their goals they would not be interested in taking a more mature epistemological stance that was motivated towards intellectual or epistemological growth. The evaluation of how successful the planning was to succeed in those motivations could be intrinsically and extrinsically evaluated.

Those players who emphasized motivations of socialization or escape as the primary motivation were unlikely to focus on personal growth as part of their strategy. Personal epistemology would provide a means to achieve their other goals. They might choose a more mature epistemological stance but only if the game context required it and it would help them meet their other goals. Socialization would be evaluated against the successful creation of relationships. Escape could be either focused on minimizing stress or maximizing positive affect. The concept of escape does occur in personal epistemological research and is discussed in Perry's (1999) work on intellectual development. Individuals who entered into this mindset chose to avoid the stress created by the intellectual challenges of a post-secondary context.. They were trying to avoid the demands for growth that had been placed upon them. Although the escape was usually seen as temporary, most of them would resume their development later. If games were predominantly a component in an individual's escape from life, including intellectual development, it is unlikely that they would facilitate any sort of growth.

Participants who were extrinsically motivated were looking for acknowledgment of the success in the game, usually by outside sources, most likely their peers. One aspect of this type of player is that although they may have a tolerance to failure that is typical of video game players, they are also very good at avoiding situations where they might fail. This active avoidance of failure is linked to their need for affirmation but it will also limit their exposure to any kind of dissonance that might facilitate their growth. It is unlikely this player type would be interested in the kinds of challenges that might be intellectually stimulating and this was consistently described as an intrinsically motivated activity by the participants.

Types of games

Game type isn't a true barrier to exhibiting a mature epistemological stance or growth as video game players are very creative in their approach to game play. Some games, such as puzzle games, casual game, platformers, and first person shooters are perhaps the most simplistic in their design. Most participants described their epistemic perspectives are quite naïve in order to successfully learn how to play these kinds of games. It is important to keep in mind that some game players would create complexity in even simple games by trying to understand the underlying system and achieve creative game behaviours. The description of "gaming the system" came up repeatedly among the participants.

The current AI in video games is another barrier to growth. Current AI isn't able to provide the kinds of uncertainty and sophistication that can challenge most experienced game players. There has been a steady improvement in game AI that is facilitating more complex and uncertain behaviour but they are still relatively basic in the opinion of an experienced game player. As the games become more capable of evaluating and learning from the human players in the video game environment they will be more able to challenge human players in ways that would encourage growth of their personal epistemology.

6.3 Conclusions

One of the central issues in discussing the value of video games is the generalization of video games into a single category. This relates to the issue of how we define the boundaries of the concept of video games. The reality is that there are many different types of video games available and people will play them very differently depending on how they are influenced by their mood and motivation. Understanding the context of that game play, and how the player is playing them, is going to provide the most evidence of how beneficial or detrimental that game play is to the player.

Personal epistemology is one of the elements that can help provide the evidence needed to critically evaluate the game play experience. Personal epistemological beliefs inform the game player, in an abstract way, about what learning requirements to expect from the video game. It helps them when they were planning his or her strategy of how to learn to play the game and address the challenges presented there. Lacking clear objectives or expectations, the game player is required to make his or her own interpretation of what is expected of the player.

Personal epistemology is only one influence however, and it is important to understand that a single individual can exhibit many different epistemological stances depending on the game play context and underlying motivation of the game play. This mixture of external context, personal epistemology, cognition, affect, motivation, and prior knowledge is not consistently applied in a video game context across genres or even sessions within the same game. The degree of influence can drastically affect the observed game play behaviour of an individual. A number of different stances may be observed and each one represents a unique coordination of multiple influences that guide their approach in learning in the video game.

Affect seems to be the largest modifier to learning in a video game among the participants. Affect can often be the dominant influence during the planning stage for learning in a video game. This can have significant implications. If the motivation to learn is the creation of a positive affect, or the escape from negative affect, then the participants were less willing to engage in the stress that would occur when they encountered cognitive dissonance.

Participants who were motivated by personal growth were different from those participants who were only looking for emotional rewards. Those seeking intellectual stimulation and growth were willing to engage in considerable cognitive dissonance in order to experience that kind of challenge. These participant seemed to hold the most promise for the group who would experience growth and maturation of personal epistemology in a video game environment. They had the opportunity to build awareness of their personal epistemology and how it affected their sense making of the game play experience. The types of games they played and how they played them seemed to provide the most opportunity of epistemic metacognition. Games, such as real-time strategy and MMORPGs were recognized as intensive learning environments that required a considerable amount of effort. Adventure games were recognized for their slower pacing and opportunity for reflection. When time constraints were in place the participants would often know to avoid such games.

The participants who discussed a motivation of personal growth were also the group that seemed to be the most disappointed with video games. They had a long experience with video games in their lives and continued to look to video games to provide them with the kinds of experiences they craved as they continued to grow. Despite this, many of them were beginning to feel that they had grown out of games and often didn't see them having much of a role in their future.

Most of the evidence seems to indicate that the epistemological stance of game players is domains specific. Their perspectives towards knowledge and knowing are rooted in the game play context. Societal perceptions of the game play experience and a lack of the metacognitive skills both contributed to a limited amount of generalization. Although many of the participants had described mature personal epistemologies while learning in a video game context, this was not consistent with their perspectives towards learning in a post-secondary environment. They were not able to discuss any reconciliation between the two perspectives and instead believed that their epistemological stances that promoted success in a formal education system were the most valuable.

It must be acknowledged that this was a small group of research participants, and other students also, might be more metacognitively aware of how knowledge gained in the video game world could transfer to the real world. Students who have used games during their education would likely have already experienced this kind of media during their learning experience. These kinds of students were not reflected in this sample as none of them discussed having used video games as part of their education careers. These participants were also actively attracted to a research study on video gaming; their participation was not completely random so they may have had a level of interest in video games that is not reflective of a general population of video game players.

It also needs to be acknowledged that this study uses an academic framework to organize and interpret the results. Although considerable effort was put in place to transfer the framework to a game context, it may also have blind spots that have limited the range of interpretations possible. The analysis of the personal epistemology survey instrument (EBS) indicates that the narrow range of perspectives presented in the survey were not complete enough to describe personal epistemology in a video game context.

Chapter 7 Conclusions and Recommendations

7.1 Introduction

The purpose of this survey-based and multi-case study was to explore conceptions of personal epistemological beliefs in relation to video game play. Personal epistemological beliefs were chosen as a research framework because of their increasing importance in the study of how perspectives towards knowledge and knowing affect how we learn in a formal educational setting and in the real world. There are two main reasons that they are considered important in that research framework. The first is that the maturation of personal epistemology is a stated goal of education. The maturation of these beliefs has been shown to facilitate successful learning in a formal learning environment. The second reason is that epistemological beliefs are believed to generalize across domains and the maturity of those beliefs is considered critical to thriving in the modern world. They will provide an individual with the disposition and critical thinking ability necessary to succeed in a knowledge-based, democratic society. Mature personal epistemological beliefs facilitate the evaluation of any new knowledge and support individuals in understanding the reasons they think the way they think. It was this idea, that the outcomes of education were not simply the creation of content knowledge but also the development of knowledge process, which generated an interest in examining the general outcomes of learning in video games. It was hoped that by better understanding how personal epistemology influences learning in video games that we will have:

1. A real-world example of personal epistemology in action.
2. A better understanding of the implications of the thousands of hours of video game play undertaken by video game players.

3. Perspectives on the video game play contexts necessary to encourage and support the growth and maturation of personal epistemological beliefs.

The conclusions from this study follow with the research questions, findings, and interpretations in previous chapters. These conclusions address a number of areas that align with the organization of the findings in the interpretations chapter. These include: (a) the use of personal epistemological belief structure survey instruments, (b) perceptions of what players need to learn in a video game to succeed and how they acquire that knowledge, (c) how personal epistemological beliefs developed in video games transfer to other contexts, including the real world, and (d) the supports and barriers to the growth and maturation of personal epistemological beliefs in a video game environment. Following is a summary of the conclusions and recommendations for further study.

7.2 The use of personal epistemological belief structure survey instruments.

There were a number of findings that related to the use of the EBS instrument in the study. The EBS instrument is a questionnaire designed to determine the personal epistemological beliefs of students in a post-secondary setting.

The EBS instrument was unable to detect any statistically significant difference in scores between undergraduate years. The conclusion drawn from the interpretation is that the EBS instrument was not appropriate for detecting differences between years of study in the undergraduate population. This is consistent with the conclusions of other research studies.

The EBS instrument was also unable to detect any difference in the scores based on video game preferences of the participants. The conclusion drawn from this interpretation is that the instrument was designed to work in a specific post-secondary context and it was not appropriate to use it to detect differences outside of that context. Although the instrument came out of a tradition that believes that personal epistemological perspectives in a post-secondary environment would generalize to other dimensions of personal worldview, it seems likely that personal epistemology is a much more complex and contextual construct. It is also likely that human perceptions about the meaning and organization of domains can affect their perspectives about the nature of personal epistemology in those different domains making it difficult to transfer interpretations of personal epistemology between domains. It seems likely that these instruments are documenting what an individual believes is an epistemological stance that will facilitate his or her success in a specific domain rather than their true perspectives on epistemology. In the case of the EBS instrument, the participants are describing what they think they need to do in order to succeed in a post-secondary environment. As previous research has shown, this is most often accomplished by aligning their perspectives towards epistemology with their instructor to minimize the chances of conflict and thereby maximize their chances of success in the classroom.

7.3 Perceptions of what video game players need to learn to succeed and how they acquired the knowledge

What video game players needed to learn to play a video game was a reflection of a very personal need that had to be fulfilled. Learning in video games is not an imposed form of learning that is typical in formal education. Learning how to play a video game is a voluntary activity on the part of an individual who is seeking to gain something that only they can define.

This concept is a critical distinction from formal educational settings. When individuals define their own needs, they also define their own approach to learning and their own measures of success. Accordingly, this particular analytic category became the most complex to interpret during the study.

In the course of the study it was recognized that there were multiple influences that needed to be understood when discussing learning in a video game context. These influences were identified at some point in the inductive process of developing a rubric during the content analysis phase of the research. One of most important goals in interpreting the findings was determining if an individual's personal epistemological belief structures, as described in the research, could be identified as a relevant influence on learning. In addition to identifying these beliefs, it was important to understand how they could be used to describe, as well as provide insight into, learning in video games. A second important goal was to identify all other relevant influences on learning to play video games.

To make sense of all the influences identified from the research findings, an organizing framework based on the theory of Self-regulated Learning (SRL), was used. The SRL framework has been used successfully in the past to describe the process of learning in self-directed, autonomous learners. The SRL framework was helpful for both organizing the influences identified in the study and assisted in the understanding of the dynamic between them. It was the interplay of those influences that created the perceptions that a video game player had about learning how to play a video game.

The influences on learning were organized into external and internal. External influences included game design and social context. Internal influences included personal epistemological beliefs, motivation, affect, and prior knowledge of the game or game genre.

The following is a discussion about several of the influences. The first point of discussion is whether or not personal epistemological belief structures could be successfully used to describe learning in video games and be considered one of the influences on learning how to play them. The second is a description of the findings of the other influences and conclusions about their effect on learning. The third is a summary of the findings and conclusions about the relative importance of these influences.

7.3.1 Personal epistemological beliefs and learning to play video games

Personal epistemological belief structure research has developed a number of descriptive parameters for use in academic learning environments. Despite this context-specific domain, a major finding of the research is that many of the same constructs can be used to describe their influence on learning in a video game environment. The conclusion that can be drawn from this is that most of the described personal epistemological structures can provide a meaningful framework to discuss learning in video games and growth of personal epistemology that may occur in that context. It is not a perfect fit however, as not every component in the framework is completely appropriate for use in a video game context.

The findings were organized by personal epistemological belief components in order to discuss the strengths and weaknesses of those components in describing learning in video games. The conclusion, based on the findings, was that the components certainty of knowledge, quick learning, and source of knowledge were most successfully used in describing learning in video games. The component fixed ability was largely successful in describing video game learning while simplicity of knowledge was the least successful.

The component certainty of knowledge was found to be a meaningful category for describing learning in a video game. Most of the participants described several of the video game contexts they had encountered in terms of uncertainty and ambiguity. There were often different levels of predictability in the games but almost universally the participants described multiplayer environments as the most unpredictable. The conclusion is that not only is the component certainty of knowledge a valid construct to discuss video game learning but also that video games are capable of creating the kinds of uncertainty and ambiguity that require the adoption of a mature epistemological stance in order to succeed. The participants described a multiplayer environment as the most uncertain because of the challenges of dealing with other human intelligences. Game AI was mostly considered too predictable to facilitate a consistently uncertain environment. Many participants actively tried to understand the underlying mechanic of the AI in order to increase the predictability of the game and therefore increase their success. Several of them were extremely successful at the task and were able to "game the system", effectively subverting the AI and dominating the game.

The component quick learning was also a meaningful component for describing learning in video games. Findings indicate that players understand that considerable time would be required to learn certain games. They described many instances where they would measure learning how to play a video game in months. The conclusion is that the component quick learning is a valid construct to discuss video game learning. Another conclusion is that some video games can require the adoption of a mature epistemological perspective towards quick learning by typically requiring a long learning period to accomplish mastery and success in the game. This was most typical in complex games, such as sociopolitical simulations like the Civilization series. The implicit understanding that learning to play certain video games takes considerable time became apparent when most self-identified dormant gamers in the study indicated that time constraints were the most common reason they didn't try to learn new games.

The component source of knowledge was also a meaningful component for describing learning in video games. The findings indicate that players understood that they would be personally responsible for creating their own approach to learning in the video game environment and they would have to gauge their own learning against criterion they created themselves. The conclusion is that the component source of knowledge is a valid construct to discuss video game learning. An additional conclusion from the findings is that video games can require the adoption of a mature perspective towards the epistemological component source of knowledge. This mature stance was most typical when the player gained personal satisfaction through learning how to play a game on his or her own without any outside help. The player took personal pride in being both autonomous and successful. Although they would occasionally seek help in online forums, this was rare. Some players did not share this perspective and took a more naïve stance by seeking an outside authority for help. These players typically lacked the motivation of personal accomplishment in a particular aspect of the game and wanted to skip certain challenges in order to progress in the game. In some cases this represented substantial portions of the game. Time constraints were also used to justify a reliance on an external authority.

The conclusion from the findings was that the component simplicity of knowledge was not completely relevant in a video game environment as video games are implicitly based on systems. This is based on another conclusion that in order to learn how to play any game, a video game player is required to take on a mature epistemological stance, accepting knowledge as complex and interconnected. There isn't really an ability to define a range of perspectives from naïve to sophisticated personal epistemological beliefs using the current descriptions in the research. The existing research defined a naïve perspective as being focused on knowledge as composed of separate, unconnected items of information. Rote memorization of facts in a formal education setting would be a typical example. Simplicity of knowledge would therefore be most relevant in a traditional educational context but not in a video game environment as there is a basic assumption that being able to negotiate the systems in a video game eliminates the relevance of the more naïve stance.

There was also a conclusion that fixed ability had a limitation in describing a game player's perceptions towards learning. Determining the underlying attitude towards failure is difficult. The wide range of choices of video games gave some of the participants the option of only playing the games where they knew they would succeed. These participants expressed this view by explaining that they would only endure failure if they were playing a game that they believed they would eventually dominate. This is not the same as having resilience in the face of failure and continuing to try to learn because they believed intelligence was malleable and eventually they would learn how to play the game successfully. Instead it is an example of avoiding failure altogether. It was difficult to identify which belief guided the actions of the participants.

The overall conclusion is that the use of personal epistemological belief structure studies provides a significant basis for understanding the nature of learning and the development of knowledge in a video game playing context. Another conclusion is that many video games encourage the adoption of a mature personal epistemological stance in order to be successful in the game. Both of these conclusions are significant as they identify an educational value proposition that video games can encourage mature epistemological stances in the course of learning how to play them. Personal epistemological belief studies also provide as a research framework for studying video games. Despite this, it became apparent during the study that personal epistemological beliefs are only one aspect of a collection of factors that influence learning how to play video games. Some of these other components that influenced learning in video games included affect, motivation, and social epistemology. These highlight the blind spots in the current personal epistemological beliefs research that cannot be ignored if there is to be further study into the growth and development of personal epistemology in a video game environment. These other influences have a significant impact on learning in video games and need to be considered beyond the components that have been previously identified from the study of personal epistemology in a formal education environment.

7.3.2 Other relevant influences

As the process of learning how to play video games was examined it became plausible from the findings that the range of influences on learning was much wider than just personal epistemological beliefs. As these influences affected both approaches to learning to play video games, as well as the impact of personal epistemological beliefs during video game play, it became necessary to identify them. This mixture of influences made the analytic category about perceptions of learning in video games the most challenging to interpret during the study.

