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LEARNING IN SIMULATION STRATEGY GAMES

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GAMING THEIR WAY:
LEARNING IN SIMULATION STRATEGY VIDEO GAMES

By

Aroutis N. Foster

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ABSTRACT

GAMING THEIR WAY:
LEARNING IN SIMULATION STRATEGY VIDEO GAMES

By

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This mixed methods study investigates how and what students learn by playing a simulation strategy game. 26 children averaging 11 years old played the simulation strategy game RollerCoaster Tycoon 3: Platinum (RCT3) for 24 hours over seven weeks. It was found that the participants learned economics and social studies principles, developed information and technology literacy, and transferred these acquired knowledge and skills to new contexts. They also valued the gaming experience and the disciplinary knowledge gained.

The quantitative component of the study examined disciplinary knowledge gain and transfer as well as motivational valuing. A range of instruments were used to collect data, including pretest-posttest knowledge tests, transfer questions, and a pretest-posttest intrinsic motivation inventory. Despite no prior formal education about basic and foundational economic principles, and their initial belief that games are not for learning school content, participants both acquired disciplinary knowledge and skills and transferred them to new contexts. Participants also reported valuing the experience of learning economics and social studies in a game environment.

The qualitative component of the study examined the process by which students acquired knowledge, and their motivation for doing so. The data for this part of the study came from video-taping of participants as they played the game, interviews of participants, log-sheets of their progress, and participant observation. Analysis of this

data indicates that learning by game play was highly personalized and identified two general categories (goal seekers and explorers) of player types that influenced the process of learning. Further quantitative analysis on each of these player types show that though both explorers and goal seekers had significant knowledge gains, explorers were more likely to value the experience of gaming and learning content compared to goal seekers.

The findings of this study indicate that learning of core disciplinary ideas from games is possible. However, it is a complex process dependent on player type, and the nature of game play. This study can inform the design of better games for learning and suggest ways in which such games can be integrated into the curriculum. Finally, this research supports the arguments for mixed methods research on learning from media.

Dedicated to:

My father - Herbert Foster,

My mother - Paulette Robertson,

My brother - Andre Foster,

My relatives and friends who have helped to shaped me as a man and scholar.

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Chapter 1

Purpose of the Study

Video games[1] are all around us. Electronic games are a big part of the lives of American students. In 2006, 30% of the most frequent computer game players and 40% of console game players were under 18 years old (Entertainment Software Association, 2006). American children between the ages of 8 and 18 play video games for an average of seven hours per week (National Institute on the Media and the Family, 2002). It is argued that electronic games capture the attention of children and engage them in important ways by posing challenging tasks that are set at levels that are neither too easy nor too difficult and include scaffolding elements to support the players (Buchanan, 2005; Gee, 2003; Malone, 1981; Prensky, 2001). It has been suggested that these elements make games ideal environments for learning (Gee, 2003). Support for the use of digital games for learning is echoed by the government and notable researchers in education (Federation of American Scientists, 2006; Shaffer, 2006). The President of the Federation of American Scientists, Henry Kelly, argues that education in the United States is facing a critical problem in preparing students to face the challenges of America. He believes that electronic games can help (Federation of American Scientists, 2005; Kelly, 2005).

[1] "Video games," "electronic games," "games" and "digital games" will be used interchangeably in this dissertation as general terms to refer to any electronic, computer, console or arcade games that meet the parameters of the following. A digital game is an interactive, often automated, complex system in which players store and manipulate information and engage in an artificial conflict defined by rules of the system that results in a quantifiable outcome.

Clearly games are a pervasive technology that has spawned many claims about learning, and these claims have been the topic of many debates (Mishra & Foster, 2007a). The *claimed affordances of games*[2] range from arguments about games causing violence or obesity to games being good for preparing children for the 21st century workforce (Anderson & Dill, 2000; Anderson & Ford, 1986; Foreman, 2003; Shaffer, Squire, Halverson, & Gee, 2005). The general consensus from these debates is that there is some kind of learning from video games; however, what is learning meaning how it is often conceptualized, how it happens meaning the process of learning, and whether or not it is beneficial meaning does it help children learn content and skills that can help them personally as well as prepare them for lifelong learning, is still in question.

The research findings in the area of learning from games are mixed. Large scale analyses of studies done on games for learning did not show significant effects on learning outcomes (Emes, 1997; Mitchell & Savill-Smith, 2004). In addition, there has not been much research on the claims about games and learning school content (Mishra & Foster, 2007a, 2007b). Mishra and Foster argue that there are methodological problems with the general lack of focus on disciplinary knowledge[3], and ignoring the differential potential of game genres in current research practice on learning (Williams, 2005).

Few studies have investigated the knowledge and skills that children gain when they play games freely and also examined the process of learning via player types. In

[2] "Claimed affordances of games" refers to philosophical, anecdotal or poorly warranted arguments about what video games can do for learning. A deeper analysis is presented in the review of relevant literature (Chapter 2).

[3] Disciplinary Knowledge refers to understanding subject matter and how it relates to other aspects beyond a discipline or domain.

addition few studies in game-based learning research and motivation research have looked at the valuing of disciplinary knowledge and skills (Brophy, 2008; Heeter, 2009). In addition, Williams (2005) argues for a multiple methods approach for research in game based learning. Most studies are either qualitative (with small samples that inhibit the ability to generalize) or quantitative (missing the rich, individualistic interaction that is at the heart of playing and learning with games). They each have their own strengths and focus. Nonetheless, Williams argue for multiple methods that will combine the strengths of both qualitative and quantitative approaches in game studies. Finally, given the large range of commercially available video games, it is surprising that few studies have looked at the learning of subject matter that occurs (or could occur) through playing these games, a question of ecological validity.

This Dissertation Study

This dissertation research seeks to address some of these concerns. It does so by designing a mixed-methods study that focuses on learning of subject matter, of game content, and of technology through extended interaction with a commercially available video game.

More specifically, this dissertation is designed to examine learning from games by evaluating what children in grades four to six learn by playing an existing, off the shelf, commercially available electronic video game: *RollerCoaster Tycoon 3: Platinum (RCT3)*. The game *RCT3* was developed to entertain, but can also be used to teach economics because of its business or entrepreneurial focus. The study is done in two parts: Part one or Study 1 (Appendix A) addresses question 1 is a detailed game analysis of the selected game focusing on the content, pedagogy, and technology in order to

understand the pedagogical potentials of playing. The researcher played *RCT3* and analyzed it by focusing on its content to determine what disciplinary knowledge and skills could be learned, including social studies, economics, information literacy, and technological literacy. The researcher also focused on the pedagogy via the genre of the game to determine its interactivity influenced learning. The game was viewed as form of technology. Thus, the game was analyzed by focusing on the game as form of technology, focusing on the content, and focusing the embedded pedagogy. Appendix A shows the preparation that was done to aid in determining what to assess and in thinking about appropriate ways to assess the skills and content.

This was followed by the empirical mixed method study, part two, that evaluated what was actually learned, transferred, and valued from game play. Learning in this study was specified in multiple ways: *disciplinary knowledge* — economics and social studies content ideas inherent in the game; *game knowledge* — knowledge of the gameplay; and *technology knowledge* — information and technology skills. The study also looks at motivational valuing in what participants valued in terms of game and disciplinary knowledge and how they transferred the knowledge gained to new tasks or problems. Finally, the study also looks at the nature of gameplay or the process of learning (i.e., what play strategies did the participants use to navigate the game).

Project Significance

This dissertation aims to construct a comprehensive view of learning through games and to apply a framework for assessing games for learning based on the claimed affordances. An examination of the claims for games through the framework of appropriate assessments is significant because it can help teachers, parents, and

researchers become better able to examine and analyze games for instructional purposes and to help game developers to design better games and similar interactive digital environments for learning. Further, it highlights the strength of the various interdisciplinary approaches to research when they combine the literature from education, psychology, and media studies. It could influence policy on games and learning by helping policymakers to understand the power of games for learning in informal settings outside of school and for after school programs. It could also inform theory from the situative learning perspective as it relates to discussing and developing disciplinary knowledge and motivational valuing in interactive digital environments.

Overview of Chapters

This dissertation is organized into six chapters.

Chapter 1, the current chapter, provides an overview of the research problem, purpose of the study, significance of the study and overall organization of the project.

Chapter 2 reviews the relevant literature and theoretical perspectives needed for examining the research questions. Relevant literature and theoretical perspectives are integrated from game studies, educational psychology, educational technology, and media studies.

Chapter 3 outlines the concurrent mixed methods approach that is employed in the study to collect data and provide for triangulation of data in the results. It provides the research context, design, data collection procedures, and data analysis.

Chapter 4 reports the results for the whole group of participants using quantitative data analysis for questions 2 and 3 of study 2, the empirical study. Question 2 and 3 examines content and skills learning, and motivational valuing in the simulation strategy

game. Chapter 4 shows that there is statistically significant learning of the content and skills as well as motivational valuing of the game and content for the participants in the study.

Chapter 5 reports results using a mixed methods approach for study 2, the empirical study. It addresses questions 2 to 4 examining content and skills learning, motivational valuing in the simulation strategy game, and the process of learning by way of player strategies in gameplay. It provides a closer examination of learning and motivation by player types using mixed methods, unlike Chapter 4 which shows learning and motivation for only the whole group of participants. Chapter 5 shows the emerging player types based on play strategies which highlights the process of learning and participants' attitude to the game and content.

Chapter 6 discusses the results of the study. In essence, it connects the results of the study to the theoretical arguments presented by the field about what is learned from digital games. It also discusses implications for policymakers, parents, teachers, students, and researchers.

Chapter 2

Review of Relevant Literature

This chapter provides a review of literature from educational psychology, educational technology, and game studies in an integrated manner to outline a framework for studying games and learning. Much of current game-based research has examined learning and motivation behind the playing of games; however, few have focused on disciplinary knowledge and transfer, motivational valuing, and the process of learning educational content through player strategies. In addition, few studies have focused on the role of the game genres in influencing learning through games.

The chapter is outlined first by setting the stage through a discussion of our socialization in a technology and media driven culture. This is followed by discussing the affordances of games based on what researchers say games have the potential to do. Next a review of learning in games is conducted. This is followed by discussing games and motivation based on research of motivational valuing of game and content. Next a review of play strategies is discussed to elucidate the role of play styles or characteristics to aid in understanding the process of learning in games. Next, the context for this study is discussed by introducing the game to be examined and addressing the need to focus on game genres. Finally, the Technological Pedagogical and Content Knowledge framework is used to frame the disciplinary knowledge and motivational valuing within the simulation strategy genre (Mishra and Koehler, 2006).

Setting the Stage

We live in a technology and media driven culture that affects how we are socialized and how we learn (Jenkins, 2006; Turkle, 1995, 1997). Today many young

people socialize themselves through commercial video games (Roberts, Foehr, & Rideout, 2005). American children play video games for about 365 hours each year (Roberts et al., 2005). According to the Entertainment Software Association (ESA), across all age groups, video games generate an estimated $10.3 billion in direct sales per year and another $7.8 billion in sales of complementary products (Crandall & Sidak, 2006). In 2007, sales of video and computer games exceeded $18.8 billion dollars and the top games such as *Halo 3* made more money in sales in the opening weeks than the top box office movies (The NPD Group, 2008).

The first video game was attributed to William Higginbotham, who created *Tennis for Two* in 1958 to help ease the anxiety and tension in people who visited the government lab to learn more about nuclear energy (Rabin, 2005). Since then the technological sophistication of electronic games has grown to rival that of the movie industry (The NPD Group, 2008). As the technological attributes and popularity of games grow, so do the claims about what games can do for learning (Fabricatore, 2000; Shaffer, 2006; Williams, 2004). These claims are related to the affordances of games for learning and for motivating players to value what they are doing.