The conclusion of the findings is that there were several different influences in learning identified but there was no single identified influence that dominated the findings. External influences include game design and social context while internal influences included motivation, affect, and prior knowledge.

The percentage of participants who described their motivation to learn how to play a video game is as follows: personal growth (56%), socialization (44%), affect (56%), and relaxation and escape (44%). Throughout all of these conversations was an expressed understanding that game design was always an influence, no matter what the motivation behind playing the video game. These influences were identified during the content analysis of the interviews and the inductive construction of the rubric designed to analyze the content of the interviews. During the course of triangulating these influences for validity against existing research, it was noted that motivations around game play can include other many elements. Although this study acknowledges that other motivations are likely, they were not detected in the course of the research.

7.3.3 Conclusions on relative importance of influences

The findings indicated that all of the noted influences could have an impact on the participant's approach to learning how to play that video game. Game design cannot be changed and the participants had to agree with the underlying epistemology behind the design or they would never succeed in the game. Much like a student choosing to align with the epistemology of their teacher to succeed in class, the participant needed to align with the epistemology of the game designer. If the participant chose not to agree they could simply stop playing the game. There were many ways that this discovery would be described by the game player. If the game was too simplistic it would be described as boring, it is was too complex it would be too hard, if it was morally distasteful it might be described as too violent or too gory. In the games that the participants did decide to play, they were able to define their motivations for learning to play the game by themselves. They were able to make a decision about the importance of the different influences in relation to their personal motivation and choose appropriate learning strategies for the game. The conclusion is that the relative importance of these other influences versus personal epistemological beliefs depended on the underlying goals the participant had for learning how to play the video game. For example, the importance of achieving a positive affective state would be most important to an individual who was motivated by a need for coping or stress relief. This motivation would be much more important than enduring a challenging and stressful game experience that might result in intellectual or personal growth. Each game play instance could be a very different learning context depending on the relative importance of each of the influences. The learning was a reflection of the needs of the game player at the time. These needs would be reflected in the criterion the participants had created to gauge their success in the game.

The findings indicated that the criterion for success in a video game did not always place a great deal of importance on the use of mature epistemological beliefs. Although all learning experiences require the individual to take a stance on the nature of knowledge, those learning experiences do not always require a mature or sophisticated perspective. As a result, both naïve and mature personal epistemological beliefs were evident in all game play contexts. A conclusion from this finding is that in order to learn how to play video games the participants would need to adopt the availing personal epistemological beliefs that were defined by the video game play context they had themselves created. Essentially, the participant would voluntarily choose a personal epistemological stance that aligns with the requirements of their social group, the limits defined by the game designer or their own personal motivation.

It should not be surprising that learning in a video game context requires the consideration of a wide range of influences beyond personal epistemological beliefs. The research on personal epistemological beliefs originally developed out of a formal education environment. These environments have narrowly defined learning contexts and this limits the range of influences that need to be considered when exploring conceptions of learning. The formal educational environment is also imposed on the learner by an authoritative source that has its own philosophy on the nature of the learning experience. This limits the range of influences to only those that the authority deems relevant. It is likely that a wide range of influences have an impact on learning in a post-secondary environment. These additional factors are just not typically considered when curriculum is designed.

7.4 Transfer of personal epistemological beliefs from video games to other contexts

The conclusion from the findings indicate that perspectives towards knowledge and learning how to play video games would transfer to other video games but not consciously to the real world. The only skills identified as being transferrable to the real world were time management and teamwork.

Understanding the value of the video game experience required not just identifying if mature personal epistemology could be exhibited and grow in those contexts. In order for those beliefs to be valuable to an individual beyond the videogame, that mature perspective had to influence the way they interpreted knowledge in the real world. One of the findings of the research is that most of the participants didn't believe that their experiences in video games would transfer to the real world. A conclusion can be drawn from this finding that any growth and maturation of personal epistemic stances in a video game will not consciously generalize to the real world. The conclusion is based on an assumption that metacognition, or self-awareness about personal approaches to knowledge and thinking, is necessary to recognize how personal epistemology affects learning in a context and then transfer that recognition to other contexts. Although some of the participants seemed to exhibit self-awareness about themselves and their learning they didn't believe that anything from video game play could or should transfer to the real world. They seemed to base this upon a negative value judgment about the importance of their video game experience and a lack of metacognitive development.

This conclusion is discussed in more detail in the section of supports and barriers to the growth of real world personal epistemological beliefs during video game play, specifically in the sections about metacognition and societal perceptions.

7.5 Supports and barriers to growth of personal epistemological beliefs during video game play

A major finding was that personal epistemological belief structure research could be used to describe and frame learning in a video game environment. One of the goals of this research was to see if this research paradigm could be used to describe learning but also to come to a better understanding of the meaning of personal epistemological beliefs in video games. In the course of the study a number of other factors that influence learning in video games were identified. These influences include metacognition, types of video game players, types of motivation to play video games, types of game design, time depth of video game play, and societal perceptions. These influences appear to either support or limit the growth and maturation of personal epistemological beliefs in a video game environment. Understanding these influences was an important part of the study. It provided insights into whether the observed mature epistemological beliefs were just a reflection of existing beliefs or the video game environment provided an environment that would facilitate their growth.

7.5.1 Personal epistemological belief structure research

The research from personal epistemological beliefs does not support or limit growth. It does provide us with a lexicon to describe the phenomenon as well as a considerable amount of published knowledge for comparison. The conclusion on personal epistemological belief research is that the decades of research is relevant when discussing the self-directed autonomous learning that occurs in video games. This conclusion comes with a provision though, as exhaustive as the research may be, personal epistemological belief structure research does not include all of the elements relevant to learning in video games.

Despite the limitations, video games provide an example of personal epistemological beliefs in action. The findings have indicated that the personal epistemological beliefs exhibited in game play can frequently be classified as mature or sophisticated. During this learning, the game players are constantly monitoring their learning and modifying their approaches based on feedback from the game. This dynamic is constantly in action during game play.

There are limitations to using the current research to understand personal epistemological beliefs in video games. Transferring a research paradigm from one context to another is challenging. There are several missing elements in personal epistemological belief structure research that are relevant to discussions about learning in video games. These important elements included personal motivation, social epistemology and affect. All of these have been discussed in several research studies on personal epistemological beliefs as potential limitations of the research paradigm in a formal education setting. Not surprisingly these limitations became evident during this study. These limitations don't provide either a support or a barrier to growth but it limits our vocabulary range when discussing learning in video games using only the narrow framework of personal epistemological beliefs.

7.5.2 Epistemic metacognition

Metacognition involves thinking about thinking and can facilitate reflection upon personal epistemological beliefs as well as assist in their growth. The conclusion of the findings related to metacognition is that although monitoring of learning is a constant activity during video game play it does not seem to be consciously articulated by the participants. This doesn't create a barrier to growth but it does limit the potential for video game players to be consciously aware of growth while playing video games. A lack of metacognition also limits the transfer of that growth to other domains.

Learning in video games can provide an example of epistemology in action. It provides the video game player with many experiences where they can ask questions about knowledge such as "What is the purpose of this activity?" or "What have I learned?" These questions can be directed at themselves or at their peers to encourage similar thinking about their experience. The questions are answered by feedback from the game and other players in the game. This feedback provides an evaluation of the player's strategy in the game. This happens every time a video game player enacts a strategy they have conceptualized and hope will lead to success in the game. In order to learn, the game player must monitor this constant feedback. The monitoring is not necessarily conscious however. When dealing with a game AI much of the process is non-verbal. This means that the player interprets feedback from the system and enacts new learning strategies without ever articulating them consciously. When these questions are posed by other human players there is more possibility that an active verbal discussion will ensue that will require the individual to consciously articulate their knowledge and justification for it.

Not all video game experiences are necessarily suited to encouraging the metacognition that would facilitate epistemic growth. Many video games require a high frequency, shallow level of monitoring in order to play. These kinds of strategies are typical in the "twitch" style games such as first-person shooters. This limits the kind of deep monitoring that would facilitate thinking about the experience. There are some game play experiences that seem most likely to encourage metacognition. Those players who are motivated by personal growth seem most suited for the kinds of deep monitoring necessary to begin thinking about their own epistemology in relation to the gaming experience. There are also certain game designs, such as adventure games, that are better suited for the slower pace that can allow the time and consideration required for deep monitoring.

Although there is potential for developing mature personal epistemological beliefs, there needs to be something occurring in video game play that encourages a game player to come to epistemic awareness. This would entail a transition from unconsciously playing games to an awareness of their own thought. There are two contexts where metacognitive growth is most likely to occur in an educational context (Kuhn & Dean, 2004). One is during activities that encourage personal evaluation of that activity. The second is during social learning activities.

Educational events that encourage personal evaluation of that activity are designed to heighten interest in the actual purpose of the activity itself. When students are asked to explain the purpose of an activity in an educational context they are more likely to question why they are engaged in an activity and what they have gained from it (Kuhn & Dean, 2004). This is most likely to occur when the student is voluntarily engaging in an activity and not just doing something in school because it has been imposed on them. Video games do provide the autonomy of action for their players that let them ask questions about why they are playing games. There was no direct evidence from the research data that any game design is currently encouraging players to actively develop metacognition by asking questions about the player's purpose for playing them in the first place. In this way, they provide a supporting context for epistemic awareness but lack the cues necessary to drive a game player down that path.

During a social learning situation, an individual must deal with questions about how they justify their knowledge. They need to constantly justify their knowledge by answering how they "know what they know" to their colleagues. As they begin thinking about how to answer those questions they are more likely to internalize their arguments and ask the same question to themselves (Kuhn & Dean, 2004). In a video game setting, a multiplayer setting provides a context where an individual is constantly being asked to justify their knowledge. Often this is done through example rather than discourse as a successful demonstration of knowledge is often provided in the game context itself. The concept of interiorization believes that once the process has begun externally, it has a greater chance of occurring internally. Given the large amount of research participants who engaged in multiplayer games there is support for the idea that the same kind of phenomena can occur in a video game context.

It has been recognized that moving to an evaluativist perspective is one of the most challenging growth experiences for an individual. Many adults remain in a more naïve epistemological stance of absolutists or relativists for life (Kuhn & Dean, 2004). It is not simply that video games are challenged in facilitating metacognition and therefore growth; all learning contexts face the same challenge.

One of the most interesting aspects of the research findings is that those participants who began to articulate a critical evaluation of their experiences in a video game were mostly likely to be the ones who recognized that they were outgrowing games. They recognized that games were limited in being able to facilitate their further personal and intellectual growth. As a result they had begun to marginalize video games in favour of other growth experiences that they considered more thought-provoking and meaningful. This group seemed to be the most likely to exhibit the metacognitive skills that could potentially be used during video game play. Unfortunately, they were also the group that was going to end up not playing games at all.

Although the video game context is well-suited for the development of metacognition through active monitoring of learning, there was little evidence of metacognition in the study participants. This doesn't limit the ability of personal epistemological beliefs to grow in a videogame but it does limit the ability of those beliefs to transfer that growth to other contexts. This is not a design flaw in video games as it is challenging to develop metacognition in all learning contexts, not just in video games. Even in the context of formal education it has been noted that only a small number of individuals develop into evaluativistic thinkers that have a more sophisticated approach to personal epistemological beliefs. Most adults remain absolutist or relativistic in their thinking during their lifetime (Kuhn & Dean, 2004).

7.5.3 Types of video game players

The findings indicated that many of the participants had, at some point, adopted a mature epistemic stance in order to learn how to play a video game. Those video game players who use a mature personal epistemological stance while learning to play video games are most likely to support the maturation and growth of their personal epistemology. The conclusion is that a video game player with certain playing characteristics would support the growth of personal epistemological beliefs.

These playing characteristics were seen in players who would demonstrate a continued reliance on themselves as a source of knowledge even when faced with failure in the game. They would rather learn how to play the game themselves and succeed than look to an outside authority for answers. They would feel comfortable with ambiguity and constantly adapt to any new challenge presented in the game environment. They would accept failure as a learning experience and believe that they may need a considerable amount of time to learn everything. Continual success in learning how to play video games using this mature personal epistemological stance will encourage more frequent use of those perspectives.

Although this may seem obvious, many players did not consistently exhibit a single epistemic stance during their descriptions of learning in video games. They would often shift their approach depending on their needs from the video game experience. The same player who exhibited a mature stance one week could take a very different stance the following week if other aspects of their lives became more influential. This would include such things as increased stress and time limitations in their lives. This lack of consistency means that it is unlikely that anyone will always be the type of player who uses a mature epistemic stance.

7.5.4 Types of motivation

Learning to play a video game is voluntary so motivation to play is an important consideration when understanding how personal epistemological beliefs interact with other influences in that context. The conclusion of the findings is that the players who are motivated by personal growth were mostly likely to support the consistent use of a mature epistemological stance while learning how to play a video game. They did not describe this experience in terms of growth or maturation of their epistemological beliefs. They most typically described their motivation in playing video games as a need for intellectual stimulation. They did not have a detailed knowledge of personal epistemology and it seems that the vocabulary they had to describe their motivations and experience using epistemological terms was limited. The players would seek out very complex games that they believed would be the most challenging to their current knowledge and perspectives. The learning experience they described in playing these games often included considerable time to explore, learn, and reflect on their game experiences. The challenges in the game would provide them with the thought-provoking experiences they believed would achieve their goal of growth and stimulation.

Players who were more motivated by escape, socialization, or the attainment of status were most likely to throw up barriers to growth. They were unlikely to engage in the kinds of deep monitoring or mental energy expenditure necessary to tackle difficult learning challenges. These types of players would tend to avoid the stress related with those kinds of learning experiences. Some players view video games exclusively as a source of coping and stress release and would never consider that context as relevant to any kind of personal growth.

7.5.5 Types of games/ game design

The findings indicated that certain game genres were more likely to require a mature epistemological stance in order to learn how to play them and succeed in them. This stance was encouraged by the underlying game design that defined the learning necessary to succeed in the game. The conclusion was that any game with a multiplayer component and the game genres of MMORPG, real-time strategy, and adventure games were the most likely to support the use of a mature epistemic stance during learning.

There were two elements to multiplayer games that supported the growth and maturation of personal epistemology. The first is that multiplayer games were typically the most uncertain and ambiguous environments. They also had the most social interaction that would facilitate interaction and discourse as well the potential for development of social epistemology. The second is that the game player would be most likely to experience multiple viewpoints from other players that would require them to acknowledge many different epistemological stances. In order to play, the game player would need to accept and incorporate those stances, at least for the duration of the game. Although game AI was also capable of providing feedback to the players, it was consistently noted that it was too simple and not capable of providing the kind of experience that was comparable to playing with other human players.

MMORP games already have a multiplayer element as a basis for their design. In addition, they would typically be based on open worlds that were also supportive of growth. These game designs would allow a considerable range of approaches to learning and succeeding in the game. A player could pick a personal epistemic stance that best suited their motivations and use it successfully in the game. There were several examples in the study where different participants described very different personal epistemic stances they took towards game play but all these different approaches occurred in the same MMORP game.

Adventure games were also supportive as they provided the most space for reflection and engagement. These games were typically paced through a thoughtful narrative that was designed to engage and motivate the game player. Despite these being the most typical kinds of games, it should be noted that video game players can create a complex and challenging environment in any game. Situations where a game player would analyze and dissect the game mechanics of a game were a prime example.

7.5.6 Time depth

The finding from the study that the participants had been playing video games for years was consistent with other existing research. As growth of personal epistemological beliefs takes a considerable amount of time, the conclusion is that the video game experience has enough time depth to be a context that would support growth of personal epistemological beliefs.

7.5.7 Societal perceptions

Societal perceptions were identified as a limitation to growth by restricting the perceived value of anything learned by the player during the experience. Many of the participants had adopted the typical societal perceptions of video games as an escapist activity that represented a complete waste of time. Although it is possible to pursue an exclusively escapist agenda while playing video games, players are capable of providing a learning environment that can facilitate growth. In the course of their own discussions players had described a number of occasions where they had exhibited a mature epistemological stance in the course of learning how to play a video game. Despite this, when asked to reflect on the value of learning in video games they tended to view their game play experience as recreational and believed that valuable learning was defined by formal credentials. Although this may be a realistic perspective given the increasing reliance on credentials in order to obtain employment, it did not seem to be a judgment that had come from the game players themselves. Most of the participants did not articulate any kind of personal evaluation of the worth of video games. They tended to rely on an evaluation from an external source. It is ironic that unquestionably relying on the opinions of an outside authority is typical of a naïve personal epistemological stance but it is likely consistent with the messaging they have received their entire lives about the value of learning outside of a formal educational context. It is also consistent with the conclusions related to a general lack of metacognitive skills in the participants. This would limit their ability to reflect on their game playing experience and come to their own conclusions about the experience.

7.6 Summary

In this study, there are many things to consider in summarizing the perceptions that the participants had about learning in video game environments. In addressing these perceptions, the study reviewed perspectives on the types of personal epistemological stances taken and the relative importance of those beliefs while learning. It also required the consideration of several other influences including player motivations, affect, social context and game design.

The conclusion that mature epistemological beliefs can be a part of learning how to play video games is significant. If mature epistemological beliefs can be described in the environment then there is a chance that they can also be part of the growth and development of those beliefs. This provides a bridge between the development of personal epistemological beliefs in a video game and the research that has already been undertaken in the same research domain. Researchers in video game learning now have a framework for study that has demonstrated value and not just an opinion of value, a typical approach of many popular discussions on the value of video games. Personal epistemological beliefs have demonstrated value for a learner in a formal educational setting as well helping them to successfully negotiate the real world. However, there were two main limitations to the impact of this conclusion. One was that the participants were not consistently using mature epistemological beliefs during game play. The second was that video game players view their experience as contextual and don't usually consider the transfer of their video game perspectives on knowledge to other domains.

Learning in video games could best be described as a continuously dynamic system that is constantly changing under several different influences. These influences would combine to create very different motivational states for learning to play the game. This study was most interested in understanding when mature epistemological beliefs had a significant influence in the motivation to learn and would guide the strategies undertaken by the learner. It became apparent that although video games had a considerable amount of potential to facilitate a mature epistemological stance, the participants would only use that stance when it suited their motivations to learn how to play a particular game. This often occurred when a player was dealing with the uncertainty other human intelligences in multiplayer environments. It was also typical when a participant was intrinsically motivated to deal with challenges in games on their own rather than seek help. Sometimes these challenges were motivating because the participants believed that solving them would help them achieve personal growth or intellectual stimulation within the game environment. There are many competing motivations for personal growth however, such as positive affect and escapism that favour a naïve epistemological stance, a position that prefers very little cognitive dissonance or stress. It is likely that there is a mix of both mature and naïve epistemological perspectives being utilized by an individual, with either perspective having the potential to become dominant depending on the strength of the influences in the system. The beliefs would be chosen because they provided the most significant advantage in meeting the needs of the individual at that particular time. The ratio of time spent focused on personal growth, which typically requires a mature epistemological stance, versus pure escapism, which typically uses a more naïve epistemological stance, is still an unknown. It seems from the interviews that when stress and time constraints appeared in the lives of the participants their motivation for personal growth is the first to disappear.

The lack of transfer from video games to the real world is an issue related mostly to metacognition. The participants didn't seem to recognize how their video game experience related to their own personal epistemology. It has nothing to do with a strength or weakness of video games to facilitate epistemic growth. It has to do with the participants understanding their video game experience in their own terms within the game context. For example the participants hundreds of hours of game play in a MMORPG could have been focused on gaining status so they could develop new friends in that online environment. They may not have thought about the intellectual work that went into gaining mastery in that game. The participants only described the gaming experience as a condition of their success in fulfilling the motivations they could identify. A lack of metacognitive skills makes it likely that any growth or epiphany that occurs in a video game stays within that context. The lack of transfer is supported by societal perceptions that anything learned in a game context should stay there. As a result, the game players don't tend to reflect on learning in a game environment. They don't critically examine how this relates to their perceptions of knowledge and knowing, and generalize what they have observed to other contexts.

Video games provide a unique environment for discussing personal epistemological belief structures. The autonomous nature of the learner allows them to choose from a wide range of epistemic stances when learning how to play the game. This presents a unique opportunity to observe a variety of epistemic stances in action. However, the audience for observing this learning phenomenon is not limited to researchers and educators. It represents a context where the players themselves can discuss ideas about knowledge and knowing while they are playing. It also provides those players with years of experience and memories to reflect upon. When remembering or observing their own play, the players are seeing their epistemological stance interact in a dynamic environment that will provide them with constant feedback. That feedback is evaluated by success conditions that are set by the player themselves. Defining their own success allows them to create their own meaning for that experience. That is perhaps one of the most powerful aspects of video games. Video game players have the autonomy and the opportunity to come to their own personal perspective on the meaning of their own epistemology through observation and reflection. This reflection, or metacognition, allows players to reflect on the meaning of their own experiences and it is a step towards those meanings having a wider influence on their lives. This skill is usually attributed to either an education that has a philosophy to promote those skills or the growth that accompanies aging and maturation. Therefore, a lack of reflection in video game players is not a judgment of the games themselves. They still have the potential to facilitate epistemological growth, but it may impact the potential of games to impact our real life epistemological viewpoint. Video games still present a compelling learning environment that has the prospect of being more impactful experience beyond just entertainment.

The fact that the researcher himself can see the potential of video games to exhibit and facilitate mature personal epistemologies is perhaps one of the most significant issues in this study. Given my own experiences with video games it seems that I view them from many different perspectives but most importantly I see their potential for personal growth. There are many writers and researchers who have made similar observations about video games but they are likely looking at video games from a more mature epistemology perspective as well. All of us have seen this potential but not the fact that personal epistemology may not play a major role in the experience of many video game players. Even those video game players who also feel that they could demonstrate and develop their own epistemology within a game-based environment have constraints on when they are able to engage in that type of game play. They were usually constrained by time and several motivational factors that vie for their attention.

So this point to a very significant and overarching question, of the thousands of hours of video game play, how much of that time is really spent in a context where a game player can experience growth and maturation of their personal epistemology? Video games provide the opportunity for a wide range of epistemic stances. The choice of epistemology is linked to the motivations of the player. If the majority of the time is spent using a naïve epistemology in the service of the motivations and goals they have created, it is unlikely that much time has been spent facilitating growth. Gaining awareness of this balance may provide the game player with an honest perspective on the value of those thousands of hours of game play, at least from the perspective of personal epistemological belief structures.

7.6 Recommendations

The findings, analysis, and conclusions from the research lead to a number of recommendations for the following interest groups:

1. Personal epistemological beliefs structure researchers.
2. Educators and parents.
3. Video game players.
4. Game designers.

Recommendations for personal epistemological belief structure researchers

The research field in personal epistemological belief structures is complex and there is no consistent understanding of how these beliefs are described and analyzed. That in mind, these recommendations should be evaluated based on the research paradigm to which they are attached, rather than personal epistemological belief structure research in general. Some of these recommendations are already becoming apparent in the field as other research also identifies some of the gaps that have created a limited focus for studying the phenomena of personal epistemological beliefs.

1. The EBS instrument, and likely other personal epistemological belief survey instruments, should only be used in the context for which they were designed. There are enough complicating factors and methodological problems that affect a researcher's ability to consistently measure personal epistemology in an

educational environment; video games are too different a context for any results to be useful or meaningful.

2. Rather than developing a new survey instrument that is specific to the context of video games it would be more meaningful for the game play itself to become the measure. Video game playing is personal epistemology in action and it would be an authentic representation of an individual rather than a reflection afterwards. Its observation would be a better measure of personal epistemological beliefs of the video game player. In addition, a question-based instrument is not entirely appropriate for a video game context as this kind of assessment or evaluation is not part of a typical game play experience.
3. There are many more influences on learning in a video game environment than are considered when looking at the impact of personal epistemological beliefs in a formal learning environment. If researching personal epistemology beliefs in a video game environment is going to continue to be valuable it would be best to continue to delineate all the meaningful components that influence the expression of personal epistemology in that context. This would include continued work on the rubric that was designed in this study to identify new categories and refine the existing ones.

Recommendations for parents and educators

Parents and educators are the most influential factors in the education of video game players as they grow and mature. They should consider the following:

1. Don't believe the hype, on either side of the debate. Parents and educators need to critically review what they are seeing when they watch an individual playing a

video game. There is no simple answer about the nature and potential benefit of that experience. There are questions they need to ask about the motivation behind the game play that might help them understand if that experience is what they would judge to be a "waste of time" or if there is value in the experience. They need to continue trying to understand the meaning of the video game playing experience and utilize tools, if necessary, in order to evaluate the experience. These tools might include a rubric or form of inquiry that can be used to review video games. Only with a better understanding will parents and educators be able to understand the value of the game and how it is being played in comparison to the goals of maturation and growth of an individual's personal epistemology. They need to understand that not all gaming experiences are going to facilitate growth and that isn't necessarily a negative thing. They will need to weigh out the ratio of different kinds of motivations that are exhibited by the game player before they can decide if the overall experience is having any potentially positive effects or not.

2. Video game play provides a point of discussion that takes personal epistemology out of the esoteric and into a contextualized, real world experience that most students have already experienced. By engaging in conversation with them about their game play experience, it can help these students understand how personal epistemology affects their strategies in video games and how that might generalize to other knowledge construction activities in the real world. It would also help them to understand the complexity and flexibility of personal epistemology.

3. There is an opportunity for video game play to allow an individual to explore the meaning of their experience. If educators provide those game players with a perspective based on a critical inquiry into this personal activity, it could facilitate understanding and learning about metacognition and epistemic metacognition through gaining awareness of personal approaches to video game play.
4. Recognize that learning observed in the informal world of video game play may not transfer to a formal educational context. Educators need to make sure that their own epistemological perspectives aren't affecting their perceptions about learning needs to occur. There are many interesting types of learning behaviour in video gaming but that learning is the result of self-directed learning that incorporates a large number of influences that ultimately form the motivation for playing that game. It is problematic to assume that this learning can just transfer over to an educational context that may have a very different philosophy towards how students should learn. For example, a conflicting philosophy about learning would be an authoritarian perspective that viewed the teacher as the only authentic source of knowledge who would then transmit that knowledge to their students.
5. Parents and educators need to understand that epistemological growth is most likely when motivation is intrinsic rather than extrinsic. At this point a student is not trying to impress their teacher or parent but trying to grow themselves. Parents and educators can't entice students towards intrinsic motivation. Educators can set the stage, lead by example and mentor them along the way but the students ultimately need to create the motivation to learn in games on their own.

Recommendations for game players

Video game players should consider:

1. That by thinking about the meaning of video game play and how they are learning to play, players can come to a better understanding of video games as well as any other media with which they are interacting. This awareness will allow them to decide to monitor choices in game play and classify different types of game play as pure recreation or perhaps involving personal growth. These kinds of evaluations will help them to reflect on the personal value of their game play experience as well as relate their experience to other contexts.
2. What they gain from video game play is going to be a reflection of the motivations they use to play those games. Video games represent a virtual location to explore and "play" with their epistemological beliefs. The player is able to experience dissonance with his or her own perspectives and experiment with that dissonance without risk to them. The choice to engage in this kind of game play is up to the game player. If they are focused on avoiding dissonance and conflict with his or her worldview then games will allow them to spend all of his or her time simply enjoying themselves. The choice in how they play is completely up to the player.

Recommendations for game designers

Game designers are admonished to consider the following:

1. They need to understand how their own personal epistemology sets the stage for game players to plan their tactics for learning in a video game. The way they present the epistemological assumptions of the game will affect if game players

are attracted to the game as well as their willingness to continue playing the game. In reflecting on these concepts, game designers will be able to review the considerable amount of research on personal epistemology which might assist them in understanding how players learn and what motivates them to learn how to play video games.

2. They need to address the issue of game players growing "out" of video games. This seems to occur as the player matures and begins to critically examine their game play experience. There has been a growing recognition in the game design world that a ghettoization of video games is happening. This is marginalizing video games as a form of media that is capable of addressing topics other than pure escapism and entertainment.

Researcher's Reflections

In conclusion, I have sincerely wanted to find a consistent, beneficial aspect to video game play as I have always seen them more for the potential they possess rather than any detrimental effects. The conclusions of the research were much more ambiguous than I expected. While I recognize that the strengths of video game play that I had identified are indeed evident, I have become aware of a number of conditions that qualify those strengths. I understand that my own motivation for personal growth led me to view that potential but it is not a perspective that is shared by all people who play video games. The range of other motivations is considerable and limits the ability of others to see that same potential.

In terms of my own classification as player type, I recognized the potential for games to be more than just a form of relaxation and entertainment. I recognized that many games are purely about entertainment but I saw the growing complexity and sophistication of games having much more potential. I hadn't considered that for many people, they are evaluated exclusively by their ability to escape real life and avoid any kind of dissonance that might trigger growth. This not only limits their ability to grow as a consequence of learning to play games, it means they actively avoid such situations.

I have come to realize that the term "video game" comes with certain preconceptions that do not even come close to the range of possible experiences. Large scale marketing and headline catching stories have created a very shallow perspective on the meaning of video games to their players. There are many video games out there that most people have never heard of, yet they have the potential to create an engaging environment where epistemological growth is possible.

I have used a high degree of rigour in order to question the transfer of any maturation of personal epistemology out of the context of video games and into the real world. I have found a number of limitations to that transfer. I do not believe that this lack of transfer is a limitation in the potential of video games to impact our personal epistemology in other contexts. Our ability to build our metacognitive skills and reflect on our experiences can be facilitated through our educational experiences. Allowing video games to become another context to explore and discuss our learning experiences will only provide a greater richness to both education and video game play.

References

Abanes, R. (2006). *What every parent needs to know about video games: a gamer explores the good, bad, and ugly of the virtual world.* Irvine, CA: Harvest House Publishers.

Aldrich, C. (2005). *Learning by doing: A comprehensive guide to simulations, computer games, and pedagogy in e-learning and other educational experiences.* San Francisco: Pfeiffer.

Alexander, L. (2011). How fantasy worlds shape our lives: The relationships and magic that gaming fosters are why we play. *Gamerpro*, 1, 268.

Ali, S. & Kelly, M. (2004). Ethics and social research. In C. Seale (Eds.), *Researching Society and Culture* (pp. 115-127). Thousand Oaks, CA: Sage.

Arriaga, P., Esteves, F., Carneiro, P., & Monteiro, M. (2006). Violent computer games and their effects on state hostility and physiological arousal. *Aggresive Behaviour*, 32, 358-371.

Bailey, J.(2008). First steps in qualitative data analysis: transcribing. *Family Practice,* 25 (2), 127-131.

Barbour, R.S. (2008). *Introducing qualitative research: A student's guide to the craft of doing qualitative research.* Thousand Oaks, CA: Sage.

Bartholow, B., Bushman, B., & Sestir, M. (2006). Chronic violent video game exposure and desensitization to violence: Behavioural and event-related brain potential data. *Journal of Experimental Social Psychology*, 42, 532-539.

Bartle, R., (1996). Hearts, clubs, diamonds, spades: Players who suit MUDS. Retrieved January 1, 2001, from http://ww.mud.co.uk/richard/mudhist.htm

BBC. (2006). How gaming is all work and no play. Retrieved September 5, 2006, from http://news.bbc.co.uk/2/hi/technology/4774534.stm

Belenky, M. F., Clinchy, B. M., Goldberger, N. R., & Tarule, J. M. (1986). *Women's ways of knowledge: The development of self, voice and mind.* New York: Basic Books.

Benbasat, L., Goldstein, D.K., & Mead, M. (1987). The case research strategy in studies of information systems, *MIS Quarterly*, 5(4), 369-386.

Bendixen, L.D. (2002). A process model of belief change. In B. Hofer and P.Pintrich (Eds.), *Personal epistemology: The psychology of beliefs about knowledge and knowing* (pp. 191-208). Mahwah, NJ: Lawrence Erlbaum Associates.

Bendixen, L. D., & Rule, D. C. (2004). An integrative approach to personal epistemology: A guiding model. *Educational Psychologist*, 39(1), 69-80.

Beswick, D. G. (2007). Management Implications of the Interaction Between Intrinsic Motivation and Extrinsic Rewards. Beswick recent psychological research home page. Retrieved January 1, 2011, from http://www.beswick.info/psychres/management.htm

Bialystock, E. (2006). Effect of bilingualism and computer game experience on the Simon task. *Canadian Journal of Experimental Psychology*, 60, 68-79.

Black, J. B., & McClintock, R. O. (1996). *An interpretation construction approach to constructivist design.* Englewood Cliffs, NJ: Educational Technology Publications.

Bloomberg, L., & Volpe, M. (2008). *Completing your qualitative dissertation: A roadmap from beginning to end.* Thousand Oaks, CA: Sage.

Bowers, C. A. (2005). *The false promise of constructivist theories of learning: A global and ecological critique* (Vol. 14). New York: Peter Lang Publishing, Inc.

Braten, I., & Stromso, H. I. (2006). Epistemological beliefs, interest, and gender as predictors of internet-based learning activities. *Computers in Human Behavior*, (22), 1027-1042.

Bromme, R., Pieschl, S., & Stahl, E. (2010). Epistemological beliefs are standards for adaptive learning: a functional theory about epistemological beliefs and metacognition. *Metacognition Learning*, 5: 7-26.