Overview of the Affordances of Games

The affordances for games to help learners are widely proclaimed and are evident in the claims made by opponents and proponents about what games can do for people and by extension for society (For examples see Appendix B) (Foster & Mishra, 2009; Mishra & Foster, 2007a). Mishra and Foster (2007a) conducted a survey about the claims about games affordances where the researchers argued that affordances fall within two sets of claims: psychological and physiological (See Figure 1). Psychological claims

included cognitive, practical, motivational, and social claims, while physiological claims refer to seven specific claims including aggressiveness, antisocial behavior, coordination, introversion, motor skills, obesity and violence. The researchers contend that the physiological and psychological effects influence each other. In addition, the claims afford experiences that influence motivational orientation as well as cognitive, social, and practical knowledge. In addition, Mishra and Foster (2007a) argue that digital games afford learning and development by shaping attitudes, affecting behavior, influencing understanding, and affecting spatial and motor abilities.

Other researchers argue that games demand things from players in ways that other texts do not (Krzywinska, 2006; Oblinger, 2004). Proponents say that some of these attributes included in games is the ability for contextualizing, individualizing and collaborating, feedback and assessment, experiential and social learning, active learning, intrinsic and extrinsic motivation, transfer, and scaffolding (Asgari, 2005; Gee, 2003; Oblinger, 2004; Prensky, 2001). The claimed affordances of games for learning and motivation shape games as an embodied semiotic domain much like a curriculum.

For instance, studies on the affordances of games tend to focus on the principles or elements of games that make these environments suitable for experiences that are anchored, generative, and embodied (Aarseth, 1997; Barab, Dodge, & Ingram-Goble, 2007; Calleja, 2007; Malone & Lepper, 1987). It is argued that games present a fundamentally different pedagogical stance from traditional direct or guided instructional practices. Learning in gaming environments is based on challenge, reward, learning by doing and guided discovery as opposed to "tell and test" methods (Federation of American Scientists, 2006, p. 6). It has been argued that when users play games, they

have the potential to become active participants in shaping their role and game actions. Thus it is suggested that when students become active participants in the knowledge construction process (Greeno, Collins, & Resnick, 1996), the focus of learning shifts from covering the curriculum to working with ideas (Scardamalia, 2000).

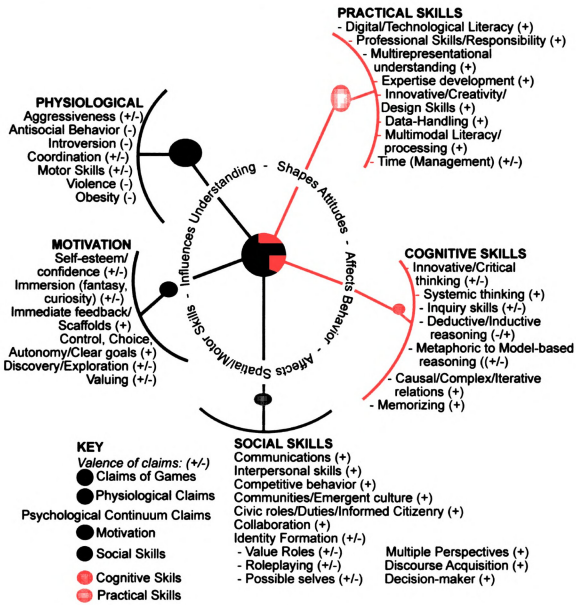

Figure 1: Emergent Themes from the Claims of Games Survey about Game Affordances

In a small-scale pilot study by BECTA (2006) involving the use of six computer games in school settings to better understand their relationship to learning, the

researchers found that gameplay can be competitive, co-operative or individualistic. BECTA concludes that the aspects of game that make them important in education is that they are narrative, personal, and interactive. Further, they build curiosity and logic, have a story line, challenge players, enable problem-solving, and encourage imagination (BECTA, 2006).

In general, historical trends about the affordances of games for learning and motivation focused on aspects such as intrinsic and extrinsic engagement and spatial abilities and other skills (Ball, 1978; P. Greenfield & Subrahmanyan, 1994). In the 1980's Greenfield's research epitomized the focus on studies of sensory-motor skills using games. De Aguilera and Mendiz (2003), in their meta-analysis of studies on games from the 1970's to the 1990's, concluded that adolescents with medium- or long-term experience playing video games show greater visual capacity, motor activity, and spatial abilities-reflexes and responses. They contend that early work seemed to have focused on the development of skills including psychomotor skills. De Aguilera and Mendiz (2003) also argued that the first studies on cognitive abilities in game studies focused on the potential of games in the development of learning processes such as trial and error. De Aguliera and Mendiz (2003) contends that the first researchers who focused on cognitive abilities in the field concentrated on problem-solving strategies and on a series of markedly cognitive questions involving learning as the main focus of educational interest. However, researchers still argued that the learning was not focused on content and even within studies on learning a clear understanding of the process of learning was not the focus (Squire, 2003). By 1994 researchers such as Greenfield (1984) argued that games were good for helping children with basic skills. De Aguilera and Mendiz (2003)

concluded that many video games are conducive to the development of specific skills: attention, spatial concentration, problem-solving, decision-making, collaborative work, creativity, and information and technology skills.

The claims about games tend to focus on affordances to develop skills and learning. However, the affordances do not point to the learning of content or even the role of game genres. The studies discussed here indicate that the focus is on the structural elements of video games and its ability to develop skills. Some researchers said games are good for helping with intellectual development and argue about the cognitive affordances of games (Squire, 2003); however, there is a paucity of work in the area of disciplinary knowledge, skills, and the transfer of the knowledge. Jenkins and Squire (2005) are among researchers who have called for research that focuses on content in order to build theory. If we are to use games in education, games should be viewed as for of technology and then there should be a focus on content knowledge and pedagogy when discussing learning or teaching.

In order to understand what to look for in terms of disciplinary knowledge and skills within the genre of the game to be studied, an analysis should be done to understand the affordances for learning. According to Aarseth (2003), there are three ways to acquire knowledge about what is in a game or what it affords: 1) by studying the mechanics and design of the game, 2) by observing others play the game, and 3) by playing the game yourself to develop an understanding. Aarseth argues that the third way is the best, especially when combined with one or both of the other ways. Hence, a central step in this study follows Aarseth's third charge of addressing the affordances for learning provided by the game. This game analysis was conducted by the researcher to

help determine the content, pedagogy, and the affordances within the design of the game and its genre (See Appendix A). The game analysis along with the help of a content expert from an economics department and a psychometrician from a measurement and quantitative methods department aided the researcher in creating assessments and in determining an appropriate methodological approach. The first question which focused on the affordances for learning provided by the selected game aided in the literature review in knowing what content to focus on, the kinds of pedagogy in the game, and in determining if the game had a good mix of disciplinary knowledge and gameplay. Thus it is reported as research Study 1 in Appendix A because it was a preparatory stage before the empirical study 2 which addresses Aarseth's second charge.

In the literature there appears to be little focus on disciplinary knowledge or content areas when discussing learning as an affordance of games. Thus, how learning is investigated when studying games is the focus of the next section.

Learning from Games

Games and learning is a contested terrain with both proponents and opponents arguing about the ill-effects of learning with games as well as the positive effects of learning with games (Facer, 2003; Roe & Muijs, 1998). They agree that there is some learning. However, reviews of several studies (Kirriemuir & McFarlane, 2004; Mitchell & Savill-Smith, 2004; Randel, Morris, Wetzel, & Whitehill, 1992) about learning with games found that there are no firm conclusions about learning. Nonetheless, researchers continue to advocate games for learning (Gee, 2005b, 2006; Steinkuehler, 2006) arguing that current commercial games contain the "best" theories of learning from the cognitive sciences (Foreman, 2003; Gee, 2003). To complicate learning with games even more,

Mitchell and Savill-Smith (2004) noted that the literature base relating to the use of computer games for learning remains small and that of the eleven reviews they examined prior to their own, none of the studies focused on learners who had basic skills. With the continued push to use games for learning, what is the current status of research about learning from games? Before answering that question, how is learning conceptualized?

Learning as conceptualized: Traditionally, learning was viewed as a mental process void of context (Phillips & Soltis, 1998) or acknowledging the role of the body or affect (Barab, Bransford, Greeno, & Gee, 2007). Current theories of learning see it as the active construction of knowledge via the cognitive or situative perspectives (Brown, 1994; Greeno, 2007; Greeno et al., 1996; Phillips & Soltis, 1998). From the situative perspective, (Greeno, 1997; Lave & Wenger, 1991), learners learn through a process of social interactions that depends on the context or specific setting. From a situative perspective, knowledge refers to an activity (not a thing), is always embodied (not abstract), is reciprocally constructed as part of the individual-environment interaction (not objectively defined or subjectively created), and involves whole persons (not disembodied minds) (Barab, Bransford et al., 2007). Thus, in the embodied cognition view, learning takes into consideration both mental processes and processes of the whole body in an activity.

Researchers and scholars in the area of game based learning often argue for learning from games as being an instantiation of these theories. Thus, many researchers using virtual environments, such as games or simulations, conceptualize learning through situative learning and embodied perspectives (Barab, Bransford et al., 2007; Barab et al., In Press; Gee, 2007b). According to Gee (2007b) in a game environment "players inhabit

the goals of a virtual character... [and] the virtual world is designed to be attuned to those goals. In these video games, the real-world player gains a surrogate, i.e., the virtual character the player is playing" (p. 11). The player has knowledge and skills that the virtual character does not have and vice versa. Thus, players become embodied in a participative or virtual presence way in adopting the goals, values, attitudes, and feelings that is attuned to the goals of the game.

The initial question asked, what is the current status of research about learning from games? A quick response is that research on the games for learning has shown that learning is possible in games, irrespective whether it is negative or positive or if the focus is on disciplinary knowledge. A more nuanced response, however, includes how games studies are done and paints a picture of what is learning from games. Foster and Mishra (2009) argues that current studies treat games as being a monolithic entity (i.e., ignoring game genres and their differential potential for learning), and the content-neutral nature of many of these claims ignores disciplinary knowledge. Squire (2003) argue that computer and video games are a maturing medium and industry and have caught the attention of scholars across a variety of disciplines; however, when educators have discussed games, they have focused on the social consequences of game play while ignoring important educational potentials of gaming. From an educational perspective, it appears that what is learning in games is complex and to discuss learning in education without any focus on disciplinary knowledge is problematic because disciplines vary.

Disciplinary knowledge varies greatly from one discipline to another and this needs to be reflected in both the design and research on games for learning in order for learners to capture big ideas and have transformative experiences. Gardner (2007) argues

that students must learn disciplinary knowledge, be able to synthesize large amounts of information, be able to think out of the box, and be creative. Gardner (2006) contends that students must learn disciplinary knowledge (the ways of thinking and working with information that are particular to a given subject matter), but this is difficult and requires years of education in the big ideas and nuances of the disciplines. Thus, if games are to be successful for pedagogical purposes they need to consider what must be learned in the form of disciplinary knowledge and skills.

Games based learning studies: Studies that examine learning from games range widely from basic content focus to enhancing interest in content to developing skill. For instance, Foster, Koehler and Mishra (2006) using an edutainment game to learn basic physics principles found that the participants who were non-science college students learned the basic concepts. The study had two groups: An experimental group playing a game called *Physicus* and a control group playing a game called *Tropical America.* Both groups played for an average of about 82 minutes of game play to complete their game. Participants in playing *Physicus* played from a saved point in the game. It was a lab-study without elements of naturalistic play, such as free-play, and it had a very short duration of one session per player. The study found significant learning of the basic physics content; however, it did not give a complete picture about the process of learning in the game, such as how and why learning occurred. In addition, the learning effects of the game are difficult to validate because participants did not play freely or for an extended period of time, and the process of learning was not examined.