Brownlee, J. & Berthelsen, D. (2006). Personal epistemology and relational pedagogy in early childhood teacher education programs. *Early Years: An International Journal of Research*, 26(1), 17-29.

Buehl, M.M., & Alexander, P.A. (2006). Examining the dual nature of epistemological beliefs. *International journal of educational research*, 28(42), 28-42.

Buehl, M. M., & Fives, H. (2006, April). *Exploring teachers' beliefs about the nature of pedagogical knowledge: Where does it come from? Does it change?* Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Butler, D., & Winne, P.H. (1995). Feedback and self-regulated learning: a theoretical synthesis. *Review of Educational Research*, 65(3), 245-281.

Carstens, A., & Beck, J. (2005). Get ready for the gamer generation. *TechTrends*, 49(3), 22-25.

Chandler, M. J., Hallett, D., & Sokol, B. W. (2002). Competing claims about competing knowledge claims. In B. Hofer & P. Pintrich (Eds.), *Personal epistemology: The psychology and beliefs about knowledge and knowing* (pp. 145-168). Mahwah, NJ: Lawrence Erlbaum Associates.

Chumbley, J., & Griffiths, M. (2006). Affect and the computer game player: The effect of gender, personality, and game reinforcement structure on affective responses to computer game-play. *CyberPsychology & Behavior*, 9(3), 308-316.

Clancy, D., Fazey, J., & Lawson, R. (2007). Personal epistemology and teaching and learning in higher education, in *Enhancing Higher Education, Theory and Scholarship*, Proceedings of the 30th HERDSA Annual Conference [CD-ROM], Adelaide, Australia, 8-11 July.

Clarebout, G., Elen, J., Luyten, L., & Bamps, H. (2001). Assessing epistemological beliefs: Schommer's Questionnaire revisited. *Educational Research and Education*, 7, 53-77.

Colbeck, D. (2009). *Knowledge genesis: Bridging gaps between learning and understanding*. PhD dissertation, School of Computing and Information Systems, University of Tasmania, Tasmania, Australia.

Connolly, P. (2007). *Quantitative data analysis in education: a critical introduction using SPSS*. Routledge, New York.

Crawford, C. (1982). *The art of computer game design*. Retrieved September 15, 2004, from http://www.vancouver.wsu.edu/fac/peabody/game-book/Coverpage.html

Csíkszentmihályi, M. (1990) *Flow: The psychology of optimal experience*. New York: Harper and Row.

David, M., & Chen, S. (2006). *Serious games: Games that educate, train, and inform*. Boston: Thomson Course Technology.

Davis, B., Sumara, D., & Luce-Kapler, R. (2000). Learning theories. In B. Davis, D. Sumara & R. Luce-Kapler (Eds.), *Engaging minds. Learning and teaching in a complex world*. Mahwah: Lawrence Erlbaum Associates.

Dede, C. (1996). The evolution of constructivist learning environments: Immersion in distributed, virtual worlds. In B. G. Wilson (Ed.), *Constructivist learning environments: Case studies in instructional design* (pp. 252). Englewood Cliffs, NJ: Educational Technology Publications.

Denzin, N. (2001). Interpretive interactionism, Volume 16 of *Applied social research methods series, Applied social research.* SAGE Publications, Thousand Oaks, California.

Depraz, N., Varela, F., & Vermersch, P. (2003). *On becoming aware: A pragmatics of experiencing (Vol. 43).* Philadelphia: John Benjamins Publishing Company.

Dube, L., & Pare, G. (2003). Rigor in information systems positivist case research: current practices, trends, and recommendations, *MIS Quarterly*, vol. 27, no. 4, 597-636.

Dweck, C. (2006). *Mindset: The new psychology of success.* New York: Random House.

Dweck, C.S., & Legget, E.L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review*, 95(2), 256-273.

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, 62, 107–115.

ESA (2009) 2009 sales, demographics and usage data: Essential facts about the computer and video game industry. Entertainment Software Association. Retrieved October 20, 2009, from http://www.theesa.com/facts/pdfs/ESA_EF_2009.pdf

Fagone, J. (2008). The video-game programmer saving out 21st-century souls. Esquire, Retrieved January 1, 2011, from http://www.esquire.com/features/best-and-brightest-2008/future-of-video-game-design-1208-2

Freeman, W. J. (2000). *How brains make up their minds.* New York: Columbia University Press.

Friedl, M. (2003). *Online game interactivity theory.* Hingham, Massachusetts: Charles River Media.

Gagnon, G.W., & Collay, M. (1996). *Constructivist learning design: key questions for teaching to standards.* Thousand Oaks, CA: Corwin Press.

Gallagher, J. M. (1978). The future of formal thought research: The study of analogy and metaphor. In B. Z. Presseisen, D. Goldstein & M. H. Appel (Eds.), *Language and operational thought* (Vol. 2, pp. 210). New York: Plenum Press.

Gee, P. J. (2003). *What videogames have to teach us about learning and literacy.* New York: Palgrave Macmillan.

Gilligan, C., & Kohlberg, L. (1978). From adolescence to adulthood: The rediscovery of reality in a postconventional world. In B. Z. Presseisen, D. Goldstein & M. Appel

(Eds.), *Language and operational thought* (Vol. 2, pp. 210). New York: Plenum Press.

Glasersfeld, E. (1995). *Radical Constructivism: A Way of Knowing and Learning.* Washington: The Falmer Press.

Globus, G. (1995). *The postmodern brain.* Philadelphia, PA: John Benjamins Publishing Company.

Gourgey, A.F. (2001) Metacognition in basic skills instruction. 17-32, In *Metacognition in learning and instruction: theory, research and practice*, ed. H. J. Hartman, Kluwer Academic Publishers, Netherlands.

Graham, J., Zheng, L., & Gonzalez, C. (2006). A cognitive approach to game usability and design: Mental model development in novice real-time strategy games. *CyberPsychology & Behavior*, 9(3), 361-366.

Greasley, P. (2008). *Quantitative data analysis using SPSS: An introduction for health and social sciences.* Open University Press.

Hagood, M. C. (2000). New times, new millennium, new literacies. *Reading Research and Instruction*, 39(4), 311-328.

Hofer, B. (2005). The legacy and the challenges: Paul pintrich's contributions to personal epistemology research. *Educational Psychologist*, 40(2), 95-105.

Hammer, D., & Elby, A. (2003). Tapping epistemological resources for learning physics. *The journal of learning sciences*, 12(1), 53-90.

Hofer, B. K., & Pintrich, P. R. (1997). The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research*, 67(1), 88-140.

Jeng, S., & Teng, C. (2008). Personality and Motivation for Playing Online Games. *Social Behavior and Personality: An International Journal.* 36(8), 1053-1060.

Johnson, S. (2005). *Everything bad is good for you: How today's popular culture is actually making us smarter.* New York: Riverhead Books.

Kahn, R. (1996). Chaos theory, scientific revolutions and creativity in learning. In W. Sulis & A. Combs (Eds.), *Nonlinear dynamics in human behaviour* (Vol. 5, pp. 319-342). New Jersey: World Scientific.

Kvale, S. & Brinkmann, S. (2009). *Interviews. Learning the craft of qualitative research interviewing.* Los Angeles: SAGE, 2nd ed

King, P. M., & Kitchener, K. S. (1994). *Developing reflective judgment: Understanding and promoting intellectual growth and critical thinking in adolescents and adults.* San Francisco: Jossey-Bass.

King, G., & Krzywinska, T. (2002). Hands-on horror. In G. King & T. Krzywinska (Eds.), *Screenplay: Cinema/Videogames/Interfaces* (pp. 206-223). London: Wallflower Press.

Kitchener, K. S., Lynch, C. L., Fischer, K. W., & Wood, P. K. (1993). Developmental range of reflective judgment: The effect of contextual support and practice on developmental stage. *Developmental Psychology*, 29(5), 893-906.

Kuhn, D. (1991). The skills of argument. Cambridge University Press.

Kuhn, D., & Dean, D. (2004). Metacognition: A bridge between cognitive psychology and educational practice. *Theory Into Practice*. 43(4), 268-273.

Kuhn, D., & Park, S.H. (2005). Epistemological understanding and the development of intellectual values. *International Journal of Educational Research*, 43, 111-124.

Kuhn, D., & Weinstock, M. (2002). What is epistemological thinking and why does it matter? In B. Hofer & P. R. Pintrich (Eds.), *Personal epistemology: The psychology and beliefs about knowledge and knowing* (pp. 430). Mahwah (NJ): Lawrence Erlbaum Associates.

Lavallee, A. (2006, July 11). Videogame makers, states battle over content; ratings system, retailers draw the industry's focus amid calls for new laws. *Wall Street Journal.*

Lindley, C.A. (2003). Game Taxonomies: A high level framework for game analysis and design. Retrieved November 14, 2010 fromhttp://www.gamasutra.com/features/20031003/lindley_01.shtml accessed Nov. 25, 2004.

Lenhart, A., Kahne, J., Middaugh, E., Macgill, A.R., Evans, C., Vitak, J. (2008). Teens, video games, and civics: Teens' gaming experiences are diverse and include significant social interaction and civic engagement. Retrieved April 3, 2007, from http://www.pewinternet.org/~/media//Files/Reports/2008/PIP_Teens_Games_and_Civics_Report_FINAL.pdf.pdf Accessed Nov. 20, 2009.

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

Liu, P. (2010). Are beliefs believable? An investigation of college students' epistemological beliefs and behavior in mathematics. *The journal of mathematical behaviour*, 29, 86-98

McPherson, G. (2001). *Applying and interpreting statistics.* Sprin-Verlag, New York.

Merleau-Ponty, M. (1945). *Phenomenology of perception* (C. Smith, Trans.). New York: Routledge.

Moore, D. M., Burton, K. K., & Myers, R. J. (1996). Multi-channel communication: The theoretical and research foundations of multimedia. In D. H. Janassen (Ed.), *Handbook of research for educational communications and technology* (pp. 979-1005). New York: Simon and Schuster.

Moore, W. S. (2002). Understanding learning in a postmodern world: Reconsidering the perry scheme of intellectual and ethical development. In B. Hofer & P. R. Pintrich (Eds.), *Personal epistemology: The psychology of beliefs about knowledge and knowing* (pp. 428). Mahway (NJ): Lawrence Erlbaum Associates.

Muis, K.R. (2004). Personal epistemology and mathematics: A critical review and synthesis of research. *Review of educational research*, 74, 317-377.

Muis, K.R. (2007). The role of epistemic beliefs in self-regulated learning. *Educational Psychologist*, 42(3), 173-190.

Muis, K.R. (2010). Epistemic profiles and metacognition: support for the consistency hypothesis. *Metacognition Learning*, 5, 27-45.

Muis, K.R., Bendixen, L.D., & Haerle, F.C. (2006). Domain-generality and domain-specificity in personal epistemology research: Philosophical and empirical questions in the development of a theoretical framework. *Educational Psychology Review*, 18, 3-54.

Muis, K. R., & Franco, G. (2010). Epistemic profiles and metacognition: Support for the consistency hypothesis. *Metacognition and Learning*, 5, 27-45.

Nist, S. L., & Holschuh, J. P. (2005). Practical Applications of the Research on Epistemological Beliefs. *Journal of College Reading and Learning*, 35(2), 84-92.

Opdenakker, R. (2006). Advantages and Disadvantages of Four Interview Techniques in Qualitative Research [44 paragraphs]. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 7(4), Art. 11, http://nbn-resolving.de/urn:nbn:de:0114-fqs0604118.

Pedersen, R.E. (2009). *Game design foundations.* Burlington, MA: Jones & Bartlett Learning.

Perry, W.G. (1999). *Forms of intellectual and ethical development in the college years: A scheme.* San Francisco: Jossey-Bass Publishers.

Piaget, Jean (1955). *The construction of reality in the child.* New York, NY: Basic Books.

Piaget, Jean (1987). *Possibility and necessity.* Minneapolis, MN: University of Minnesota Press.

Pintrich, P. R., Marx, R.W., & Boyle, R.A. (1993). Beyond cold conceptual change: The role of motivational beliefs and classroom contextual factors in the process of conceptual change. *Review of Educational Research.* 63(2), 167-199.

Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. *Science Education*, 66, 211-227.

Prensky, M. (2001). Digital natives, digital immigrants, part ii: Do they really think differently? *On the Horizon*, 9(6), 1-9.

Prensky, M. (2004). Capturing the value of "generation tech" employees. enews: developments in strategy+business Retrieved September 2, 2006, from http://www.strategy-business.com/enewsarticle/enews063004

Remo, Chris (2009). Hecker: Indies can't do all the heavy creative lifting. Gamasutra. Retrieved December 20, 2010, from http://www.gamasutra.com/view/news/26128/Hecker_Indies_Cant_Do_All_The_Heavy_Creative_Lifting.php

Ridenour, C.S., & Newman, I. (2008). *Mixed methods research: Exploring the interactive continuum.* Carbondale: Southern Illinois University Press.

Rideout, V.J., Vandewater, E.A., & Wartella, E.A. (2003). *Zero to six: Electronic media in the lives of infants, toddlers and preschoolers.* Menlo Park, CA: Henry J. Kaiser Family Foundation.

Riesbeck, C. K. (1996). Case-based teaching and constructivism: Carpenters and tools. In B. G. Wilson (Ed.), *Constructivist learning environments* (pp. 252). Englewood Cliffs, NJ: Educational Technology Publications.

Rollings, A., & Adams, E. (2003). *Andrew rollings and ernest adams on game design.* Indianapolis: New Riders.

Ruben, B. D. (1999). Simulations, games, and experience-based learning: The quest for a new paradigm for teaching and learning. *Simulation & Gaming*, 30(4), 498-505.

Schommer, M. (1989). Students' beliefs about the nature of knowledge: What are they and how do they affect comprehension? *Technical Report No. 484*, Center for the Study of Reading, University of Illinois.

Schommer, M. (1990). Effects of beliefs about the nature of knowledge on comprehension. *Journal of Educational Psychology*. Vol 82(3), 498-504.

Schommer, M. (1994). Synthesizing epistemological belief research: Tentative understandings and provocative confusions. *Educational Psychology Review*, 6(4), 293-319.

Schommer-Aikins, M. (2004). Explaining the epistemological belief systems: Introducing the embedded systemic model and coordinated research approach. *Educational Psychologist*, 39(1), 19-29.

Schommer-Aikins, M., & Easter, M. (2006). Ways of knowing and epistemological beliefs: Combined effect on academic performance. *Educational Psychology*, 26(3), 411-423.

Schraw, G., Bendixen, L. & Dunkle, M. (2002).Development and Validation of the Epistemic Belief Inventory (EBI)', in Hofer, B. & Pintrich, P. (ed), *Personal Epistemology: The psychology of beliefs about knowledge and knowing*, Lawrence Erlbaum Associates, Mahwah, New Jersey, pp. 261-275.

Schwab, B. (2004). *Ai game engine programming*. Hingham, Massachusetts: Charles River Media, Inc.

Seale, C. (2004). Coding and analyzing data. In C. Seale (Eds.), *Researching Society and Culture* (pp. 305-321). Thousand Oaks: Sage.

Shank, R., & Cleary, C. (1995). *Engines for education*. Hillsdale: Lawrence Erlbaum Associates.

Sharples, M., Hogg, D., Hutchinson, C., Torrance, S., & Young, D. (1989). *Computers and thought: A practical introduction to artificial intelligence* (Vol. 5). Cambridge, Massachusetts: MIT Press.

Silverman, D. (2005). *Doing qualitative research: A practical handbook*. Thousand Oaks (CA): Sage.

Sotamaa, O. (2007). Perceptions of player in game design literature. *Situated play, proceedings of the DiGRA 2007 Conference.*

Spicer, N. (2004). Combining qualitative and quantitative methods. In C. Seale (Eds.), *Researching Society and Culture* (pp. 293-304). Thousand Oaks: Sage.

Spiro, R. J., Feltovich, P. J., & Coulson, R. (1996b). Two epistemic world-views: Prefigurative schemas and learning in complex domains. *Applied Cognitive Psychology*, 10(7), 51-61.

Steinkuehler, C. & Chmiel, M. (2006). Fostering scientific habits of mind in the context of online play. In S. Barab, K. Hay & D. Hickey (Eds.), In *Making a difference: Proceedings of the seventh international conference on the learning sciences* (pp. 723-729). Mahwah (NJ): International Society of the Learning Sciences, Inc.

Stocker, M., & Hegeman, E. (1996). *Valuing emotions.* Cambridge University Press

Tonkiss, F. (2004). Analysing text and speech: content and discourse analysis. In C. Seale (Eds.), *Researching Society and Culture* (pp. 367-382). Thousand Oaks (CA): Sage.

Video game industry sales rise to $12.5 billion. (2007, January 13) *Los Angeles Times.*

Von Glaserfeld, E. (1995). A constructivist approach to teaching, In L.P. Steffe and J. Gale (Eds.), *Constructivism in education* (pp. 3-15). Hillsdale, NJ: Lawrence Erlbaum Associates.