Two recent qualitative dissertations (Egenfeldt-Nielsen, 2005; Squire, 2004) conducted in classrooms revealed that students learned superficial information, not

enough to satisfy educational school needs of the students, but enough for them to grasp basic ideas. Using three cases to examine learning in the classroom with *Civilization III*, Squire reported an incompatibility between the game's content and what was required for the school's curriculum. Learning for the class was difficult to be validated because what was learned from the game was incompatible with what was required for the classroom curriculum. In *Civilization III* handling of the content was different from what was required in classroom. Egenfeldt-Nielsen (2005), using the game *Europa Universalis II* in schools, found a similar problem and also added other limitations such as gender differences, teachers' knowledge of games, and students' questioning whether playing the game in school was a valid activity. Even so, both Squire and Egenfeldt-Nielsen concluded that students developed a more holistic understanding and interest in historical information through playing these games. Squire and Egenfeldt-Nielsen noted that because of the classroom setting, player strategies or process of learning was difficult to assess. In both of these studies, the focus was on integrating the commercial game into the classroom, and content learning became problematic because of the differences in the game design stance on epistemological approach and the school curriculum.

In a study that used an augmented-by-reality approach, Beckett and Shaffer (2005) examined learning and valuing by students. Beckett and Shaffer's qualitatively weighted mixed-methods study used a computer game-simulation called *Madison 2200*, a game for learning urban planning. The aim was to examine innovative approaches to learn by having high-risk high school students work as urban planners to redesign a popular downtown mall. The students visited the mall, collected data, and also worked in their class on the design in *Madison 2200*. Based on the theory of pedagogical praxis (Shaffer,

2004), the researchers hypothesized that using a computer simulation game augmented by reality and the practices and tools of urban planners would help students develop an understanding of what it means to be an urban planner. They concluded that students were beginning to adopt the epistemic or professional frames of urban planners. This study also showed an example of how transfer of knowledge was conducted via augmented play with reality. Nonetheless, the study had a short duration of several weekends. It was not focused on learning disciplinary knowledge, but on learning how to think like an urban planner to design cities. It was conducted with participants who did not have basic skills to play the game or learn the content of urban planning. In addition, the study did not encourage free-play. Thus the learning is difficult to validate because of the conflation of the background of the participants, game skills, and learning in the game as opposed to their visit to the mall. The research was not focused on documenting the process of learning; rather, it was focused on whether students were beginning to develop the basic skills of urban planners.

In assessing the association of computer games and the parallel-processing skills for 46 boys and girls aged 4 to 6 years, Yuji (1996), assigned 17 player and 17 non-player groups by their enthusiasm for computer games. Yuji assessed their skills using tests of discrimination perception. Yuji found that the game had no effect on parallel-processing skills. This study did not say what the role of the game genre was or identify the genre and how it influenced the developing of skills being assessed.

In another study by Thomas, Cahill and Santilli (1997), the researchers used computer games with high-risk adolescents to increase their knowledge of HIV/AIDS. They found statistically significant learning gains for both the knowledge items and self-

efficacy scores. This study did not give a complete view of learning by the participants because researchers had no interpretive data. Researchers were interested only if students had statistical changes in the content being assessed. In addition, the researchers did not say what role the game genre played in students learning. Mayer (2002) in an after-school study using a variety of educational games concluded that participants were able to develop factual computer literacy skills and comprehension skills for following instructions. Mayer did not assess disciplinary knowledge, but focused on information literacy and technology skills.

Studies about the transfer of learning from games have shown mixed results, and many have focused on pure simulations rather than video games (Fletcher & Tobias, 2006; Moreno & Mayer, 2005; Moreno, Mayer, Spires, & Lester, 2001). Fletcher and Tobias (2006) argue that transfer is not attributable merely to playing the games or to superficial similarities between games and an external task, rather transfer seems to be a function of the similarity in cognitive processes engaged by the game and the transfer task. Gopher, Weil, and Bareket (1994) found statistically significant differences for transfer between an experimental group trained for 10 hours on the *Space Fortress II* and a control group who was not trained. Transfer was assessed on actual flight occurring later based on the gaming experience. The researcher concluded that differences were attributed to the similarity of the game to actual flight conditions in terms of coping with the attention demands and high cognitive load in both situations. Many studies have found no effects on transfer from games (Fletcher & Tobias, 2006; Hart & Batiste, 1992). Fletcher and Tobias argue that studies in games and learning seem to focus on transfer of learning; however, not many focus on transfer in content areas. Squire (2006) argues that

transfer from games is possible with content areas, but it should account for the context within which the content is being learned.

The literature on learning from games indicates that researchers do focus on learning from games, but what is being learned in terms of content is not so clear (Foster & Mishra, 2009; Squire, 2002, 2003; Williams, 2005). It is evident that there is a focus in developing skills (De Aguilera & Mendiz, 2003; P. Greenfield & Subrahmanyan, 1994). Fletcher and Tobias (2006), in their analysis of numerous studies on learning, motivation and transfer concluded that learning tends to focus more on skill development for cognitive structures and less on content areas. What is usually not clear is what content or disciplinary knowledge is being learned (Foster & Mishra, 2009). This is probably due to the fact that the content to be learned usually determines what pedagogical approach to use to meet learning goals, and there is not much discussion of the pedagogy of games, except that it is embedded within the game, and it is the best for learning. In this study a central focus is on what disciplinary knowledge and skills are learned and transferred from the game.

Learning educational content in games is crucial, but learning it without valuing the experience and the content leads to inert knowledge (Whitehead, 1929). Coupled with the fact that an important reason for using games is because of the claimed affordances that they can engage, immerse (Asgari, 2005) and enable players to have flow like experiences (Csikszentmihalyi, 1996) that may lead to creating interest and enabling players to value the activity. Thus the next section discusses games and motivation, especially the motivational valuing aspect. The motivational valuing is within the external aspects of studying games, one of the social practices within a domain.

Motivation and Games: External Aspects as Valuing the Game and Content

According to Williamson, Land, Butler, and Ndahi (2004) using games to engage or motivate children in learning activities is not new. They argue that children instinctively create games to help make sense of the world around them. Digital games add to the mix by enhancing imagination and role-playing in children through rules. Research has shown that one major reason researchers tend to use games in education is to motivate students to learn (Asgari & Kaufman, 2005; Calleja, 2007; Foster, 2008; Galarneau, 2005; Shaffer, 2006; Steinkuehler, 2006).

Initially, the sort of motivation many researchers referred to when studying games was intrinsic motivation (Asgari & Kaufman, 2005; Greer, Schwartzberg, & Laycock, 1977; Malone, 1981). Intrinsic motivation theories warrant only seeking for pleasure (Brophy, 2004). This is not surprising, since a major goal of commercial video games is to entertain (Buchanan, 2005; Foreman, 2004). The self-deterministic value in videogames does not stem from focusing on learning goals, but rather on its entertainment value associated with gameplay. In supporting this argument, Gee (2007a) argued that when gamers play games, they do not focus on content, but on gameplay. If a game is designed without focusing on learning goals for education, then focusing on gameplay does not help educational learning goals, but rather its entertainment value. Currently, researchers argue that while part of the motivation may initially come from novelty effects, competitive enjoyment, or the stimulation younger generations seek, the best types of engagement come from the learner's enjoyment of a more effective learning experience (Asgari, 2005; Papert, 1997).

A primary goal in education is to motivate learners to value disciplinary knowledge. Thus, the aims of research with games for learning in education should involve supporting students to appreciate or value the content being learned in the games. Brophy (2008) argues that currently there is limited knowledge about situations that afford opportunities for learning school content with appreciation for its value. Gee also argues that studies of games and learning should focus on both the content and the social practices of the domain being investigated. The social practices of a domain involve valuing the domain.

In a study by Beckett and Shaffer (2005), the authors describe the learning of high-risk students by augmenting reality to engage in urban planning and developing the epistemic frames of urban planners. Shaffer (2004; 2006) describes epistemic frames by arguing that games can provide students with the beginning of understanding and valuing what it means to be in certain professional roles. With epistemic frames students do not need to learn all the beliefs and know everything that professionals know; however, they do need to know the basics that form the core structure of the content as well as the social practices or culture of the domain. Epistemic frames are another way of speaking about valuing the educational content in games. From this perspective, it helps if students learn to value the basic core structure of the content domain.

Roe and Muijs (1998) in their large-scale survey study of 51 schools with a total of 1001 Flemish 10- to 11-year-olds concluded that heavy use of computer games is associated with negative rather than positive outcomes in terms of academic achievement, self-esteem, and sociability. The study was design to document the use of media by children, but focused primarily on games. In the study the aim of researchers

was to sketch a profile of heavy computer games use and how it affected learning and motivation. The study did not involve gameplay. In this study, the results for sociability and self-concept related to both the expectancy and the valuing aspects of motivation, and both were significantly affected negatively by game playing. However, the study did not focus on motivational valuing of disciplinary knowledge as the aim of the study was to examine literacy in the media age.

Malone (1981), in exploring the motivational aspects of digital games, concluded that content which is intrinsically related to fantasy will produce better learning than content which is merely extrinsically related. Malone's goal was not to examine the motivational valuing of educational content, but to explore ways in which games engage learners intrinsically and extrinsically. Habgood, Ainsworth, and Benford (2005) argue that an integration of learning content with flow activities and representations may increase motivation.

Valuing is a necessary construct for believing, thinking, acting, and seeing as a professional in a domain because it is connected to interest (Anderman & Wolters, 2006; Shaffer, 2004). Interest may either be personal (a person's ongoing attraction or liking for a domain or activity) or situational (a person's current enjoyment or satisfaction as produced by an immediate context) (Anderman & Wolters, 2006). Researchers contend that the goal is to make situational interest become personal interest and then students may begin to value an activity. Working within the construct of personal interest, the aim is to make the activity not only immediately enjoyable or useful, but for it to always be perceived as attainable, useful, and intrinsically valuable (Anderman & Wolters, 2006; Wigfield & Eccles, 2002). Theoretically, research has shown that the learner's interest as

it is when discussed with motivational valuing is related to beneficial outcomes. That is students who are personally interested are more cognitively engaged, cope longer, and enjoy the tasks more. Research has also shown that situational interest may be beneficial for students (Schiefele, Krapp, & Winteler, 1992). As this relates to game playing or school learning, valuing of disciplinary knowledge or game practices may help students to have situational interests via catch factors (elements that engage the student and provide immediate enjoyment) in the game, such as building theme parks, managing money, and other novel or incongruous situations, and then lead to more personal interests which are intrinsic in nature (Schraw, Flowerday, & Lehman, 2001).

To date there are few studies that focus on the motivational valuing of content in games as shown in the review. Many focus on motivation for engagement in the game, but not motivation to learn content or value the content. Researchers have argued that motivation in games and learning studies tend to focus on students as being more highly motivated by games than by more traditional instructional presentations, including those not especially interested in the subject matter, or they focus on game elements that afford motivation (Asgari, 2005; Asgari & Kaufman, 2005; Fletcher & Tobias, 2006). Researchers such as Gee (2003) and Fletcher and Tobias (2006) suggest that there should be a focus on instructional outcomes that assess the student's attitude to the game and content. Motivation researchers, such as Brophy (2008), contend that there is a need for more studies that documents the valuing of disciplinary knowledge. Therefore, one focus of this study is on participants motivational valuing of the game and content.

The investigation of learning and motivational valuing in a game would not be complete if the process by which players learn was not elucidated. For this the next

section discusses player strategies or styles using different player types and their potential characteristics to aid understanding of the process of learning.

Strategies: Elucidating Play Characteristics Using Player Types

Games and simulations provide practice that are tailored to the users' needs, interests and intentions (Oblinger, 2004). The plurality of game players is reflected in how they play games. The cliché that one size does not fit all in education is epitomized in player characteristics or styles and types in games. In Education this has been studied for years through motivation and learning styles, while in game studies there is a paucity of research on player styles and learning (Heeter, 2009). According to Heeter (2009) player types are the archetypes of extreme behaviors by players along observable and meaningful dimensions. A player type is a combination of a player's play style and motivational characteristics. Heeter argues that play styles are behavioral while player types describe a player. Player types and styles are used by game designers and can be used by educators to appeal to the individual players and how to design curriculum for particular types of students. Player styles also highlight the process of play and, by extension, the process of learning since gameplay is the process of knowledge construction and both are inextricably linked when students play games (Barab, Hay, Barnett, & Squire, 2001). However, much of the research on player types and styles have been conducted with Massively Multiplayer Online games (MMOs) (Heeter, 2009).

Bartle (2006) in his analysis of Multiuser Domains (MUDs) text-like games, such as *Dungeons and Dragons,* documented four types of game players: explorers, achievers, killers, and socializers. *Explorers* are players who delve into the inner-working of the game to explore game features, and they prefer interacting with the game rather than

socializing. *Achievers* are players who aim to beat the game. They explore to beat the game, socializing only to find techniques to beat the game. They find playing to beat their peers a bother. *Socializers* are players who are interested in other players. The game is only a platform for socializing. They are empathetic to others. Finally, Bartle described *killers* as players of few words. They try to impose themselves on others, beating other players, and frustrating other players. For Bartle these player types illustrated the approach players adopted when playing games.

Following up on Bartle's player types, Yee (2006) collected data from an online survey of 30,000 users playing Massively Multiplayer Online Roleplaying Games (MMORPGs).The survey was conducted over a three year period to explore the demographics, motivations, and derived experiences of users. Using an exploratory factor analysis Yee showed that motivation of players in MMORPGs derived from achievement of goals, relationship with other players, immersion in the micro-world, escapism from there daily lives, and manipulation of others. This study document the motivation of players and their player styles by way of gaming approaches such as manipulation of other players.

To develop a taxonomy that links player styles with motivation and learning, Heeter (2009) analyzed data and documented 17 player types from existing game literature. The palette of player types and learning styles that underlie their motivation orientation were either social or achievement, including the tendency of players to be pro-social or anti-social or to be extrinsically or intrinsically motivated. Heeter further argued that there were four distinct types who played educational games and these included achievers, explorers, lost, and careless type of players. In demonstrating the

player types Heeter conducted two studies online with 90 seventh graders learning evolutionary science. In the studies, Heeter described the types of players through reward structures and by those who played individually versus in pairs. Achievers and careless players played the game the fastest and made more decisions in completing it, while explorers and lost players played slower and did more exploration. Explorers and achievers made fewer mistakes in gaming, while lost and careless players made four times more mistakes. Heeter concluded that achievers "appear to be the best player type for learning" while explorers were the next best. Lost players learned the least amount of content and careless players were third. Heeter also concluded that paired playing has some beneficial impact on the attention to the player to the learning content of the game.

Heeter argues that in reality players usually adopt at least two play styles. Klug and Schell's (2006) highlighted nine player types sometimes used by commercial game companies: competitor, explorer, collector, achiever, joker, director, storyteller, performer, and craftsmen. They argue that it is clear that there are many player types and styles. Like Heeter (2009) Klug and Schell argue that a player usually embodies at least two of the player types. In no way will this study imply players are solely one way or the other. Players adopt certain play styles to achieve their goals with the design of the game.

This section of the review of literature argued that player styles or strategies are an important aid in understanding the process of learning through play types adopted by the players. Through navigational strategies of the players and their attitudes to the content of the game player types may help to elucidate the process of learning. However, there are few research studies that show how player styles and learned disciplinary knowledge interact, and how game genres influence the adopted player styles. The role

of game genres is discussed in the next section, the context for the study. In addition in this review, no study focused on disciplinary knowledge and the process of learning via player types. Heeter's (2009) approach represents one step to achieving a method to examine the process of learning in games via player types. Thus, in this study one focus is on player strategies using player types and styles to help elucidate the process used to navigate the game.

Context for This Study

Within this study, one focus is on the role of game genre in aiding to better understand learning from games. Many studies that examine content or learning from or in games usually ignore the differential potential or the role of game genres or the pedagogical implications of videogame genres (Aarseth, 1997; Caldwell, 2004; Foster & Mishra, 2009). Game genre, the basic mechanism of gameplay, allows players, educators, researchers, designers and developers to see differences in games and what they afford for specific learning experiences (Foster & Mishra, 2009). Galarneau (2005) argues that games and simulations are only as effective as the pedagogical approach that is employed, and their effectiveness must be measured against the learning objectives and methods selected. Galarneau contends that this is not being done. However in order to use the appropriate pedagogical approach one must focus on the genre of the game.

Williams (2004) found that research in game-based learning continues to use conflated variables such as genre difference and fail to acknowledge the manner in which game genre limits their claims. Foster and Mishra (2009) argue that it is important to look carefully at game genre because the design stance (including the design of a game, the kinds of choices regarding the gameplay, the structure, the nature of progress through

a game, the nature of representation, and so on), is the result of conscious (and maybe subconscious) decisions made by game designers. From an educational perspective, this stance can be seen as an implicit pedagogical approach with implicit theories of learning, behavior, and epistemology. Thus the pedagogical stance in a game is implicit in the game genre.

Caldwell (2004) discusses the importance of game genres in his analysis of *Civilization II*. He contends that game genres help in organizing the knowledge in the game by how it is played. Game genres influence play mechanics, which in turn influence what can be done and learned through playing electronic games. For instance, in simulation strategy games there are usually feedback screens such as dropdown windows, as is found in *The SIMS, Civilization* series, and the *Tycoon* series of games. In this genre, the mechanics of play on a computer is usually done by pointing and clicking with a computer mouse, while the primary navigation or pedagogical approach is observing and then intervening in game actions through feedback to manage the micro-world. This is a result of the simulation strategy genre of games being designed so that players interact with game from a third person perspective or "gods or birds eye view" to manage gameplay. This influences interactivity, the pace of the game, and the nature of exploration– a reason why simulation strategy games have a slower pace of play and lend themselves to more exploratory play than first–person shooter games. Observing and then intervening helps to determine what is learned because of the information that is feedback through drop-down screens on what to focus on in managing the world.

Simulation strategy games have been the focus of many researchers for learning deep knowledge and basic facts (Oblinger, 2004). According to Oblinger, if the objective

is to learn a skill that requires practice, a game or simulation may be best. Gredler (1996) argues that simulation games have potential to enhance educational learning especially in ill-structured domains. In discussing simulation games, De Aguilera and Mendiz argue that simulations stand out for their enormous educational potential. Simulation games can help in the development of all intellectual abilities and a mind for machines (De Aguilera & Mendiz, 2003). It is apparent that by ignoring game genres one fails to see how the genre affects play and by extension what is learning. The game that is used in this study is a simulation strategy game.

Given the gaps highlighted in the literature and the arguments that well-designed commercial games have the best learning theories embedded within them as well as the potentials of simulation strategy genre, this researcher planned to study a commercial simulation strategy game to examine what knowledge and skills children could gain when playing the game as well how they learned from the game. To discuss disciplinary knowledge and skills learned from a simulation strategy game, assessment must focus on the content and skills within the genre. Thus content and skills will be assessed based on knowledge gained from playing the game *RollerCoaster Tycoon 3 Platinum (RCT3).*

RCT3 is a game from the simulation strategy genre whose focus is on building and managing resources in theme parks. It covers the content of microeconomics and social studies as well as information that aids the development of technology and information literacy. According to the publishers and literature about the game and genre, it should appeal to both genders because of its characteristics, such as managing resources, and building and designing artifacts. It also has no explicit violence and no explicit scoring to record performance and affect self concept or competence. For boys it

has the action elements such as building roller coasters and fireworks. For girls it has managing a world and dealing with exploratory and empathetic elements. In addition, it embodies a good mix of disciplinary knowledge and skills for upper-elementary or middle school children 9-12 years of age relating to economics, social studies, information literacy, and technological literacy. The goals and criteria for success are also clearly given to players via game objectives and scenarios. Thus, *RCT3* was chosen for the study primarily because it has a good combination of disciplinary knowledge with gameplay, it is in a popular genre, it has clear expectations for success, and it is appealing to both genders. This does not mean that the game is perfect as it only represents the game designers' view of some fundamental economic principles with gameplay for entrepreneurial pursuits.

RCT3 embodies ways of knowing content and developing social practices related to the content and game including valuing basic ways of being a business professional. In addition, the simulation strategy genre offers unique ways to communicate meaning and thus learn from the main content areas and social practices within the game. The specific content a participant would be expected to learn would relate to micro-economic principles such as opportunity cost, supply and demand, and scarcity.

Learning with RCT3: A Semiotic Domain

Equally, if we are to examine learning in games in education it has to be done in a manner that captures the content from the particular game. Gee (2003) says that games should be examined as semiotic domains to better understand learning. Semiotics is concerned with meaning making and representations, such as in texts and media. The texts could be verbal, non-verbal or both (Chandler, 2002). According to Gee (2003), a

semiotic domain is "any set of practices that recruits one or more modalities to communicate distinctive types of meanings" (p. 18). A semiotic domain includes self-contained multimodal situated environments where individuals develop ways of knowing content and social practices to communicate or participate in the domain.

Games should be treated as semiotic domains because they are self-contained multimodal situated environments where individuals develop ways of knowing content and social practices to communicate or participate in the domain (Gee, 2003). According to Gee, an examination of a semiotic domain should be done internally and externally. The internal aspects of a semiotic domain refer to its content, while the external aspects refer to the social practices people engage in within it. Thus an examination of games as semiotic domains means internally examining the content structure and externally examining the typical social practices including the ways of thinking, acting, interacting, valuing, and believing within the domain (Gee, 2003). In this study, the focus is on only one aspect of social practices and that is the motivational valuing of the game and content as discussed in motivation and games in order to have a focused and practical dissertation.

Internal Aspects of RCT3

The internal aspects of the game are focused on economics, social studies, information literacy, and technology literacy as game knowledge. *RCT3* is classified as an economic simulation strategy (a label used by its publishers) game because the main content area is economics. However, the game covers other content areas such as social studies, information literacy, and technological literacy.

Economics at the primary grade levels (K-6) is usually within the social studies curriculum. Social studies is defined as, "the integrated study of the social sciences and humanities to promote civic competence" (National Council for the Social Studies, 1994, p. 3). Further, according to the National Council for the Social Studies (NCSS) (1994), "the primary purpose of social studies is to help young people develop the ability to make informed and reasoned decisions for the public good as citizens of a culturally diverse, democratic society in an interdependent world" (p. 3). The seventh strand (production, distribution, and consumption) of the ten strand national standards covers the definition of economics indicating the broad purview of social studies and its relationship to economics education. The National Council on Economic Education (2005) defines economics as the study of how limited resources are used to meet the needs and wants of people in society. Economics is also defined as the study of production, distribution, and consumption of goods and services (Brophy & Alleman, 2007). The latter is the definition that fulfils the social studies requirements for schools. It addresses decision making about utilizing and obtaining various forms of resources such as time and raw materials. The Michigan Curriculum Framework (MCF) has five content standards for social studies under the economics perspective from early elementary to high school; however, later elementary students (as in this study) have not covered much information from the content standards. Some of the standards information is introduced. Standards 1, 2, 3, and 4 are covered in the game at both the later elementary and middle school levels and with more information than is required by the MCF. These include understanding how purchasers obtain information about goods and services from advertising, exhibiting decision making on personal choices, and

understanding scarcity, opportunity cost, cost benefits, goods and services, profit, and pricing. The fifth standard is not covered. The NCEE outlines that for K-6, experience should be provided for simple principles such as scarcity, opportunity cost, or exchange because they provide labels that can be enriched later.

The NCEE outlined 20 essential principles that K-12 students should understand by the time they have graduated from high school: 1) scarcity, 2) marginal/cost benefit, 3) allocation of goods and services, 4) role of incentives, 5) gain for trade, 6) specialization and trade, 7) markets – price and quantity determination, 8) role of price in market system, 9) role of competition, 10) role of economic institutions, 11) role of money, 12) role of interest rates, 13) role of resources in determining income, 14) profit and the entrepreneur, 15) growth, 16) role of government, 17) using cost/benefit analysis to evaluate government programs, 18) macro-economy-income/employment, prices, 19) unemployment and inflation, and 20) monetary and fiscal policy. The standards are broken in three sets of benchmarks for K-4, K-8, and K-12. According to the NCEE standards, Sixteen (16) of the 20 principles should be introduced by the time students complete K-4, the exception being content standards 12, 17, 18 and 20. The NCEE (2005) outlines the following key skills that student must develop in K-12:

> "Skills, as well as content, play an important part in economic reasoning. The key skills students must develop in economics include an ability to: (a) identify economic problems, alternatives, benefits, and costs; (b) analyze the incentives at work in an economic situation; (c) examine the consequences of changes in economic conditions and public

policies; (d) collect and organize economic evidence, and (e) compare benefits with costs."