Walker, W. E. (1995). *Rand/ european-american center for policy analysis p-7897. The use of scenarios and gaming in crisis management planning and training.* Santa Monica: Rand.

Wan, C., & Chiou, W. (2006). Psychological motives and online games addiction: a test of flow theory and humanistic needs theory for Taiwanese adolescents. *Cyberpsychology & Behaviour*, 9(3), 317-324.

Wang, X., & Perry, A. C. (2006). Playing video games: Sloth or exercise? *Pediatric Alert*, 31(10), 56-57.

Westen, D., Blagov, P.S., Harenski, K., Kilts, C., &Hamann, S. (2006). Neural bases of motivated reasoning: An fMRI study of emotional contraints on partisan political judgment in the 2004 U.S. presidential election. *Journal of Cognitive Neuroscience*, 18:11, 1947-1958.

Winne, P.H. (2001). Self-regulated learning viewed from models of information processing. In *Self-regulated learning and academic achievement: theoretical perspectives* B.J. Zimmerman (eds.) (pp. 153-190). Schunk: Routledge.

Winne, P. H., & Jamieson-Noel, D. L. (2002). Exploring students' calibration of self-reports about study tactics and achievement. *Contemporary Educational Psychology*, 27, 551-572.

Wittgenstein, L. (1958). *Philosophical investigations.* Basil Blackwell Ltd: Oxford.

Yee, N. (2002). Five motivational factors for why people play MMORPG's. Retrieved January 1, 2011, from http://www.nickyee.com/facets/home.html

Yee, N. (2006). The Psychology of MMORPGs: Emotional Investment, Motivations, Relationship Formation, and Problematic Usage. In R. Schroeder & A. Axelsson (Eds.), *Avatars at Work and Play: Collaboration and Interaction in Shared Virtual Environments* (pp. 187-207). London: Springer-Verlag.

Yin, R.K. (2009). *Case study research: Design and methods.* Thousand Oaks, Sage.

Yuruk, N., Ozdemir, O., & Beeth, M. E. (2003). The role of metacognition in facilitating conceptual change. Paper presented at the *Annual meeting of the National Association for Research in Science Teaching*, Philadelphia, PA.

APPENDIX A: Survey Instrument

Full Survey Instrument

Question No.	EBS No.	
1		What is your current age?
2		Are you male or female?
3		What is the degree or discipline that you are currently studying?
4		What is the year of study in your current program?
5	**1**	You never know what a book is about unless you know the intentions of the author.
6	**2**	Most words have one clear meaning.
7	**3**	A sentence has little meaning unless you know the context in which it is used.
8	**4**	The best thing about science courses is that most problems have only one right answer.
9	**5**	The most important part of scientific work is original thinking.
10	**6**	A good lecturer will keep their students from wandering off the right track.
11	**7**	You will just get confused if you try and integrate new ideas in a textbook with knowledge that you already have about the subject.
12	**8**	Studying means understanding the big issues, rather than details.
13	**9**	A really good way to understand a textbook is to reorganize the information according to your personal way of looking at it.
14	**10**	Being a good student means that you can memorize a lot of facts.
15	**11**	It is a waste of time working on problems that have no possibility of coming out with a clear cut and unambiguous answer.
16	**12**	I find it refreshing to think about issues that experts can't agree on.
17	**13**	If lecturers would stick more to the facts and less about theory, students would get more out of University.
18	**14**	I don't like movies that don't have a clear-cut ending.
19	**15**	Truth is unchanging.
20	**16**	The only thing certain in life is uncertainty itself.
21	**17**	Events from the past do not influence events in the future.
22	**18**	If scientists try hard enough, they can find out the truth about almost anything.
23	**19**	When you first encounter a difficult concept in a textbook, it is better for you to work it out on your own rather than ask your lecturer.
24	**20**	Sometimes you need to accept answers from a lecturer even though you don't understand them.
25	**21**	Even advice from experts should be questioned.
26	**22**	People who challenge authority come across as a bit full of themselves.
27	**23**	You can believe almost everything you read.
28	**24**	If you believe you are familiar with the topic, you should evaluate the accuracy of the information in your textbook.
29	**25**	Some people are born to be good learners; others are stuck with a limited ability.
30	**26**	Almost all the information you can learn from a text you will get from the first reading.

31	**27**	If you find the time to re-read a textbook chapter, you would get more out of it the second time around.
32	**28**	Going over and over a difficult textbook chapter usually won't help you understand it.
33	**29**	*If you can't understand something within a short period of time, you should just* keep on trying.
34	**30**	Working hard on a difficult problem for an extended period of time only pays off for really smart students.
35	**31**	If you are ever going to understand something, it will make sense to you the first time.
36	**32**	Successful student understand things quickly.
37	**33**	Learning is the slow process of building up knowledge.
38	**34**	Wisdom is not necessarily knowing the answers, but knowing how to find the answers.
39		Which category would best describe your video game playing? (mark one)
40		If you play games, what types do you play? (mark as many as are applicable)
41		In order to maintain confidentiality, you'll need to give yourself a pseudonym. This is just a name that will be used to connect your survey with your interview data. If you'd like to be interviewed, please put down a pseudonym in the box. It can be anything, a gamertag, nickname or usename that you will remember is usually the best.
42		I will need a contact email address so I can set up an interview time. Please enter an email address that I can use to contact you. Your email address will be kept confidential and will be stored separately from your survey and interview information.

EBS Survey instrument

EBS No.	
1	You never know what a book is about unless you know the intentions of the author.
2	Most words have one clear meaning.
3	A sentence has little meaning unless you know the context in which it is used.
4	The best thing about science courses is that most problems have only one right answer.
5	The most important part of scientific work is original thinking.
6	A good lecturer will keep their students from wandering off the right track.
7	You will just get confused if you try and integrate new ideas in a textbook with knowledge that you already have about the subject.
8	Studying means understanding the big issues, rather than details.
9	A really good way to understand a textbook is to reorganize the information according to your personal way of looking at it.
10	Being a good student means that you can memorize a lot of facts.
11	It is a waste of time working on problems that have no possibility of coming out with a clear cut and unambiguous answer.
12	I find it refreshing to think about issues that experts can't agree on.
13	If lecturers would stick more to the facts and less about theory, students would get more out of University.
14	I don't like movies that don't have a clear-cut ending.

15 Truth is unchanging.
16 The only thing certain in life is uncertainty itself.
17 Events from the past do not influence events in the future.
18 If scientists try hard enough, they can find out the truth about almost anything.
19 When you first encounter a difficult concept in a textbook, it is better for you to work it out on your own rather than ask your lecturer.
20 Sometimes you need to accept answers from a lecturer even though you don't understand them.
21 Even advice from experts should be questioned.
22 People who challenge authority come across as a bit full of themselves.
23 You can believe almost everything you read.
24 If you believe you are familiar with the topic, you should evaluate the accuracy of the information in your textbook.
25 Some people are born to be good learners; others are stuck with a limited ability.
26 Almost all the information you can learn from a text you will get from the first reading.
27 If you find the time to re-read a textbook chapter, you would get more out of it the second time around.
28 Going over and over a difficult textbook chapter usually won't help you understand it.
29 If you can't understand something within a short period of time, you should just keep on trying.
30 Working hard on a difficult problem for an extended period of time only pays off for really smart students.
31 If you are ever going to understand something, it will make sense to you the first time.
32 Successful student understand things quickly.
33 Learning is the slow process of building up knowledge.
34 Wisdom is not necessarily knowing the answers, but knowing how to find the answers.

APPENDIX B: Interview Content Analysis Rubric

Interview Rubric

Category Dimension	**Category Name**	**Category Descriptors**	
		Naïve	*Mature*
Nature of Knowledge	Certainty of knowledge		
	Simplicity of Knowledge (F1)		
Nature of Knowing	Quick learning (F2)		
Fixed Ability	Fixed ability (F3)		
Omniscient Authority	Source of knowledge (F4)		
		Absent	*Present*
Affect			
Motivation	Socialization		
	Relaxation		
	Personal growth		
Mechanisms of Change	Awareness of dissonance		
	"Responsibility" to address dissonance		
Environmental			
	Contextual epistemology		
	Social epistemology		

Explanation of Rubric

The rubric was designed to classify themes related to personal epistemology and video game play. The themes identified in the rubric have been deductively derived from existing research frameworks in the current literature.

Defintions

Challenges: The challenges would be presented by the game design, the game AI and the parameters for playing alone and with others.

Category: Certainty of Knowledge
Descriptor –Naïve
A naïve perspective towards knowledge sees it as unchanging and unambiguous. They would look for, and single correct way of solving challenges in the game. They would believe that the correct way of solving the game was knowable and unambiguous.

Example
A naïve perspective of certainty of knowledge in a gaming context would believe that information within the game was straightforward and unchanging. Any knowledge gained during the course of gameplay would remain consistent throughout the entire duration of the game. This would include understanding of game mechanics that remain the same between games within a genre. An example would be the use of the same game controls, mechanics and game design between different first person shooters. When it comes to finding answers to challenges presented in the games a naïve player would believe that there is a single correct answer to solving the problem.

Descriptor –Mature
A mature perspective towards knowledge sees it as ever changing and subject to any number of variations. A game player would believe that there are many ways to solve a challenge in a game and there may not be a single "right" answer. They would also believe that some challenges in the game may not have a correct answer.

Example
A more mature perspective on games would understand that the game was an interrelated complex of factors that changed within the game and needed to be evaluated constantly in order to succeed. The answers or solutions generated during those evaluations would be different depending on the individual player. It is possible that some many players might come up with a solution but one of those solutions may be superior.

Category: Simplicity of Knowledge
Category Descriptor -Naive
Simple knowledge from a naïve perspective views knowledge or information as isolated and unconnected to one another. The game player would be looking for one, single correct answer to challenges in the game.

Example
The actions available within the game are discrete and only used in a single context. Once those actions have been identified, learned and memorized, it is possible to use those skills over and over again to win the game.

Category Descriptor -Mature
As more mature perspective views knowledge as more of a collection of interrelated concepts. The game player would accept that the complexity of the game allows for

multiple answers to challenges in the game. They would try to integrate the knowledge they have developed in game play to more successfully solve challenges in the game.

Example
A more mature perspective would look at the underlying process behind the game, believing that understanding that process is the key to succeeding in the game. Once the underlying models are uncovered they can be adapted to deal with any problem encountered in the game.

Category: Quick Learning
Descriptor-Naïve
A naïve approach to the speed of learning believes that you should learn something quickly or you simply won't learn it at all. If the game player does not master the game play very quickly they will stop game play because they don't believe they will be able to play the game successfully.

Example
A game player would become quickly frustrated and quit when they try to play a game they can't learn initially. These games are described as having a steep learning curve and would be abandoned when it became obvious that they would be challenging to master.

Descriptor-Mature

As epistemology matures, a new perspective evolves that learning is gradual and takes time.

Example
A more mature perspective would believe that initial frustrations at learning how to play the game would be overcome by continued persistence at playing the game. Success in the game was a slow process of building of knowledge about the game. The strategy for learning would be persistence and trying multiple approaches to challenges presented in the game.

Category: Fixed Ability
Descriptor-Naïve
Fixed ability is not necessarily about competence but rather how an individual reacts to failure. A naïve individual believes that their failure is the result of low intelligence and inadequacy. After a first failure, their subsequent attempts to address a challenge become less and less effective as they do not believe they can ever solve the problem. Their goals are generally around performance targets and external validation.

Example
A more naïve player would believe that they lacked the intelligence or ability to learn the game if they failed early during game play. They would indicate that problems in the game were insurmountable and would likely have quit playing that game. They are often focused on obtaining high scores in games they can master as a status mechanism.

Descriptor-Mature
A mature perspective doesn't react to failure the same way. When they don't succeed at a challenge they believe that they can try again and eventually succeed. Their intelligence is malleable enough that they can rise to the challenge and succeed. They will actively seek out such experiences to grow and increase their competence.

Example
A more mature perspective for game play would see any a video game as winnable. This perspective would persist with a video game with a steep learning curve through effort and self-instruction. That player would also actively seek out challenges that were beyond their competence and knowledge as an opportunity to grow.

Category: Source of knowledge
Descriptor-Naïve
The game player will look to an external authority as the source of knowledge for solutions to challenges in the game.

Example
The game player has a reliance on friends, websites or some kind of "cheat" created by another player in order to succeed in the game.

Descriptor-Mature
A more mature perspective is that the individual is the source of knowledge and the player will need to develop knowledge on their own in order to solve the challenges in the game.

Example
The game player will develop their own knowledge base, either on their own or collaboratively with other players. This internal knowledge base will serve as the basis of solving any challenges presented in the game.

Category: Affect
Descriptor-No emotion
The game player coldly engages in the game and methodically solves challenges presented to them.

Example
The game player describes their game play experience as game play as a completely intellectual experience that never involves an emotional response.

Descriptor-Emotional
The game player describes emotion as an integral part of their game playing experience and is often a factor when they are encountering and solving challenges presented in the game.

Example
The game player describes their emotional state as part of their experience and often an influence on the strategy they undertake to solve problems.

Category: Motivation
Category: Socialization
Descriptor –Present
The game player engages in games as a socialization activity with friends. The social aspect is often related to companionship and increased social standing within a group.

Descriptor –Absent
The game player only plays game alone

Category: Motivation
Category: Relaxation
Descriptor –Present
The game player will engage in video game play when they are stressed or bored.

Descriptor –Absent
The player will not engage in video game play as a way to coping with stress or dealing boredom.

Category: Motivation
Category: Personal Growth
Descriptor –Present
The game player will engage in a video game if they believe it will help them grow as a person.

Descriptor –Absent
The player does not consider video game play as a way to help them grow.

Category: Environment
Category: Contextual epistemology
Descriptor –Present
The worldview presented by the player is only considered relevant in the video game context.

Descriptor –Absent
The skills that the game player develops generalize to their everyday life.

Category: Environment
Category: Social epistemology
Descriptor –Present

The epistemology of the game player is created by a social group and does not reside in the individual.

Descriptor –Absent
The epistemology of the game player is solely their own.

APPENDIX C: Statistical Results

Analysis of Variance of EBS Subsets by year of study

Tool: Microsoft Excel

Subset 1: Seeks single answers

Analysis:

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
1	11	30.5	2.772727	0.04596
2	12	34.33333	2.861111	0.266835
3	16	44	2.75	0.17037
4	8	21.66667	2.708333	0.30754
5	3	7.5	2.5	0.527778

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.350219	4	0.087555	0.430189	0.786049	2.578739
Within Groups	9.15867	45	0.203526			
Total	9.508889	49				

In subset 1, the F ratio (0.430189) is not larger than the F crit (2.578739) indicating that there is not statistically significant difference between the undergraduate years.

Subset 2: Avoid Integration

Analysis

Calculated with an alpha of 0.05.

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*

1	11	28.25	2.568182	0.288636
2	12	27.5	2.291667	0.179924
3	16	35.75	2.234375	0.21224
4	8	19.75	2.46875	0.239955
5	3	7	2.333333	0.270833

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.880772	4	0.220193	0.964773	0.436122	2.578739
Within Groups	10.27048	45	0.228233			
Total	11.15125	49				

In subset 2, the F ratio (0.964773) is not larger than the F crit (2.578739) indicating that there is no statistical significance between the undergraduate years.

Subset 3: Avoid Ambiguity

Analysis

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
1	11	24.75	2.25	0.3625
2	12	28.75	2.395833	0.550663
3	16	33.25	2.078125	0.25599
4	8	16.75	2.09375	0.284598
5	3	6	2	0.8125

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.930677	4	0.232669	0.610883	0.65693	2.578739
Within Groups	17.13932	45	0.380874			
Total	18.07	49				

In subset 3, the F ratio (0.610883) is not larger than the F crit (2.578739) indicating that there is not statistical significance between the undergraduate years.

Subset 4: Knowledge is certain

Analysis

Calculated with an alpha of 0.05.

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
1	11	31.5	2.863636	0.279545
2	12	36.75	3.0625	0.37642
3	16	52	3.25	0.258333
4	8	24	3	0.232143
5	3	8.25	2.75	0.25

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.31392	4	0.32848	1.142665	0.348751	2.578739
Within Groups	12.93608	45	0.287468			
Total	14.25	49				

In subset 4, the F ratio (1.142665) is not larger than the F crit (2.578739) indicating that there is not statistical significance between the undergraduate years.

Subset 5: Depend on authority

Analysis

Calculated with an alpha of 0.05.