RCT3 is a game that involves players in designing and maintaining theme parks. It has objectives within three levels including Apprentice, Entrepreneur, and Tycoon for each scenario that tells players what actions they should complete to move on to the next level and eventually the next scenario. While the game involves theme park designing and maintaining, it requires players to make decisions using fundamental economic principles such as scarcity if they are to operate their park successfully.

Economics and social studies principles guide the play and content. Players must utilize resources to meet their personal game playing needs, the needs of the park visitors, and the needs of the park to run it effectively. Making decisions about which need to satisfy requires that participants think critically in evaluating and combining information from feedback within the game environment. Brophy and Alleman (2007) argue that while elementary students are not ready for macroeconomics, they should learn microeconomics and many of the basic economic principles. They contend that many of the principles, including needs and wants, scarcity, supply and demand, and opportunity cost lend themselves to experiential learning in activities that require students to make decisions about time and money. In Michigan, students are not assessed for social studies knowledge until they are in grade 6 on the Michigan Educational Assessment Program.

Game based studies on social studies are prevalent, but not many have been done to focus on economics at middle school or upper elementary levels. Squire (2003) argues that video games such as *Hidden Agenda* allow players to play the role of a world leader

as well as learn about economics. In studies that examined the learning of economics concepts from games or simulation based environments, researchers found that high school students learned core economic ideas and were beginning to take on the values of professionals in fields such engineering or urban planning (Beckett & Shaffer, 2005). Beckett and Shaffer used a game called *Madison 2200* with at-risk students to illustrate how students may begin to develop basic but fundamental understanding. In Kimberley's (1995) Master's thesis using a virtual environment called *Marketplace* that enables students to participate in economic simulations over the Internet in the roles of buyers and sellers, it was concluded that participants gained insights into the economic ideas. *Marketplace* included online discussion facilities designed to support not only economic deal-making among participants, but also reflection and analysis of the economic patterns that arise from the interactions. In a related study, Bos, Shami and Naab (2006) used a simulation called *Island Telecom* in a classroom based study with groups of 30 and 60 students in 3-person teams in an attempt to increase ethical business understanding among MBA students. The simulation, which is set in five fictional islands, puts players in a role-playing scenario where they must consider ethical dilemmas in negotiations because the islands lack natural resources or agricultural products. Conflict develops between the teams over other resources, such as telecommunications, forcing players to consider ethical problems experienced in the real world where resources are not abundant. The researchers concluded that the game forced students to take on perspectives or views that were not very well represented in business schools and at the same allowed them to be creative in their negotiations.

Despite some indication of students gaining insight about economic concepts or principles, some researchers argue that few studies examine what is learned in games (Squire, 2003). Further, very few studies examine economics learning at the upper-elementary school level. In a recent national survey of the state of economics learning, Hawthorne and Wheeler (2006) discuss the need for alternative assessment of primary grade level economics for children as well as the need for children to develop the competencies outlined by the NCEE. The older participants in the studies discussed were dealing with sophisticated economic principles in virtual or augmented by reality games such as with Beckett and Shaffer. Through games, elementary and middle school students may also learn the microeconomic or basic principles as indicated by Brophy and Alleman and by the NCEE.

The other content areas, information and technology literacy complete the internal aspects to be examined within *RCT3*. According to the American Association for School Librarians (1998), information literacy learning means being able to evaluate information critically, creatively, efficiently, effectively, and competently. Implicit in the three categories of the standards, which have 29 indicators, is that students will know the importance of having good information to meet the daily challenges, be able to weigh information carefully and wisely, and be able to organize and integrate information from a range of sources (American Association of School Librarians & Association for Educational Communications and Technology, 1998). Like the Information Literacy Standards, according to the International Society for Technology in Education (2007), the next generation National Educational Technology Standards (NETS) say that students should know about creativity and innovation; communication and collaboration;

research and information fluency; critical thinking, problem-solving, and decision-making; digital citizenship; and technology operations and concepts. There is a major overlap between the information and technology literacy standards, hence the content and requirements for what students should know. Neither the technology nor information literacy standards specify the requirements for grade 4-6 students though it is required. In addition, there is no course designed specifically teach these skills in those grades.

Caldwell (2004) in his analysis of strategy games argues that they allow for the development of expertise because the observation and intervention interaction approach. Integrating broader perspectives from the claims of games survey, Caldwell, and Web information about *RCT3*, it is posited that *RCT3* will allow for the development of practical skills related to expertise development, cognitive skills related to systemic and critical thinking, motivational affordances related to valuing of the content, and social skills related to identity/possible selves and communication skills.

Gameplay is a result of the affordances and constraints of the game, such as the genre. This review highlighted the affordances of games, learning in games, motivation and games, and the context of study with game genres. Play strategies using player style and the influence it may have on the process of learning were also discussed. It also developed the idea that learning in games for education should involve a focus on content and game genres or learning goals (Foster, 2008). Game genre has been argued as a form pedagogy (Foster & Mishra, 2009). The content of games was discussed as disciplinary knowledge whose focus was on economics and social studies as well as information and technology literacy skills. The game in itself was presented as a form of technology.

In this research the argument is promoted that if we are to think about learning as conceptualized in a productive way from games we need to frame the content being taught (C), and the genre and implicit pedagogical stance of the game (P) and we have to discuss using a game to develop learning as a form of technology (T). Technological Pedagogical and Content Knowledge Framework (TPACK) is used to frame this connection between the game (technology), game genres (pedagogy) and disciplinary knowledge (content) (Mishra & Koehler, 2006) (See Figure 2).

Technological Pedagogical and Content Knowledge

TPACK is a framework that was designed to be used to describe teacher knowledge for the integration of technology (Mishra & Koehler, 2006). The framework focuses on Content, Pedagogy, and Technology individually and synergistically. Within the context of game-based learning and game design research, TPACK is being co-opted to help identify critical aspects of what is needed for learning in games as well as what is learned when players play any game. For this study in the game analysis, TPACK was used to identify in the game the content, the genre, and focus for assessment of learning. It aids in preventing the conflation of the game genre variable by highlighting the process of learning through the interactivity allowed by the dominant pedagogy of the genre. The pedagogy is one factor that helps to determine how players navigate as well as what is learned in terms of content. The study is framed with TPACK by taking a commercial game (T) and designing a study that focuses on the disciplinary knowledge and skills (C) within the simulation strategy genre (P).

According to Mishra & Koehler (2006), any technological solution to a pedagogical problem needs to consider the role played by Technology (T), Content (C),

and Pedagogy (P) (See Figure 2). Further, from the purview of games for learning (a form of T) and pedagogy (P), Mishra and Koehler describe this intersection as Technological Pedagogical Knowledge (TPK), which represents knowledge of the existence, components and capabilities of various technologies as they are used in teaching and learning settings. For TPK, Mishra and Koehler argue that teaching and learning changes depending on particular technologies. This requires knowing the affordances and constraints of particular technologies as well as the disciplines or content areas of usage.

From the perspective of game-based learning, TPK is useful because of the strong resemblances to game genres. The TPACK framework provides for a focused analysis on how technology integrates with content and pedagogy. When viewed through the lens of interactivity game genres are another way of describing how a particular game integrates pedagogy and technology. Thus, the game has T and P via game genre while C is designed into it. Foster and Mishra (2009) argue that a good educational game would seamlessly integrate all three aspects of TPACK, namely T, P, and C. Their analysis of game genres shows that two of the three components of TPACK are already present (i.e., T and P). What is missing from the discussion of learning from games is any discussion of C (content). The goal of educational game designers is to think about how this third circle can be brought into the framework. From the perspective of research in education, the TPACK framework allows us to ground the claimed affordances of games in the specifics of disciplinary knowledge and what can be learned.

The inclusion of TPACK provides a framework for focusing and analyzing the content of *RCT3* and how it integrates with the simulation strategy genre. It allows the

researcher to highlight the game genre, thereby reducing the conflation of that variable in learning, and it provides insight on the focus for learning and how learning could occur and be assessed. Genre plays a crucial role in game based learning assessment because of its implicit role as a form of pedagogy. Likewise the content in games needs focus as its own variable.

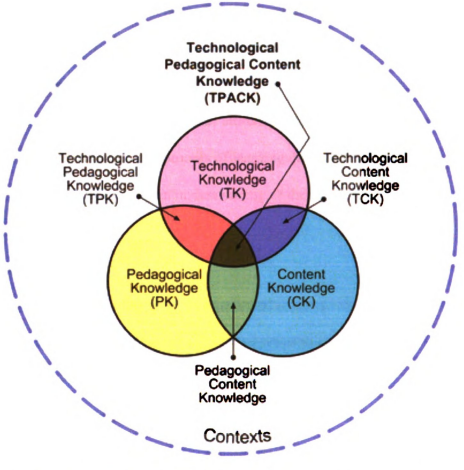

Figure 2: Technological Pedagogical and Content Knowledge Framework

This review highlighted the studies that focus on learning content in games and found while many focus on important content, few focused on disciplinary knowledge. In addition, the role of the game genre is usually overlooked and allows for blanket statements related to the claimed affordances about what games can do for learning.

However, it is shown that many studies tend to focus on skill development or on the structural elements of games, such as interactivity. Second, valuing the game and content is important for long term learning and interest. Reviews indicate that studies have shown games do engage students in learning, but few have discussed whether students valued the content. Both game studies and motivation researchers have argued that there is limited knowledge about valuing educational content. While this study does not follow the long term aspect of valuing, it is an aim of the researcher to begin the process of using games as a platform for aiding in the development of valuing educational content and possible selves. Finally, studies have shown that characteristics of the players such as player styles and types may influence their attitudes and approach to playing the game. However, few have examined the process of learning disciplinary knowledge. This research may help in developing an understanding of the process of learning through the characteristics of players.

Research Questions

Four research questions were foreshadowed in the review of literature to help address the gaps discussed. The issues addressed research lacking focus: on disciplinary knowledge and skills, on motivational valuing, and on play strategies using player types to aid understanding the process of learning.

In addition, it was discussed that in order to examine a game for learning, just as a teacher must know the curriculum materials, a researcher must examine the game as a whole curriculum, analyzing everything within it to determine what might be learned as preparatory work to understand the affordances for learning. Thus, the first research question focuses on a systematic analysis of *RCT3*:

1. What are the affordances for learning provided by the game? This question helped address the affordances of RCT3 through a game analysis examining what content is presented in the game, and how is it presented, by exploring *RCT3* technology, pedagogy, and content (economics, social studies, and technological literacy).

Three research questions empirically address the learning, motivation, and experience of the participants.

2. What did the participants learn? To determine what participants learn was examined in by looking at the knowledge of technology and development of information literacy, the knowledge of *RCT3* (theme parks), and the knowledge and transfer of disciplinary knowledge namely the basic economics and the social studies content.
3. What did participants value in terms of having or developing valuing in the game and content? To determine if participants valued the game and content was examined by looking at the social practices related to valuing, a key component of the external aspects of *RCT3*.
4. What strategies did participants use to progress in the game? To determine the process of learning was examined by looking at the strategies participants use to progress in the game from one objective to the next. This elucidates their play styles or types which aids in identifying the process of learning. The process by which the participants use to learn is revealed through the characteristics they displayed in their play styles.

Chapter 3

Research Method

This chapter outlines the *convergence concurrent mixed methodology* that is employed in the study to collect data and acquire results using triangulation of data. It outlines the research approach and process of analysis. The chapter begins with a rationale for utilizing mixed methods methodology followed by a brief outline of the research questions. Next, a description of the settings of the study is rendered as well as a description of the participants selected for the study and the participant selection process. This is followed by a discussion of the materials, data collection procedures, measures in the study, and data analysis.

The convergence concurrent mixed methods research methodology allows for both quantitative and qualitative types of data to be collected in one phase and integrated at the same time during the interpretation and analysis (See Figure 3) (Creswell, 2003; Creswell & Clark, 2007). Learning is conceptualized through performance, that is, what knowledge do students exhibit when tested, surveyed, observed, and interviewed in the study? Further learning is viewed as emerging as part of doing the activities in play (Barab et al., 2001). Learning and doing are inextricably related. In a game environment, the playing of the game is the process of constructing knowledge.

Rationale for Mixed Methods

Creswell and Clark (2007) contend that mixed methods research is both methodology and method. As a methodology, it has philosophical assumptions that guide the direction of data collection and analysis of the mixture of quantitative and qualitative approaches. As a method, it focuses on collecting, analyzing, and mixing of both

quantitative and qualitative data. The research questions in this study lend themselves to both quantitative and qualitative analysis (See Figure 3).

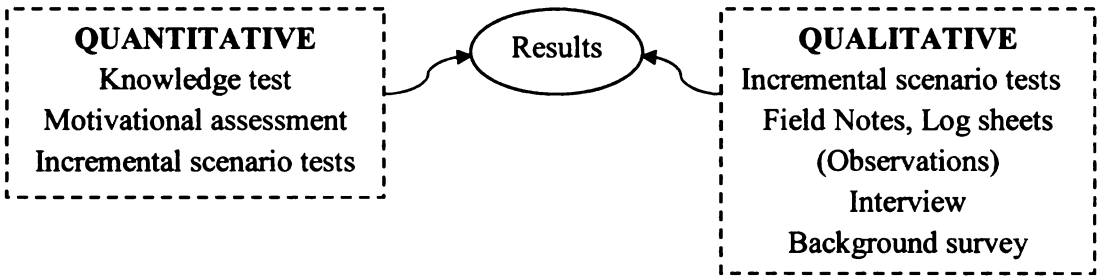

Figure 3: Quantitative and Qualitative Methods Used to Collect and Analyze Data

Using the mixed methods approach, this study aims to find out "what works," which is typical of the pragmatic approach (Smith, 2006). When quantitative and qualitative analyses are combined, the resulting triangulation of data helps to give a better understanding of the data set (Lukkarinen, 2004) in assessing the knowledge gain of students and the valuing of the social practices. Lukkarinen (2004) says triangulation is an effort to define a study by using more than one study or by using several methods to capture a social structure or a concept. Thus, in this mixed methods approach both sets of results are integrated to answer the research questions in ways that both quantitative and qualitative approaches could not do by themselves.

While there is a need for the quantitative or qualitative approaches to gather information, at times they are inadequate by themselves alone to address research problems where mixed methods would be a preferred design (Creswell & Clark, 2007). Using the quantitative or qualitative method alone may not tell the complete story. The quantitative method may not take into consideration the researcher's influence in the study and the deep interpretive analysis. On the other hand, qualitative methods do not provide statistical interpretations, and it is more difficult to generalize the findings

(Green, Camilli, & Elmore, 2006; Smith, 2006). Quantitative data attempts to provide statistical answers for what is learned and for ideas about attitudes of participants through pretests and posttests, incremental scenario tests, and motivational assessments. The qualitative data collected in the play process attempt to help with an interpretive understanding of how and why learning occurred via background surveys, interviews, log-sheets, and participant observations by the researcher. It also aids in creating qualitative categories, which are analyzed quantitatively to indicate learning in these categories.

Methodological Approach and Research Questions

Both quantitative and qualitative approaches were used to examine the research questions:

1. What affordances for learning were provided by the game? The game analysis that is conducted answered the question. It examined the game as a technology, while focusing on the disciplinary knowledge (content) and game genre as form of pedagogy (See Appendix A).

The other research questions in study 2, the empirical study addressed the learning and experience of participants based on the following questions:

2. What did the participants learn?
3. What did participants value in terms of having or developing personal interest in the game and content?
4. What strategies did participants use to progress in the game?

Settings for Study

Physical Settings

The location of this study was a technology room in the College of Education at Michigan State University. The room was set up to accommodate natural gaming and free play as a typical game play environment for preteens with friends. In addition, pizza and drinks were provided. There were 17 computers (7 desktops and 10 laptops) used in the study and the room was set up so that the participants could have optimal interaction with each other if they chose. The aim was to have the participants playing and socializing with each other during gameplay rather than playing alone with minimal interaction. This enabled participants to play in a manner which was consistent with the social setting of typical game playing with friends or siblings (Gee, 2003). As part of the setting, the researcher was present along with audio-visual equipment to capture the interaction among participants.

Virtual Settings

In the virtual game setting of *RCT3* there are eighteen scenarios; however, only the initial six scenarios, which are available at the beginning of gameplay, were used in the study because of the limited duration of the study. The six scenarios include *Vanilla Hills, Gold Rush, Checkered Flags, Box Office, Fright Night,* and *Go With The Flow.* Each scenario has the same available tools on the screen; however, the visual layouts of the theme parks are different and in some of the parks the tasks are different. In addition, the same on-screen tools are used repeatedly in various ways to accomplish the objectives for each level within a scenario. Each scenario has a synopsis. For instance, the synopsis for *Vanilla Hills* is "The *Vanilla Hills* are the starting point on your meteoric

– or not – rise to RollerCoaster Tycoon status. Can you turn this plot into the peeps [people] talk of the town? Your rating as Apprentice, Entrepreneur, or Tycoon depends on it" (Frontier Developments, 2006). Each scenario has three levels: Apprentice, Entrepreneur, and Tycoon. Each level has objectives to be met. For instance, to achieve the goals of being an Apprentice in *Vanilla Hills*, players must get 400 people in their park and raise the minimum value of their theme park to $20,000.00. The objectives of the Entrepreneur and Tycoon levels require more people and higher park values. The levels are based on the increasing complexity and difficulty within scenarios, and this requires players to master each level to achieve Tycoon status. The scenarios are all at the same level. Although the scenarios are different visually and generally by tasks, each scenario tests for the same disciplinary knowledge and skills in the game with slight variations due to game objectives.

In the career mode, participants played *RCT3* using the same free play as they would at home. They may have encountered some difficulty or cognitive friction in learning to play the game, but that is a part of the naturalistic play. Further, the game requires time to develop an understanding. Therefore, the study was seven weeks long, and participants played the game for approximately 24 hours. This allowed sufficient time for them to develop a good understanding of the game, to see their growth from the beginning through play, interactions with peers, and from the Web.

Participants

Thirty participants were selected for the study; however, twenty six completed the study. Of the four participants who dropped out of the study, two said it was too much commitment, one said it conflicted with future dates for a sporting activity, and one

withdrew because of an illness. The participants were from grades four to six, ages 9 to12, and were selected using purposive sampling techniques from a pool of 39 children who showed interest in the study. Participants were from several ethnic groups: Chinese Americans, Indian Americans, African Americans, European Americans, and Hispanic Americans. For three reasons, participants aged nine to twelve were used: First, children at that age are usually in grade 4, 5, or 6 and have not yet been exposed to the social studies or economic principles that they will encounter in *RCT3* in the Michigan school curriculum. At grade six, students would be preparing to do their *first* assessment of economics which is under the social studies curriculum. Second, the children are within the age requirements for the game to be neither too difficult nor too easy for them to play based on the recommendation of the publishers and based on the performances from a pilot study using 5 players in the same age range and gaming experience. Third, the children have matured to an age in their lives where they make decisions (consciously and subconsciously) about school content that they either like or dislike. Exposing them to content in multiple ways such as in games, may influence decisions.

Recruitment was done by way of verbal requests, emails, and flyers requesting for parents consent and volunteers for the game-based learning study and consent of parents. From the group of volunteers, potential participants were emailed questions asking about their frequency of game play and if they had played RCT3. From this pool, 30 children were purposively selected to represent the wide frequency of games played by American children that ranged from no playing of games to over the national average of seven hours a week. Identification numbers ranging from *RCT3*01 to *RCT3*30 were given to protect their privacy and their identities to the maximum extent allowable by law.

Researcher's Role

The role of the researcher was different in Study 1 and Study 2. In the game analysis section (Study 1), the researcher was the participant for the question addressing the affordances for learning provided by the game. He critically and reflexively analyzed *RCT3*'s content and pedagogy in order to understand and provide a credible and reliable perspective about the nature of what is possible to be learned in the game. This is reflective of Alan Peshkin's interpretation as "an act of imagination and logic. It entails perceiving, importance, order and form in what one is learning that relates to the argument, story, narrative that is continually undergoing creation" (Peshkin, 2000, p. 8).

In study 2, empirical information was needed. The researcher acted as an observer carefully taking notes of the actions of participants. The seven weeks of the study allowed the children to develop a sense of trust and to not see the researcher as an outsider. This enabled the researcher to develop a keen sense of who were the participants and to recognize behaviors that may not have been addressed by interviews or by what participants may not have wanted to discuss (Hatch, 2002). In some ways, the researcher the role of an adult who is *usually* present at home when children play games (National Institute on the Media and the Family, 2005). The researcher did not interact with participants unless it was *absolutely* necessary to do so and/or requested by participants, and even then the participants were encouraged to try things on their own or ask their peers for help. Third, the researcher conducted group interviews of participants after each session, followed by individual interviews. After the fourth week, further group interviews were held to get their perspectives on their experiences in the game.

Materials

Materials used in this study were 30 CD-ROMs for *RCT3*, seven desktop and ten laptop computers, one digital camcorder, an I-Pod with an audio recorder, approximately 48 one hour mini-DV tapes to supplement observations, a 20-item background survey (See Appendix C), a 17-item pre-post knowledge test (See Appendix D), a 25-item pre-post motivational assessment (See Appendix E), six 12-item incremental tests for each scenario (See Appendix F), a semi-structured interview inventory (See Appendix G), a log sheet (See Appendix H), and participant notes from observations.

Data Collection Procedures

The study's expected duration, the number of participants, and the types of items were determined after conducting a pilot study with 6 children of similar background as participants in the study. In the pilot study, data was collected over two weeks with the participants playing *RCT3* for 8 hours each.

In this study, data was collected over seven weeks from December 2007 to February 2008 on Friday, Saturday, Sunday, and Monday of each week at Michigan State University. Data was collected twice per week from each student, who played *RCT3* for two hours or three hours at a time depending on when they started the study in the first, second or third week. During this time, participants played the game for 24 hours over six to seven weeks, enough to develop expertise in gameplay. An understanding of the individual differences of participants knowledge and skill development and their social practices was gained through data collected from them regard of playing 1 or 6 scenarios.

For the collection of data, participants were asked to complete and submit several forms among them a parental consent form, a background survey form, a pre-motivational assessment, and a pre-knowledge test. After the preliminary information was obtained the participant was given a log-sheet to record the daily achievements during play and then told to begin playing the game. While the participant played the game, he/she was also video-taped and observed by the researcher. After the end of the first week of gaming all the participants were interviewed. Participants were then interviewed after every gaming session in group sessions. The researcher asked questions intermittently during gaming to understand what participants were doing. Both individual and group interviews were conducted after the fourth week. After a participant completed each game scenario, the participant would then do the corresponding incremental scenario test. This testing was helpful in assessing the disciplinary knowledge, skills, and level of appreciation for that particular scenario. After a participant completed each of the six scenarios covered in the study, or the study had come to an end after the 24-hours of gameplay at the sixth or seventh week (which ever came first), the participant would then complete the post-knowledge test and post-motivational assessment. Data was carefully collected and compiled each week.