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
1	11	35.5	3.227273	0.468182
2	12	35	2.916667	0.765152
3	16	46.5	2.90625	0.640625
4	8	22.5	2.8125	0.424107
5	3	10	3.333333	0.083333

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.401723	4	0.350431	0.610193	0.657412	2.578739
Within Groups	25.84328	45	0.574295			

Total	27.245	49

In subset 5, the F ratio (0.610193) is not larger than the F crit (2.578739) indicating that there is not statistical significance between the undergraduate years.

Subset 6: Don't criticize authority

Analysis

Calculated with an alpha of 0.05.

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
1	11	24.25	2.204545	0.260227
2	12	27.25	2.270833	0.187027
3	16	32.25	2.015625	0.295573
4	8	15.5	1.9375	0.138393
5	3	7.75	2.583333	0.333333

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1.416425	4	0.354106	1.485266	0.222562	2.578739
Within Groups	10.72857	45	0.238413			
Total	12.145	49				

In subset 6, the F ratio (1.485266) is not larger than the F crit (2.578739) indicating that there is not statistical significance between the undergraduate years.

Subset 7: The ability to learn is innate

Analysis

Calculated with an alpha of 0.05.

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
1	11	29	2.636364	1.254545
2	12	33	2.75	1.113636
3	16	53	3.3125	1.9625
4	8	21	2.625	1.696429
5	4	9	2.25	1.583333

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	5.887143	4	1.471786	0.955463	0.440925	2.574035
Within Groups	70.85795	46	1.54039			
Total	76.7451	50				

In subset 7, the F ratio (0.955463) is not larger than the F crit (2.574035) indicating that there is not statistical significance between the undergraduate years.

Subset 8: Learn the first time

Analysis

Calculated with an alpha of 0.05.

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
1	11	37.33333	3.393939	0.240404
2	12	42.33333	3.527778	0.069865
3	16	55.66667	3.479167	0.266204
4	8	28	3.5	0.063492
5	3	11.33333	3.777778	0.037037

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.3692	4	0.0923	0.54053	0.706722	2.578739
Within Groups	7.684133	45	0.170759			
Total	8.053333	49				

In subset 8, the F ratio (0.54053) is not larger than the F crit (2.578739) indicating that there is not statistical significance between the undergraduate years.

Subset 9: Learning is quick

Analysis

Calculated with an alpha of 0.05.

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
1	11	38.2	3.472727	0.162182
2	12	39.6	3.3	0.12
3	16	52.6	3.2875	0.2825
4	8	28	3.5	0.057143
5	3	10.4	3.466667	0.173333

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.445215	4	0.111304	0.63193	0.642294	2.578739
Within Groups	7.925985	45	0.176133			
Total	8.3712	49				

In subset 9, the F ratio (0.63193) is not larger than the F crit (2.578739) indicating that there is not statistical significance between the undergraduate years.

Subset 10: Success is unrelated to hard work

Analysis

Calculated with an alpha of 0.05.

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
1	11	18	1.636364	0.254545
2	12	22	1.833333	0.69697
3	16	29	1.8125	0.295833
4	8	13	1.625	0.553571
5	4	5	1.25	0.25

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.313614	4	0.328404	0.783754	0.541615	2.574035
Within Groups	19.27462	46	0.419014			
Total	20.58824	50				

In subset 10, the F ratio (0.783754) is not larger than the F crit (2.574035) indicating that there is not statistical significance between the undergraduate years.

Analysis of Variance of EBS questions by year of Study.

Tool: Instat

Question 1: You never know what a book is about unless you know the intentions of the author.

Summary statistics:

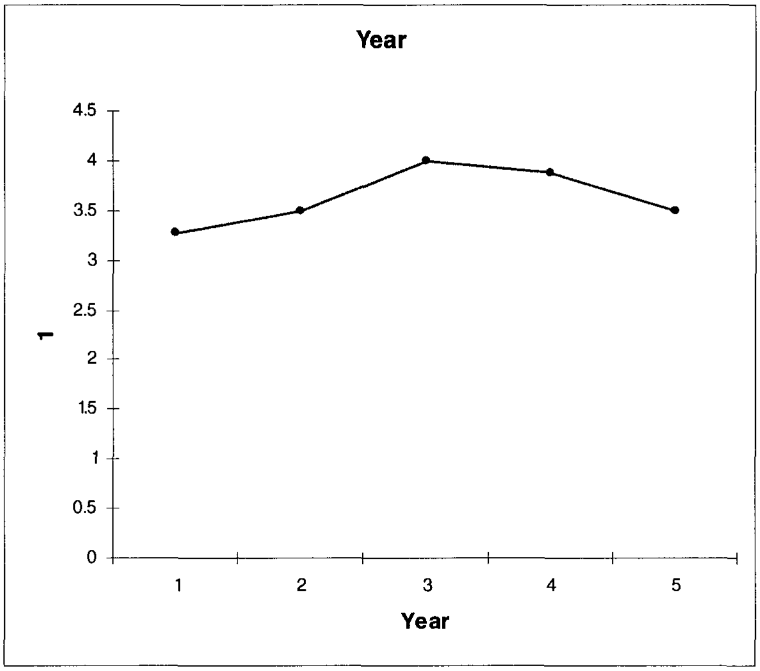
Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
1	51	0	51	2.000	5.000	3.667	0.887

Variable	Categories	Frequencies	%
Year	1	11	21.569
	2	12	23.529
	3	16	31.373
	4	8	15.686
	5	4	7.843

Correlation matrix:

Variables	Year-1	Year-2	Year-3	Year-4	Year-5	1
Year-1	**1.000**	-0.291	-0.355	-0.226	-0.153	-0.235
Year-2	-0.291	**1.000**	-0.375	-0.239	-0.162	-0.105
Year-3	-0.355	-0.375	**1.000**	-0.292	-0.197	0.257
Year-4	-0.226	-0.239	-0.292	**1.000**	-0.126	0.102
Year-5	-0.153	-0.162	-0.197	-0.126	**1.000**	-0.055
1	-0.235	-0.105	0.257	0.102	-0.055	**1.000**

Means charts:



Year / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	Significant
3 vs 1	0.727	2.127	2.839	0.226	No
3 vs 2	0.500	1.500	2.839	0.568	No
3 vs 5	0.500	1.025	2.839	0.843	No
3 vs 4	0.125	0.331	2.839	0.997	No
4 vs 1	0.602	1.485	2.839	0.577	No
4 vs 2	0.375	0.941	2.839	0.879	No
4 vs 5	0.375	0.701	2.839	0.955	No
5 vs 1	0.227	0.446	2.839	0.992	No
5 vs 2	0.000	0.000	2.839	1.000	No
2 vs 1	0.227	0.624	2.839	0.971	No
Tukey's d critical value:			4.015		

Category	LS means	Groups
3	4.000	A
4	3.875	A
2	3.500	A
5	3.500	A
1	3.273	A

Year / REGWQ / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	alpha (Modified)	Significant

3 vs 1	0.727	2.127	2.839	0.226	0.050	No
3 vs 2	0.500	1.500	2.665	0.446	0.050	No
3 vs 5	0.500	1.025	2.665	0.565	0.050	No
3 vs 4	0.125	0.331	2.665	0.742	0.050	No
4 vs 1	0.602	1.485	2.665	0.455	0.050	No
4 vs 2	0.375	0.941	2.633	0.617	0.030	No
4 vs 5	0.375	0.701	2.633	0.487	0.030	No
5 vs 1	0.227	0.446	2.633	0.896	0.030	No
5 vs 2	0.000	0.000	2.404	1.000	0.020	No
2 vs 1	0.227	0.624	2.404	0.536	0.020	No

Category	LS means	Groups
3	4.000	A
4	3.875	A
2	3.500	A
5	3.500	A
1	3.273	A

Year / Dunnett (two sided) / Analysis of the differences between categories and the control category Year-1 with a confidence interval of 95%:

Category	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
1 vs 3	-0.727	-2.127	2.542	0.869	0.113	No
1 vs 4	-0.602	-1.485	2.542	1.031	0.380	No
1 vs 5	-0.227	-0.446	2.542	1.296	0.977	No
1 vs 2	-0.227	-0.624	2.542	0.926	0.926	No

Question 2: Most words have one clear meaning.

Summary statistics:

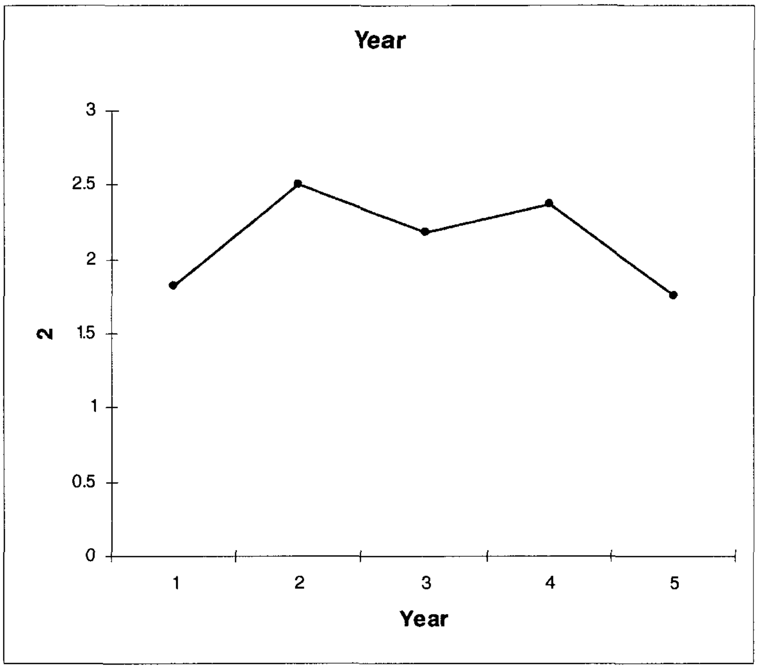
Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
2	51	0	51	1.000	5.000	2.176	1.090

Variable	Categories	Frequencies	%
Year	1	11	21.569
	2	12	23.529
	3	16	31.373
	4	8	15.686
	5	4	7.843

Correlation matrix:

Variables	Year-1	Year-2	Year-3	Year-4	Year-5	2
Year-1	**1.000**	-0.291	-0.355	-0.226	-0.153	-0.174
Year-2	-0.291	**1.000**	-0.375	-0.239	-0.162	0.166
Year-3	-0.355	-0.375	**1.000**	-0.292	-0.197	0.007
Year-4	-0.226	-0.239	-0.292	**1.000**	-0.126	0.079
Year-5	-0.153	-0.162	-0.197	-0.126	**1.000**	-0.115
2	-0.174	0.166	0.007	0.079	-0.115	**1.000**

Means charts:



Year / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	Significant
2 vs 5	0.750	1.181	2.839	0.762	No
2 vs 1	0.682	1.484	2.839	0.578	No
2 vs 3	0.313	0.744	2.839	0.945	No
2 vs 4	0.125	0.249	2.839	0.999	No
4 vs 5	0.625	0.928	2.839	0.885	No
4 vs 1	0.557	1.089	2.839	0.811	No
4 vs 3	0.188	0.394	2.839	0.995	No
3 vs 5	0.438	0.711	2.839	0.953	No
3 vs 1	0.369	0.857	2.839	0.911	No
1 vs 5	0.068	0.106	2.839	1.000	No
Tukey's d critical value:			4.015		

Category	LS means	Groups
2	2.500	A
4	2.375	A
3	2.188	A
1	1.818	A
5	1.750	A

Year / REGWQ / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	alpha (Modified)	Significant
2 vs 5	0.750	1.181	2.839	0.762	0.050	No
2 vs 1	0.682	1.484	2.665	0.455	0.050	No
2 vs 3	0.313	0.744	2.665	0.739	0.050	No
2 vs 4	0.125	0.249	2.665	0.805	0.050	No
4 vs 5	0.625	0.928	2.665	0.790	0.050	No
4 vs 1	0.557	1.089	2.633	0.526	0.030	No
4 vs 3	0.188	0.394	2.633	0.696	0.030	No
3 vs 5	0.438	0.711	2.633	0.758	0.030	No
3 vs 1	0.369	0.857	2.404	0.396	0.020	No
1 vs 5	0.068	0.106	2.404	0.916	0.020	No

Category	LS means	Groups
2	2.500	A
4	2.375	A
3	2.188	A
1	1.818	A
5	1.750	A

Year / Dunnett (two sided) / Analysis of the differences between categories and the control category Year-1 with a confidence interval of 95%:

Category	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
1 vs 2	-0.682	-1.484	2.542	1.167	0.380	No
1 vs 4	-0.557	-1.089	2.542	1.300	0.650	No
1 vs 3	-0.369	-0.857	2.542	1.095	0.808	No
1 vs 5	0.068	0.106	2.542	1.633	1.000	No

Question 3: A sentence has little meaning unless you know the context in which it is used.

Summary statistics:

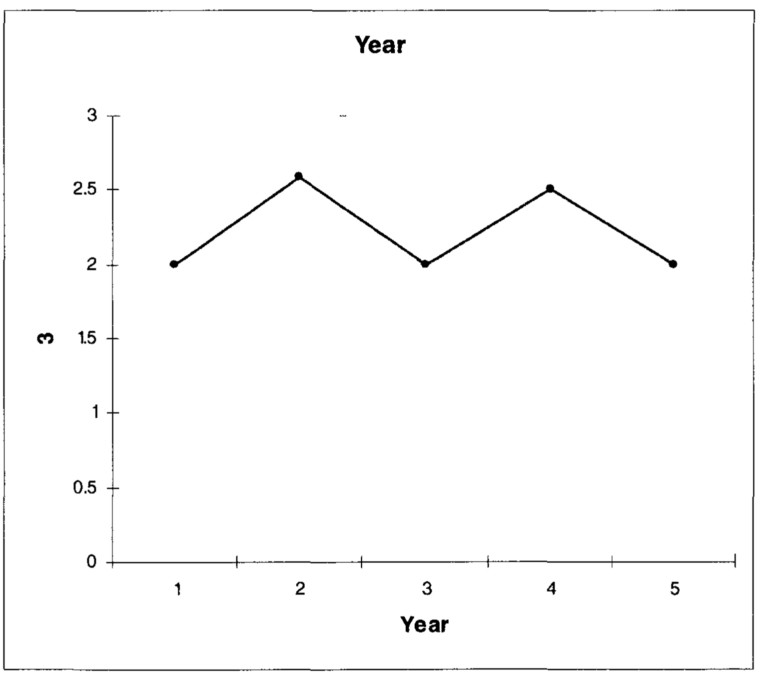
Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
3	51	0	51	1.000	5.000	2.216	0.945

Variable	Categories	Frequencies	%
Year	1	11	21.569
	2	12	23.529
	3	16	31.373
	4	8	15.686
	5	4	7.843

Correlation matrix:

Variables	Year-1	Year-2	Year-3	Year-4	Year-5	3
Year-1	**1.000**	-0.291	-0.355	-0.226	-0.153	-0.121
Year-2	-0.291	**1.000**	-0.375	-0.239	-0.162	0.218
Year-3	-0.355	-0.375	**1.000**	-0.292	-0.197	-0.156
Year-4	-0.226	-0.239	-0.292	**1.000**	-0.126	0.131
Year-5	-0.153	-0.162	-0.197	-0.126	**1.000**	-0.067
3	-0.121	0.218	-0.156	0.131	-0.067	**1.000**

Means charts:



Year / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized	Critical	Pr > Diff	Significant

		difference	value		
2 vs 1	0.583	1.482	2.839	0.579	No
2 vs 3	0.583	1.620	2.839	0.493	No
2 vs 5	0.583	1.071	2.839	0.820	No
2 vs 4	0.083	0.194	2.839	1.000	No
4 vs 1	0.500	1.141	2.839	0.784	No
4 vs 3	0.500	1.224	2.839	0.737	No
4 vs 5	0.500	0.866	2.839	0.908	No
5 vs 1	0.000	0.000	2.839	1.000	No
5 vs 3	0.000	0.000	2.839	1.000	No
3 vs 1	0.000	0.000	2.839	1.000	No
Tukey's d critical value:			4.015		

Category	LS means	Groups
2	2.583	A
4	2.500	A
1	2.000	A
3	2.000	A
5	2.000	A

Year / REGWQ / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	alpha (Modified)	Significant
2 vs 1	0.583	1.482	2.839	0.579	0.050	No
2 vs 3	0.583	1.620	2.665	0.378	0.050	No
2 vs 5	0.583	1.071	2.665	0.537	0.050	No
2 vs 4	0.083	0.194	2.665	0.847	0.050	No
4 vs 1	0.500	1.141	2.665	0.666	0.050	No
4 vs 3	0.500	1.224	2.633	0.445	0.030	No
4 vs 5	0.500	0.866	2.633	0.391	0.030	No
5 vs 1	0.000	0.000	2.633	1.000	0.030	No
5 vs 3	0.000	0.000	2.404	1.000	0.020	No
3 vs 1	0.000	0.000	2.404	1.000	0.020	No

Category	LS means	Groups
2	2.583	A
4	2.500	A
1	2.000	A
3	2.000	A
5	2.000	A

Year / Dunnett (two sided) / Analysis of the differences between categories and the control category Year-1 with a confidence interval of 95%:

Category	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant

1 vs 2	-0.583	-1.482	2.542	1.001	0.382	No
1 vs 4	-0.500	-1.141	2.542	1.114	0.613	No
1 vs 5	0.000	0.000	2.542	1.400	1.000	No
1 vs 3	0.000	0.000	2.542	0.939	1.000	No

Question 4: The best thing about science courses is that most problems have only one right answer.