A description of each measure and the purpose for data collection is detailed in the next section

Measures

The *Background survey,* a 20-item measure, was used to gather data about the demographics and psychographic characteristics of the participants, including experience with media, social studies, economics, and their information and technology literacy

skills. In addition, information about the use of digital media by the participants in and out of their household, the game playing hours, the nature of their game playing experience whether alone or with others, favorite games, and so forth was collected. The aim of the background survey was to provide answers and details from participants of their knowledge of games, their experiences with digital media, the number of hours spent weekly on games whether they play alone or with friends, and their experience with the disciplines covered in *RCT3*.

The *Pre-Post Knowledge Test,* a 17-item test, was used to collect data on the internal aspects of *RCT3*, including the knowledge of the participants before and after playing *RCT3* for microeconomics principles, social studies, information and technology literacy. In addition, it used to test for the transfer of disciplinary knowledge. Social studies was examined from the perspective of managing resources and economic principles, such as opportunity cost, pricing, reliability, thinking about consumers, and supply and demand, was assessed. Economics and social studies questions focused on thinking critically about information relating to goods and services, as well as needs and wants. Information and technology literacy questions were focused on skills associated with critical thinking, decision-making, and problem solving as indicated on their national standards as recommended by the NCSS and NCEE. The quantitative data from this multiple choice, true-false, and choice selection test assessed knowledge gain as an increase from pre-test to post-test.

Developed by the researcher, this knowledge test is based on the economics and social studies content in RCT3. It was developed with support of continuous consultation with an economics content expert at a large Midwestern University, a social

studies researcher on the dissertation committee, a psychometrics expert at a large Midwestern University, using the framework for teaching basic economics concepts (National Council on Economics Education, 2005), information from websites about teaching social studies, information from the curriculum standards for social studies (National Council for the Social Studies, 1994), a textbook about social studies for elementary school students (Brophy & Alleman, 2007), and the Michigan Curriculum Framework (Michigan Department of Education, 1996). The Information Literacy Standards for Student Learning (American Association of School Librarians & Association for Educational Communications and Technology, 1998) and the National Educational Technology Standards (International Society for Technology in Education, 2000b, 2007) were used as aids in determining technology and information literacy skills.

The *Pre-Post Motivational Questionnaire,* a 25-item Likert-scale type questionnaire, is a modified Intrinsic Motivational Inventory (IMI) that was designed to assess the subjective experience of participants related to a target activity, such as playing games (Deci, Eghrari, Patrick, & Leone, 1994). The original IMI is a 45-item scale which has seven subscales; for this study, four subscales were used. These included perceived-competence (7-items), interest/enjoyment (5-items), pressure/tension (5-items), and valuing/usefulness (8-items). The authors argue that these subscales each ranging from 5-items to 8-items can be used alone, together, or in a modified form. It has been found to be reliable and valid across multiple settings even with modification (McAuley, Duncan, & Tammen, 1987). In this study, it had a reliability factor of $r = .86$. In this study, the test was primarily used to collect data on the social practices related to

valuing as well as within the expectancy x value model of motivation (Brophy, 2004). All four subscales contribute to the assessment of the development of personal interest and valuing in both the game and the content.

Interest/enjoyment is a self-report scale specifically for intrinsic motivation. Perceived competence concepts are theorized to be positive predictors of both self-report and behavioral measures of intrinsic motivation. Pressure/tension is theorized to be a negative predictor of intrinsic motivation. Deci, et al., (1994) argue that the value/usefulness subscale is used in internalization studies because of the idea that people internalize and become self-regulating with respect to activities that they experience as useful or valuable for themselves. This 25-item motivation assessment examined pretest to posttest whether participants internalized the value of the game and content, had motivation to play the game and learn the content, had interest in or enjoyed the experience, and had belief in their own abilities to do well. This was done specifically to better understand if participants were moving from situational interest to more personal interest in the game and the content. The four categories provided data relating to the overall motivation to learn the discipline and play the game. It provided an answer to the overall interest and attitude of participants to their valuing of the content. It also provided an answer to the identity development component as participants develop personal interest in or see value in the game and content.

The *Incremental Scenario tests*, 12-item-short-answer tests, were used to collect data on gains participants made in acquiring disciplinary knowledge for economics and social studies, game knowledge for understanding each scenario, transfer of disciplinary knowledge, valuing of the content and game, and progress from objective to objective in

each scenario. It was given to participants after they had completed a scenario. It attempts to provide incremental data on the progress of participants in the game in each scenario as well as data for finding value in the disciplinary knowledge. In addition, it provides information on the development of participants and/or knowledge gain from level to level in each scenario because some questions are repeated across the tests. The scenarios are different in visual design and basic tasks but test the same skills and principles in different ways. In addition, while each scenario tests the same skills and principles they increase in complexity from Apprentice to the Tycoon level. Thus, the incremental test for each of the six (6) scenarios is generally the same, containing 12 short answer questions addressing the internal aspects and external aspects of the game with slight variation to address the specific contextual information for each scenario. For instance, *Checkered Flags* has information specific to catering to a VIP while *Go With The Flow* does not. The questions about knowledge and skills when catering for the VIP in *Checkered Flags* cannot be asked in *Go With The Flow* because it is not present there. The incremental scenario tests were not administered at the same time for all participants, but only as each participant complete his/her scenario. Not all participants completed the six scenarios due to individual differences, such as the ability to play the game, play preferences, or enjoyment of the game.

The researcher developed this instrument based on the content in each of the scenarios. The same materials and group of consultants that were used to create the pre-post knowledge tests were used to create the incremental scenario tests.

The *In-depth Interviews*, a pool of 32 semi-structured in-depth interviews, was used to gather information about the knowledge and experience of the participants. The

interview was designed after consultation with economics content expert who had also played the game. In addition, with the help of a psychometrics expert it was written at the level of understanding for students in elementary school. It was designed to explore questions relating to disciplinary knowledge, to motivation to play the game, to motivation to learn the disciplinary knowledge, and to transfer knowledge. The questions addressed the participants strategies used to play the game, their like or dislike of the game and content, their transfer knowledge related to profit, applying principles from the game to their lives, and their critical thinking about the information. A few examples of the questions follow: What are some strategies that you think are needed in this game in order to be successful? What do you think would be some of the consequences if your school should raise the price of tickets to enter a party and many of the children cannot afford the new cost? Would you play this game again? Are you interested in the content of the game – managing resources and making decisions with all the information that you are given?

Interviews were conducted with the group each week after each gaming session including in the first week with the participants to get initial reactions. This was followed by both individual and group interviews after 16 hours of play or 4 weeks. In two of the group interviews, participants interviewed each other asking what they wanted to know in the game and how what they learned could help them outside of the game. Johnson (2005) argues that interviews should be done about half-way through because it is usually at this point that players have a list of objectives and can give an explicit account of what they need to do to reach their goals. In addition, from the fourth through seventh weeks the best and worst players as perceived by the researcher were interviewed for

about twenty minutes each at the end of their session to get their experiences. These interviews provided a consistent view of the best and worst players and gave more insight into how they were learning and navigating. Johnson (2005) suggests asking players questions, such as "what problems they are actively working on [and] what objectives they are trying to achieve"(p. 48).

Aarseth (2003) contends that player interviews are necessary in game analysis because they provide us with an understanding that we could not get otherwise about the game. Qualitative researchers also argue that the unstructured, open-ended interview "offers the opportunity for an authentic gaze into the soul of another" (Sliverman, 2000, pp. 822-823). Further, Johnson (2002) contends that in-depth interviews because of their flexibility with predetermined as well as semi-structured approaches allow researchers to delve deeply and be able to articulate the multiple views of some activity. Researchers are able to go beyond common sense explanations to deeper level explanations of an activity. Thus, the interview helps greatly in collecting data that provide answers to whether participants develop any of the social practices of the game related to valuing the game and disciplinary knowledge.

The *Participant and Video-taped Observations,* field notes and video-taped observation, were used to gather data on the interactions of participants with the game and each other. It was used to document strategy used by participants as they progressed in the game. Information was noted as it related to the speed of attaining objectives, and exploring, and whether participants were aware of their objectives and strategies. The researcher used a mini-DV camera borrowed from the University to record the sessions. While the camera recorded the play sessions, the researcher took notes of the

interactions. Data drawn from the interactions of participants with the game and between each other attempt to provide a good picture of the social atmosphere and relationships while gaming. These should aid in providing answers to the external aspects of the domain especially when integrated with interview responses to see how participants were gaining knowledge of playing the game as well as developing the social practices of gaming.

The *Participant Log Sheet,* a grid-like sheet containing all six scenarios, was used by participants to log their progress during gameplay. The sheet logged the game year and month (April to November used as a time stamp) when participants completed each level and, eventually, each scenario. It also logged the awards/achievements earned by participants in each scenario. Additionally, by logging their achievement in every level and time of achievement, the log sheet also logged progress in gameplay by the participants. The achievements help to reflect what participants focused on in a scenario, indicating whether they were exploration or objective oriented. After the completion of each scenario, participants recorded their park value, amount of available cash, company value, park ratings, and the number of people in their park. Participants also explained what their awards/achievements meant to them and how it helped their park.

Given the research questions, content, and instruments, Table 1 illustrates how they are connected and the data that will be yielded.

Table 1: *Connection of Research Questions to Participants, Content, Methods and Data*

#	Question	Participant	Content	Methods	Data
1	What are the affordances for learning provided by the game?	Researcher	a. Pedagogy b. Technology c. Subject Covered	Content analysis	Qualitative
2	What did the participants learn?	Children participants	Economics, social studies, information and technology literacy	1. Overall Pre-Post knowledge, skills assessment 3. Incremental scenario assessment question Knowledge test after each scenario in *RCT3*	Quantitative
3	What did participants value in the game and content?	Children participants	Social practices - valuing	2. Pre-Post motivational assessment 3. Incremental scenario assessment	Quantitative Qualitative
4	What strategies did participants using to navigate in the game?	Children participants	Play Strategy	3.Incremental assessment 4. Random interviews after initial level in the first scenario and then again half-way into study 5. Video-based observation as well as participant-observation 6. Log Sheets	Qualitative

Table 1 also describes how each research question was addressed. Question 1 or Study 1 documented how the game was analyzed in preparing for the research and is reported in Appendix A. Question 1 was examined with the aid of an expert in economics who has experience with the RCT series (a professor with expertise in economics), data from the literature, and the researcher's knowledge of the game from playing it for more than six months in order to determine what disciplinary knowledge and skills to examine in question 2. Some examples of what question 1 indicated could be learned included knowledge related to the production-economic focus of the game, knowledge about game play, and knowledge that requires critical and innovative use of information to meet objectives. In addition, it also revealed that knowledge construction

would be made possible primarily through the dominant pedagogical approach of an observation and intervention type of interactivity. Question 1 helped the researcher to formulate the study's instruments such as the knowledge test, interview questions, and incremental scenario assessment used in the study.

Table 2*: How the Research Questions Will be Analyzed*

#	**Question**	**Data Sources**
1	What are the affordances for learning provided by the game?	Game, Content Expert, Literature
2	What did the participants learn? This specifically includes 1) knowledge of technology and development of information literacy, 2) knowledge of *RCT3* (theme parks), and 3) knowledge and transfer of disciplinary content – economics and social studies.	Pre-Post Knowledge test Incremental scenario tests
3	What did participants value, that is have or developing valuing in the game and content? Examined by looking at the social practices related to valuing, a key component of the external aspects of *RCT3*.	Pre-Post Motivational Assessment Interviews, Incremental tests,
4	What strategies did participants using to navigate in the game? Examined by looking at the progress of participants in the game from one objective to the next, from an Apprentice, to an entrepreneur, and finally to a tycoon in the game within each scenario	Incremental tests, Interviews, Observations (participant and video) Log sheets

Data Analysis

Table 3 illustrates how the research question will be analyzed. As illustrated in Table 2 each research question yielded answers from different data sources. The data sources were analyzed using both quantitative and qualitative techniques (See Table 3).