Summary statistics:

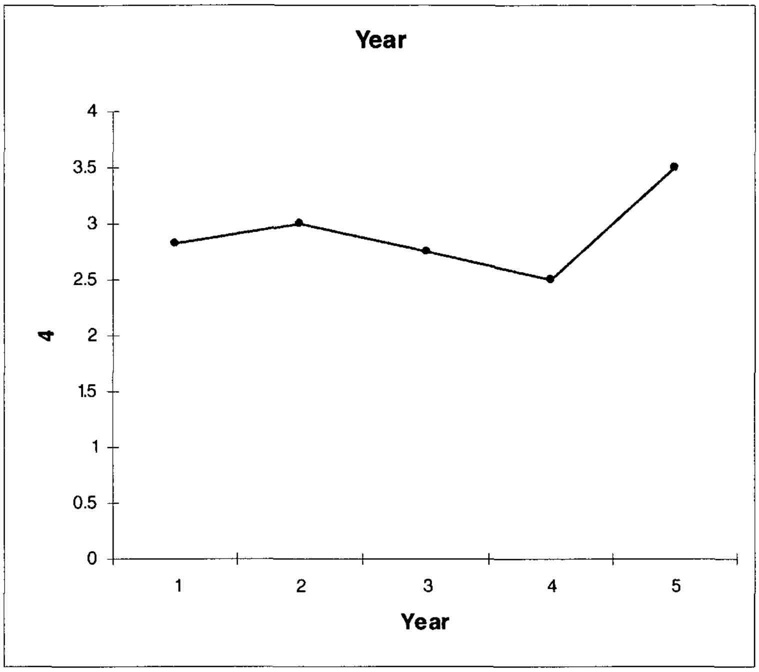
Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
4	51	0	51	1.000	5.000	2.843	1.155

Variable	Categories	Frequencies	%
Year	1	11	21.569
	2	12	23.529
	3	16	31.373
	4	8	15.686
	5	4	7.843

Correlation matrix:

Variables	Year-1	Year-2	Year-3	Year-4	Year-5	4
Year-1	**1.000**	-0.291	-0.355	-0.226	-0.153	-0.011
Year-2	-0.291	**1.000**	-0.375	-0.239	-0.162	0.076
Year-3	-0.355	-0.375	**1.000**	-0.292	-0.197	-0.055
Year-4	-0.226	-0.239	-0.292	**1.000**	-0.126	-0.129
Year-5	-0.153	-0.162	-0.197	-0.126	**1.000**	0.168
4	-0.011	0.076	-0.055	-0.129	0.168	**1.000**

Means charts:



Year / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	Significant
5 vs 4	1.000	1.388	2.839	0.638	No
5 vs 3	0.750	1.141	2.839	0.784	No
5 vs 1	0.682	0.993	2.839	0.857	No
5 vs 2	0.500	0.736	2.839	0.947	No
2 vs 4	0.500	0.931	2.839	0.883	No
2 vs 3	0.250	0.557	2.839	0.981	No
2 vs 1	0.182	0.370	2.839	0.996	No
1 vs 4	0.318	0.582	2.839	0.977	No
1 vs 3	0.068	0.148	2.839	1.000	No
3 vs 4	0.250	0.491	2.839	0.988	No
Tukey's d critical value:			4.015		

Category	LS means	Groups
5	3.500	A
2	3.000	A
1	2.818	A
3	2.750	A
4	2.500	A

Year / REGWQ / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	alpha (Modified)	Significant
5 vs 4	1.000	1.388	2.839	0.638	0.050	No
5 vs 3	0.750	1.141	2.665	0.667	0.050	No
5 vs 1	0.682	0.993	2.665	0.585	0.050	No
5 vs 2	0.500	0.736	2.665	0.465	0.050	No
2 vs 4	0.500	0.931	2.665	0.788	0.050	No
2 vs 3	0.250	0.557	2.633	0.844	0.030	No
2 vs 1	0.182	0.370	2.633	0.713	0.030	No
1 vs 4	0.318	0.582	2.633	0.830	0.030	No
1 vs 3	0.068	0.148	2.404	0.883	0.020	No
3 vs 4	0.250	0.491	2.404	0.626	0.020	No

Category	LS means	Groups
5	3.500	A
2	3.000	A
1	2.818	A
3	2.750	A
4	2.500	A

Year / Dunnett (two sided) / Analysis of the differences between categories and the control category Year-1 with a confidence interval of 95%:

Category	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
1 vs 5	-0.682	-0.993	2.542	1.745	0.718	No
1 vs 2	-0.182	-0.370	2.542	1.248	0.988	No
1 vs 4	0.318	0.582	2.542	1.389	0.941	No
1 vs 3	0.068	0.148	2.542	1.171	1.000	No

Question 5: The most important part of scientific work is original thinking.

Summary statistics:

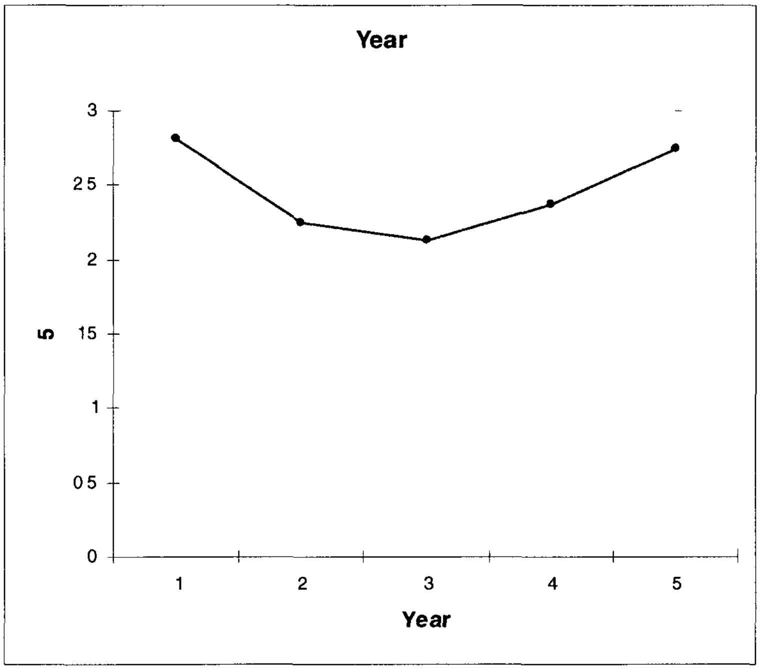
Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
5	51	0	51	1.000	5.000	2.392	1.041

Variable	Categories	Frequencies	%
Year	1	11	21.569
	2	12	23.529
	3	16	31.373
	4	8	15.686
	5	4	7.843

Correlation matrix:

Variables	Year-1	Year-2	Year-3	Year-4	Year-5	5
Year-1	**1.000**	-0.291	-0.355	-0.226	-0.153	0.217
Year-2	-0.291	**1.000**	-0.375	-0.239	-0.162	-0.077
Year-3	-0.355	-0.375	**1.000**	-0.292	-0.197	-0.175
Year-4	-0.226	-0.239	-0.292	**1.000**	-0.126	-0.007
Year-5	-0.153	-0.162	-0.197	-0.126	**1.000**	0.101
5	0.217	-0.077	-0.175	-0.007	0.101	**1.000**

Means charts:



Year / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	Significant
1 vs 3	0.693	1.693	2.839	0.448	No
1 vs 2	0.568	1.302	2.839	0.691	No
1 vs 4	0.443	0.912	2.839	0.891	No
1 vs 5	0.068	0.112	2.839	1.000	No
5 vs 3	0.625	1.070	2.839	0.821	No
5 vs 2	0.500	0.828	2.839	0.920	No
5 vs 4	0.375	0.586	2.839	0.977	No
4 vs 3	0.250	0.552	2.839	0.981	No
4 vs 2	0.125	0.262	2.839	0.999	No
2 vs 3	0.125	0.313	2.839	0.998	No
Tukey's d critical value:			4.015		

Category	LS means	Groups
1	2.818	A
5	2.750	A
4	2.375	A
2	2.250	A
3	2.125	A

Year / REGWQ / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	alpha (Modified)	Significant
1 vs 3	0.693	1.693	2.839	0.448	0.050	No
1 vs 2	0.568	1.302	2.665	0.566	0.050	No
1 vs 4	0.443	0.912	2.665	0.635	0.050	No
1 vs 5	0.068	0.112	2.665	0.912	0.050	No
5 vs 3	0.625	1.070	2.665	0.710	0.050	No
5 vs 2	0.500	0.828	2.633	0.687	0.030	No
5 vs 4	0.375	0.586	2.633	0.561	0.030	No
4 vs 3	0.250	0.552	2.633	0.846	0.030	No
4 vs 2	0.125	0.262	2.404	0.794	0.020	No
2 vs 3	0.125	0.313	2.404	0.756	0.020	No

Category	LS means	Groups
1	2.818	A
5	2.750	A
4	2.375	A
2	2.250	A
3	2.125	A

Year / Dunnett (two sided) / Analysis of the differences between categories and the control category Year-1 with a confidence interval of 95%:

Category	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
1 vs 3	0.693	1.693	2.542	1.041	0.267	No
1 vs 2	0.568	1.302	2.542	1.109	0.499	No
1 vs 4	0.443	0.912	2.542	1.235	0.772	No
1 vs 5	0.068	0.112	2.542	1.551	1.000	No

Question 6: A good lecturer will keep their students from wandering off the right track.

Summary statistics:

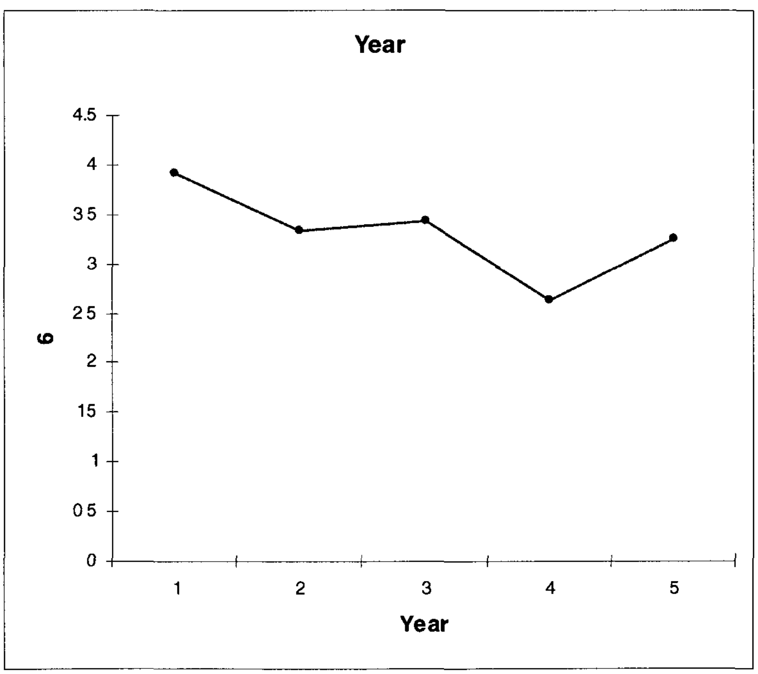
Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
6	51	0	51	2.000	5.000	3.373	0.999

Variable	Categories	Frequencies	%
Year	1	11	21.569
	2	12	23.529
	3	16	31.373
	4	8	15.686
	5	4	7.843

Correlation matrix:

Variables	Year-1	Year-2	Year-3	Year-4	Year-5	6
Year-1	**1.000**	-0.291	-0.355	-0.226	-0.153	0.284
Year-2	-0.291	**1.000**	-0.375	-0.239	-0.162	-0.022
Year-3	-0.355	-0.375	**1.000**	-0.292	-0.197	0.044
Year-4	-0.226	-0.239	-0.292	**1.000**	-0.126	-0.326
Year-5	-0.153	-0.162	-0.197	-0.126	**1.000**	-0.036
6	0.284	-0.022	0.044	-0.326	-0.036	**1.000**

Means charts:



Year / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized	Critical	Pr > Diff	Significant

		difference	value		
1 vs 4	1.284	2.887	2.839	0.044	Yes
1 vs 5	0.659	1.179	2.839	0.763	No
1 vs 2	0.576	1.441	2.839	0.605	No
1 vs 3	0.472	1.258	2.839	0.718	No
3 vs 4	0.813	1.960	2.839	0.301	No
3 vs 5	0.188	0.350	2.839	0.997	No
3 vs 2	0.104	0.285	2.839	0.999	No
2 vs 4	0.708	1.621	2.839	0.492	No
2 vs 5	0.083	0.151	2.839	1.000	No
5 vs 4	0.625	1.066	2.839	0.823	No
Tukey's d critical value:			4.015		

Category	LS means	Groups	
1	3.909	A	
3	3.438	A	B
2	3.333	A	B
5	3.250	A	B
4	2.625		B

Year / REGWQ / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	alpha (Modified)	Significant
1 vs 4	1.284	2.887	2.839	0.044	0.050	Yes
1 vs 5	0.659	1.179	2.665	0.643	0.050	No
1 vs 2	0.576	1.441				No
1 vs 3	0.472	1.258				No
3 vs 4	0.813	1.960	2.665	0.218	0.050	No
3 vs 5	0.188	0.350				No
3 vs 2	0.104	0.285				No
2 vs 4	0.708	1.621				No
2 vs 5	0.083	0.151				No
5 vs 4	0.625	1.066				No

Category	LS means	Groups	
1	3.909	A	
3	3.438	A	B
2	3.333	A	B
5	3.250	A	B
4	2.625		B

Year / Dunnett (two sided) / Analysis of the differences between categories and the control category Year-1 with a confidence interval of 95%:

Category	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant

1 vs 4	1.284	2.887	2.542	1.130	0.018	Yes
1 vs 5	0.659	1.179	2.542	1.420	0.585	No
1 vs 2	0.576	1.441	2.542	1.015	0.407	No
1 vs 3	0.472	1.258	2.542	0.953	0.529	No

Question 7: You will just get confused if you try and integrate new ideas in a textbook with knowledge that you already have about the subject.

Summary statistics:

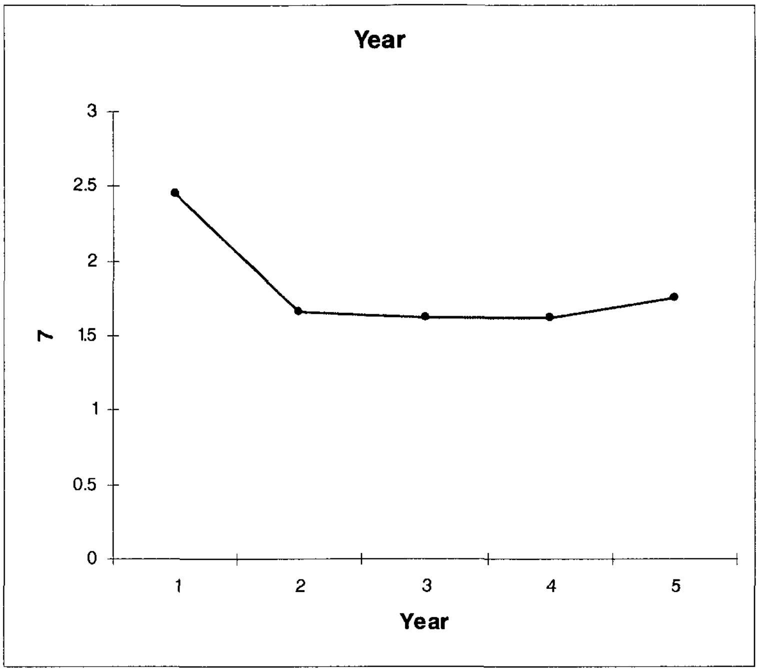
Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
7	51	0	51	1.000	5.000	1.824	0.817

Variable	Categories	Frequencies	%
Year	1	11	21.569
	2	12	23.529
	3	16	31.373
	4	8	15.686
	5	4	7.843

Correlation matrix:

Variables	Year-1	Year-2	Year-3	Year-4	Year-5	7
Year-1	**1.000**	-0.291	-0.355	-0.226	-0.153	0.409
Year-2	-0.291	**1.000**	-0.375	-0.239	-0.162	-0.108
Year-3	-0.355	-0.375	**1.000**	-0.292	-0.197	-0.166
Year-4	-0.226	-0.239	-0.292	**1.000**	-0.126	-0.106
Year-5	-0.153	-0.162	-0.197	-0.126	**1.000**	-0.027
7	0.409	-0.108	-0.166	-0.106	-0.027	**1.000**

Means charts:



Year / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	Significant
1 vs 4	0.830	2.298	2.839	0.164	No
1 vs 3	0.830	2.726	2.839	0.065	No
1 vs 2	0.788	2.429	2.839	0.126	No
1 vs 5	0.705	1.553	2.839	0.534	No
5 vs 4	0.125	0.263	2.839	0.999	No
5 vs 3	0.125	0.288	2.839	0.998	No
5 vs 2	0.083	0.186	2.839	1.000	No
2 vs 4	0.042	0.117	2.839	1.000	No
2 vs 3	0.042	0.140	2.839	1.000	No
4 vs 3	0.000	0.000	2.839	1.000	No
Tukey's d critical value:			4.015		

Category	LS means	Groups
1	2.455	A
5	1.750	A
2	1.667	A
3	1.625	A
4	1.625	A

Year / REGWQ / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized	Critical	Pr > Diff	alpha	Significant

		difference	value		(Modified)	
1 vs 4	0.830	2.298	2.839	0.113	0.050	No
1 vs 3	0.830	2.726	2.839	0.065	0.050	No
1 vs 2	0.788	2.429	2.665	0.049	0.050	Yes
1 vs 5	0.705	1.553	2.665	0.127	0.050	No
5 vs 4	0.125	0.263	2.665	0.963	0.050	No
5 vs 3	0.125	0.288	2.665	0.992	0.050	No
5 vs 2	0.083	0.186	2.633	0.853	0.030	No
2 vs 4	0.042	0.117	2.633	0.907	0.030	No
2 vs 3	0.042	0.140	2.633	0.989	0.030	No
4 vs 3	0.000	0.000	2.404	1.000	0.020	No

Groupings could not be performed with an exact method because the significance of differences is not transitive in this particular case. The harmonic mean of the group sizes needed to be used.
Harmonic mean 9.808

Category	LS means	Groups	
1	2.455	A	
5	1.750	A	B
2	1.667		B
3	1.625		B
4	1.625		B

Year / Dunnett (two sided) / Analysis of the differences between categories and the control category Year-1 with a confidence interval of 95%:

Category	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
1 vs 4	0.830	2.298	2.542	0.918	0.077	No
1 vs 3	0.830	2.726	2.542	0.773	0.027	Yes
1 vs 2	0.788	2.429	2.542	0.824	0.057	No
1 vs 5	0.705	1.553	2.542	1.153	0.340	No

Question 8: Studying means understanding the big issues, rather than details.

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
8	51	0	51	1.000	5.000	3.157	1.027

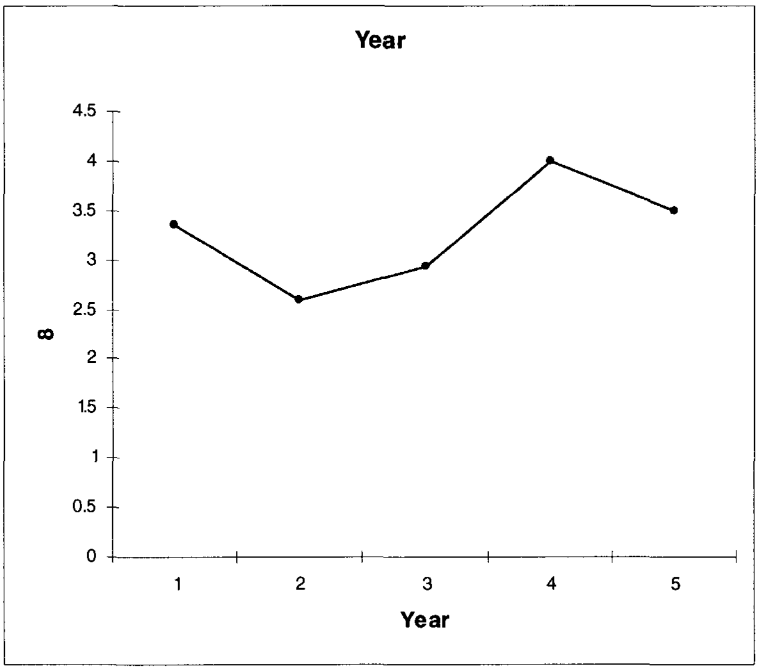
Variable	Categories	Frequencies	%
Year	1	11	21.569
	2	12	23.529

3	16	31.373
4	8	15.686
5	4	7.843

Correlation matrix:

Variables	Year-1	Year-2	Year-3	Year-4	Year-5	8
Year-1	**1.000**	-0.291	-0.355	-0.226	-0.153	0.107
Year-2	-0.291	**1.000**	-0.375	-0.239	-0.162	-0.313
Year-3	-0.355	-0.375	**1.000**	-0.292	-0.197	-0.146
Year-4	-0.226	-0.239	-0.292	**1.000**	-0.126	0.358
Year-5	-0.153	-0.162	-0.197	-0.126	**1.000**	0.098
8	0.107	-0.313	-0.146	0.358	0.098	**1.000**

Means charts:



Year / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	Significant
4 vs 2	1.417	3.272	2.839	0.017	Yes
4 vs 3	1.063	2.586	2.839	0.090	No
4 vs 1	0.636	1.444	2.839	0.603	No
4 vs 5	0.500	0.861	2.839	0.910	No
5 vs 2	0.917	1.674	2.839	0.460	No
5 vs 3	0.563	1.061	2.839	0.825	No
5 vs 1	0.136	0.246	2.839	0.999	No
1 vs 2	0.780	1.970	2.839	0.296	No

1 vs 3	0.426	1.147	2.839	0.781	No
3 vs 2	0.354	0.978	2.839	0.864	No
Tukey's d critical value:			4.015		

Category	LS means	Groups	
4	4.000	A	
5	3.500	A	B
1	3.364	A	B
3	2.938	A	B
2	2.583		B

Year / REGWQ / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	alpha (Modified)	Significant
4 vs 2	1.417	3.272	2.839	0.017	0.050	Yes
4 vs 3	1.063	2.586	2.665	0.060	0.050	No
4 vs 1	0.636	1.444				No
4 vs 5	0.500	0.861				No
5 vs 2	0.917	1.674	2.665	0.349	0.050	No
5 vs 3	0.563	1.061				No
5 vs 1	0.136	0.246				No
1 vs 2	0.780	1.970				No
1 vs 3	0.426	1.147				No
3 vs 2	0.354	0.978				No

Category	LS means	Groups	
4	4.000	A	
5	3.500	A	B
1	3.364	A	B
3	2.938	A	B
2	2.583		B

Year / Dunnett (two sided) / Analysis of the differences between categories and the control category Year-1 with a confidence interval of 95%:

Category	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
1 vs 4	-0.636	-1.444	2.542	1.120	0.406	No
1 vs 5	-0.136	-0.246	2.542	1.408	0.998	No
1 vs 2	0.780	1.970	2.542	1.007	0.157	No
1 vs 3	0.426	1.147	2.542	0.944	0.608	No

Question 9: A really good way to understand a textbook is to reorganize the information according to your personal way of looking at it.

Summary statistics:

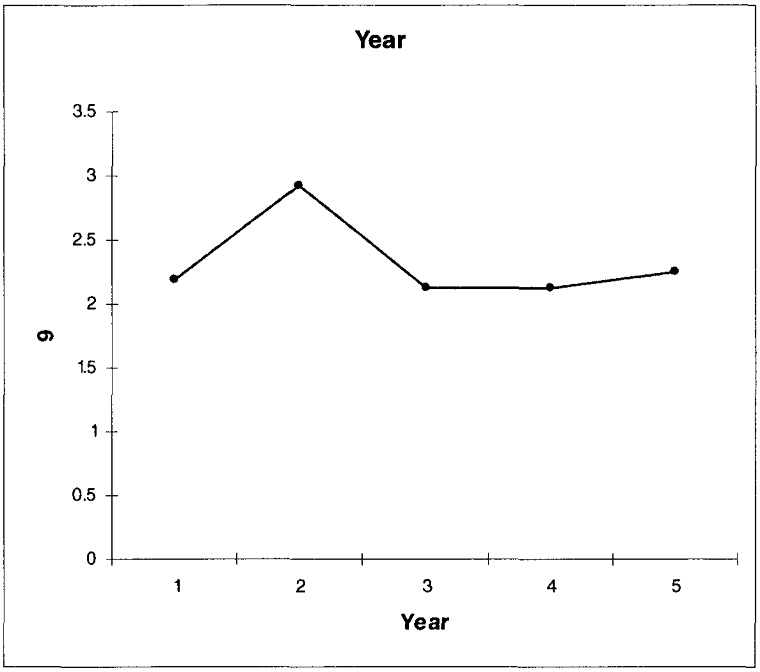
Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
9	51	0	51	1.000	4.000	2.333	0.887

Variable	Categories	Frequencies	%
Year	1	11	21.569
	2	12	23.529
	3	16	31.373
	4	8	15.686
	5	4	7.843

Correlation matrix:

Variables	Year-1	Year-2	Year-3	Year-4	Year-5	9
Year-1	**1.000**	-0.291	-0.355	-0.226	-0.153	-0.090
Year-2	-0.291	**1.000**	-0.375	-0.239	-0.162	0.368
Year-3	-0.355	-0.375	**1.000**	-0.292	-0.197	-0.160
Year-4	-0.226	-0.239	-0.292	**1.000**	-0.126	-0.102
Year-5	-0.153	-0.162	-0.197	-0.126	**1.000**	-0.028
9	-0.090	0.368	-0.160	-0.102	-0.028	**1.000**

Means charts:



Year / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	Significant
2 vs 3	0.792	2.414	2.839	0.130	No
2 vs 4	0.792	2.020	2.839	0.273	No
2 vs 1	0.735	2.050	2.839	0.259	No
2 vs 5	0.667	1.345	2.839	0.665	No
5 vs 3	0.125	0.260	2.839	0.999	No
5 vs 4	0.125	0.238	2.839	0.999	No
5 vs 1	0.068	0.136	2.839	1.000	No
1 vs 3	0.057	0.169	2.839	1.000	No
1 vs 4	0.057	0.142	2.839	1.000	No
4 vs 3	0.000	0.000	2.839	1.000	No
Tukey's d critical value:			4.015		

Category	LS means	Groups
2	2.917	A
5	2.250	A
1	2.182	A
4	2.125	A
3	2.125	A

Year / REGWQ / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized	Critical	Pr > Diff	alpha	Significant

		difference	value		(Modified)	
2 vs 3	0.792	2.414	2.839	0.130	0.050	No
2 vs 4	0.792	2.020	2.665	0.196	0.050	No
2 vs 1	0.735	2.050	2.665	0.112	0.050	No
2 vs 5	0.667	1.345	2.665	0.185	0.050	No
5 vs 3	0.125	0.260	2.665	0.994	0.050	No
5 vs 4	0.125	0.238	2.633	0.969	0.030	No
5 vs 1	0.068	0.136	2.633	0.892	0.030	No
1 vs 3	0.057	0.169	2.633	0.984	0.030	No
1 vs 4	0.057	0.142	2.404	0.887	0.020	No
4 vs 3	0.000	0.000	2.404	1.000	0.020	No

Category	LS means	Groups
2	2.917	A
5	2.250	A
1	2.182	A
4	2.125	A
3	2.125	A

Year / Dunnett (two sided) / Analysis of the differences between categories and the control category Year-1 with a confidence interval of 95%:

Category	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
1 vs 2	-0.735	-2.050	2.542	0.911	0.133	No
1 vs 5	-0.068	-0.136	2.542	1.275	1.000	No
1 vs 3	0.057	0.169	2.542	0.855	0.999	No
1 vs 4	0.057	0.142	2.542	1.014	1.000	No

Question 10: Being a good student means that you can memorize a lot of facts.

Summary statistics:

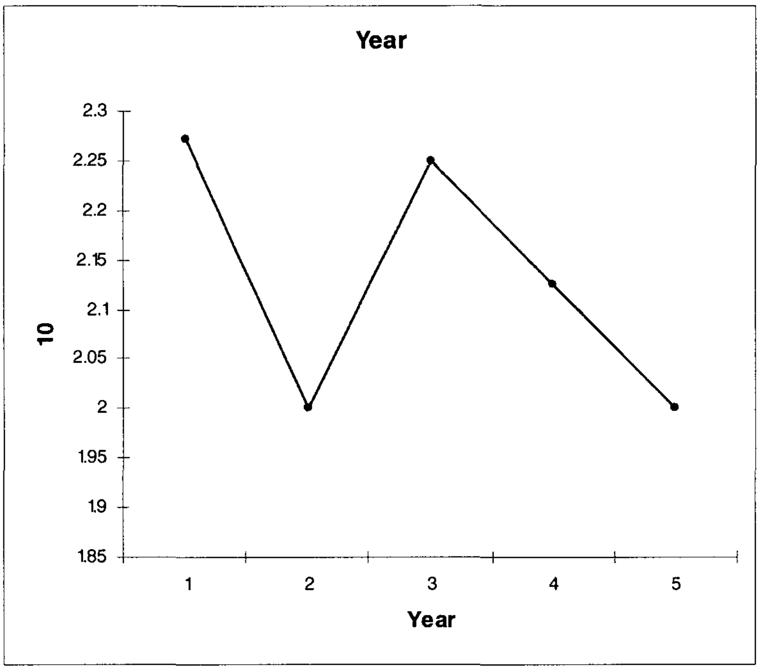
Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
10	51	0	51	1.000	5.000	2.157	1.007

Variable	Categories	Frequencies	%
Year	1	11	21.569
	2	12	23.529
	3	16	31.373
	4	8	15.686
	5	4	7.843

Correlation matrix:

Variables	Year-1	Year-2	Year-3	Year-4	Year-5	10
Year-1	**1.000**	-0.291	-0.355	-0.226	-0.153	0.061
Year-2	-0.291	**1.000**	-0.375	-0.239	-0.162	-0.087
Year-3	-0.355	-0.375	**1.000**	-0.292	-0.197	0.063
Year-4	-0.226	-0.239	-0.292	**1.000**	-0.126	-0.014
Year-5	-0.153	-0.162	-0.197	-0.126	**1.000**	-0.046
10	0.061	-0.087	0.063	-0.014	-0.046	**1.000**

Means charts:



Year / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	Significant
1 vs 2	0.273	0.626	2.839	0.970	No
1 vs 5	0.273	0.448	2.839	0.991	No
1 vs 4	0.148	0.305	2.839	0.998	No
1 vs 3	0.023	0.056	2.839	1.000	No
3 vs 2	0.250	0.628	2.839	0.970	No
3 vs 5	0.250	0.429	2.839	0.993	No
3 vs 4	0.125	0.277	2.839	0.999	No
4 vs 2	0.125	0.263	2.839	0.999	No
4 vs 5	0.125	0.196	2.839	1.000	No
5 vs 2	0.000	0.000	2.839	1.000	No
Tukey's d critical value:			4.015		

Category	LS means	Groups
1	2.273	A
3	2.250	A
4	2.125	A
2	2.000	A
5	2.000	A

Year / REGWQ / Analysis of the differences between the categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	alpha (Modified)	Significant
1 vs 2	0.273	0.626	2.839	0.970	0.050	No
1 vs 5	0.273	0.448	2.665	0.970	0.050	No
1 vs 4	0.148	0.305	2.665	0.950	0.050	No
1 vs 3	0.023	0.056	2.665	0.956	0.050	No
3 vs 2	0.250	0.628	2.665	0.923	0.050	No
3 vs 5	0.250	0.429	2.633	0.904	0.030	No
3 vs 4	0.125	0.277	2.633	0.783	0.030	No
4 vs 2	0.125	0.263	2.633	0.963	0.030	No
4 vs 5	0.125	0.196	2.404	0.846	0.020	No
5 vs 2	0.000	0.000	2.404	1.000	0.020	No

Category	LS means	Groups
1	2.273	A
3	2.250	A
4	2.125	A
2	2.000	A
5	2.000	A

Year / Dunnett (two sided) / Analysis of the differences between categories and the control category Year-1 with a confidence interval of 95%:

Category	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
1 vs 2	0.273	0.626	2.542	1.107	0.925	No
1 vs 5	0.273	0.448	2.542	1.548	0.976	No
1 vs 4	0.148	0.305	2.542	1.232	0.994	No
1 vs 3	0.023	0.056	2.542	1.038	1.000	No

Question 11: It is a waste of time working on problems that have no possibility of coming out with a clear cut and unambiguous answer.