Table 3*: Data Sources, Methods, Data Analysis and Resulting Data from Data Sources*

#	Data Sources	Methods	Data Analysis	Expected Data
a	Background survey	Qualitative	Content Analysis, Grounded Theory	Are students lacking skills, is there a good mix of gamers and non-gamers, Are familiar with digital media and game playing
b	Pre-Post Knowledge test	Quantitative	Match paired t-tests	Internal aspects
c	Pre-post motivational questionnaire	Quantitative	Match paired t-tests	External aspects
d	Incremental scenario short answer test	Quantitative and Qualitative	ANOVA, Descriptive Statistics, Content Analysis	Internal and External aspects
e	Participant Interviews	Qualitative	Content Analysis, Grounded theory	Internal and External aspects
f	Observations: Participant and Video	Qualitative	Grounded theory	Internal and External aspects
g	Participant Log Sheet	Qualitative	Contextual analysis	Participants game progress

The background survey was analyzed using grounded theory analysis (Glaser and Strauss, 1999) and contextual analysis. This aided in informing the researcher about the prior knowledge of the participants playing of games, skills, and disciplinary knowledge.

The pre-post Knowledge Test was analyzed using paired t-tests to determine mean differences pretest to posttest within the one sample used in the study. The knowledge test examined what was the disciplinary knowledge and skills that was learned and transferred. Thus, a paired t-test was used in the analysis of what disciplinary knowledge and skills was learned from *RCT3* to get an overall picture. A power analysis had shown that 24 participants would have been needed to have at least an 87% chance of detecting a difference of 1 standard deviation or significant difference on the test. Thus having 26 participants, more than the required 24 participants, increased the chances of detecting statistical significant difference on the knowledge test.

The pre-post motivational assessment was analyzed using paired t-tests to examine the means pretest to posttest for the participants overall intrinsic motivation, their expectancy x value for the game and content, and their motivation on motivational subscales for interest, value, pressure and perceived competence. This was done by scoring the Likert-type items from 1 to 6 and use the resulting number as the item score. The item score was then totaled and calculated for each subscale score. The subscale score was then added to get a total assessment score pretest to posttest and further used to calculate pretest to posttest subscale values. These analyses were an aid to better understanding results if students were developing interests and attitudes or valuing the game and content. Research has shown that the students self-concept or perceived competence is a good predictor of future behavior (Baumeister, Campbell, Krueger, & Vohs, 2003; Brophy, 2004); thus, the assessment was a viable predictor for the values and identity developed in the game if the attitudes and interests of the participants were favorable for the game and content.

The incremental scenario tests were analyzed using an ANOVA with a blocking design, participants and incremental scenario tests as two fixed factors. The questions on each scenario tests for each participant were scored and grouped together for homogeneity by outcome variables: disciplinary knowledge for economics and social studies, game knowledge as technology knowledge, information literacy, and transfer knowledge. The aim was to improve the comparisons across the scenario tests. Since each test had a different number of participants, the scores were scaled out of 1 to standardize and increase chances for comparison across scenario tests. The mean score for each test and for each participant for the four outcome variables on all six scenario

tests were found. ANOVA analysis with a blocking design was then used for each outcome variable between scenario tests and within scenario tests for the variation for each outcome by participants. Each outcome variable was examined with the fixed factors. They were placed in a customized ANOVA model that was used to examine the main effects in the analysis across scenario tests for each outcome variable as well as differences between participants on each test for the outcome variable. The scenario tests were also examined using planned polynomial contrasts to find significant linear trends across the tests; however, this was done only if there was already a significant difference for the outcome variable between each incremental scenario test. Graphs were designed for each outcome variables across the scenarios tests using the estimated marginal mean for each scenario test.

Content analysis and descriptive statistics were used to determine the content knowledge and skills gained from play characteristics, play strategies, and attitudes employed in the game. The analyses provide a snapshot after each scenario about what participants learned in terms of the internal and external aspects of *RCT3*. It also provides a map of the progress made by participants through the scenarios and transfer of the concepts in disciplinary knowledge such as supply and demand.

The in-depth interviews and observations were coded for themes related to what was learned for disciplinary knowledge and skills, for transfer knowledge, for motivation to learn content and play the game, and for strategies for progressing through the game. A grounded theory analysis was used to code data to generate themes and then recode those themes further until there was theoretical saturation (Glaser & Strauss, 1999). Interview questions focused on the experience of play in *RCT3* socially and cognitively

for learning, and transfer of knowledge from *RCT3* to business and economics. Questions addressed the students navigation strategies, personal objectives, ideas about valuing the game and content, and ideas about business and economics. Field notes from observations documented students' navigational patterns or strategies to complete objectives. The field notes also served as support to help the researcher to recall certain actions and statements.

Log sheets were analyzed by coding each of the cells for scenarios attempted, scenarios completed, achievements gained, length of time in each scenario, and what each achievement meant to a participant. This analysis provided a pattern of navigation progress for each participant showing the level of struggle, the players' preferences, and the players' achievements.

Chapter 4

Results: Quantitative

This chapter reports quantitative results for the whole group in the study on disciplinary knowledge in economics and social studies, and skills gained in information and technology literacy, and what the participants valued in the game. This chapter begins with a description of the study's sample starting with the background surveys used to provide an overall picture of the sample. The chapter is divided into parts that address each of the research questions: What did the participants learn and what did they value in the game and content? This section shows the results on the quantitative tests: knowledge tests and motivational assessments to answer the research questions.

The incremental scenario tests results were not used because only five of the 26 participants completed each of the six tests. The questions were not all the same across the tests resulting in questions about tests alignment. Total numbers of participants who completed each secnario was different: Scenario 1, n = 22; Scenario 2, n = 17; Scenario 3, n =11, Scenario 4, n =6; and Scenarios 5 and 6, n =5). In addition, each scenario tested for the same basic economics principles, but the questions were not written the same.

Participants Backgrounds

Out of thirty participants who started the study, 26 completed it. The average age of the participants was 11 years old, ranging from ages 9 to 12, with 16 males and 10 females. The participants came from urban, suburban, and rural sections of Michigan. Each of the participants had basic technological and information literacy skills necessary for using computers and playing digital games. Based on information on the background surveys from the participants, the average amount of weekly gameplay across each of the

participants was seven hours, the same as the national average. Game play time ranged from an average of 1 hour to 14 hours each week. In addition, participants averaged seven hours of reading each week. 62 percent of the participants indicated that their favorite subjects were either Mathematics or Science, (N = 11 and 5, respectively). The others preferred English (19%), followed by Computer (7.5%), Social Studies (7.5%), and Art (4%).

58 percent of the participants had parental rules about when they can play games and the length of time each day or each week they can play games. Each of the participants shared some or all of these rules:

1. Playing video games before and for the same amount of time they do reading;
2. Complete homework or practice play an instrument before playing video games;
3. No more than one hour of video gaming each day;
4. No playing of games rated M – Mature;
5. Either playing video games or watching TV on a given day;
6. Doing some outdoor activity before playing video games; and
7. No playing of video games after 9:00 P.M. each night.

Each of the participants had some experience using digital equipment ranging from cellular phones, televisions, DVD, and MP3 players to video games in their homes. In addition to their technological experience, the participants reported that they had the necessary prior knowledge needed to develop the disciplinary knowledge found in microeconomic principles as well as the social studies knowledge that could be learned from *RCT3*. Each participant reported having exposure to basic algebra and discussions

about using money in school; however, none of the participants reported having a class course in economics or any formal course through social studies about business and economics. Participants reported classes in general social studies related to history, civics, and geography, and classes on the use of computers. They had ideas and exposure to business through their everyday interactions with parents, peers, vendors, and various forms of media such as TV or the Internet.

Table 4: *Participants Average Gaming and Reading Hours Each Week*

Participants	Gaming Hrs/Wk	Reading Hrs/Wk
26	7	7

None of the students were familiar with *RCT3: Platinum* and its 3-D designed environment; however, seven of them had had experience with previous Tycoon games and similar simulation strategy environments such as *The SIMS.* It was important that participants had no playing experience with RCT3 because it would have made relating learning to the gaming experience difficult.

Participants entered the study knowing that they would play a video game and that they were part of study. They did not know the content area and had no intention to learn disciplinary knowledge related to economics and social studies or skills related to information and technology literacy. Participants reported they were interested in playing games, having a good time, and were capable of learning anything in the game. A discussion of tests results provides information on disciplinary knowledge, skills, and their attitudes towards valuing and motivation to learn the content.

Overview of Data Analysis

Preliminary data analysis was done to ensure that the data followed the assumptions of the match-paired t-tests and ANOVA tests used in the study. Exploration

of the data showed that there were no serious violations of the assumptions of these tests for homogeneity of variances, independent samples, and normality. Since the study had one sample, and a match-paired t-test was used to analyze the knowledge test and motivation assessments, homogeneity of variances was not an assumption for that analysis. Calculations of the skewness and kurtosis of the pre-knowledge test showed no violations of normality in the distributions of the knowledge test, incremental assessments, or motivation assessment.

In the analysis of the incremental tests for information literacy, disciplinary knowledge, and game playing knowledge, the assumption for homogeneity of variances was violated, but it was not of high concern because of the robustness of the ANOVA. Examination of the histograms and box- plots revealed one participant outlier in the pre-knowledge tests. The participant did not complete the pre-knowledge test making the pretest score very low. This made the score numerically distant from others that were based on a completed test. Thus the participant post knowledge test was removed so that the knowledge test (pre-post tests) results would be more conservative. Cronbach's Alpha indicated that the motivation assessment, which includes the four subscales of valuing, interest and enjoyment, felt pressure/tension, and perceived competence created from the Intrinsic Motivation Inventory, had a reliability of $r = .86$.

Table 5 provides an overview of the results for each research question as it is related to the type of test used to analyze the data source. T-tests were used for the pre-post instruments (knowledge tests and motivation assessments).

Research Questions and Results

Table 5: *General Statistical Results for Each Research Question*

Research Questions	**Tests**	**Statistical Results**
What did the participants learn? Disciplinary Knowledge: Economics and Social Studies	Paired-t	Statistically significant finding for economics and social studies
Skills: Information and Technology Literacy	Paired-t	Statistically significant finding for game knowledge (technology knowledge) and information literacy
Transfer: Near Transfer	Paired-t	No statistically significant finding
Transfer: Far Transfer	Paired-t	Statistically significant finding for transfer of knowledge from game to real world contexts beyond theme parks and business
What did the participants value? Overall Motivation: Intrinsic Motivation	Paired-t	Not statistically significant for having intrinsic interest for learning the content in the game.
Motivation: Valuing	Paired-t	Statistically significant for valuing the content (Economics) and the game
Motivation: Perceive Competence	Paired-t	Not statistically significant for having perceived competence in the game and content, but increased pre to post means
Motivation: Felt pressure/tension	Paired-t	Not statistically significant for felt pressure while playing the game. Pre –Post means show decrease in tension
Motivation: Interest	Paired-t	Not statistically significant for having interest in the game and content, but increased pre to post means.

Table 6 summarizes the descriptive statistics for the participants' disciplinary knowledge in economics and social studies, game knowledge which accounted technology and information literacy, transfer knowledge, overall intrinsic motivation to

play games and learn disciplinary knowledge and skills, motivational expectations for learning disciplinary knowledge, and motivational valuing for disciplinary knowledge.

Table 6: *Descriptive Statistics for Knowledge Test and Motivational Assessment*

Groups	Means	S.D.	Std. Err	N
Post Knowledge *RCT3*[1]	15.48	2.92	.58	25
Pre Knowledge *RCT3*[1]	13.20	2.47	.49	25
Post Knowledge Econ & Social Studies[2]	20.64	3.51	.70	25
Pre Knowledge Econ & Social Studies[2]	18.04	2.96	.59	25
Post Transfer of disciplinary knowledge[3]	6.81	1.33	.26	25
Pre Transfer of disciplinary knowledge[3]	6.08	1.70	.33	25
Post Near Transfer[3a]	5.44	1.04	.21	25
Pre Near Transfer[3a]	5.08	1.00	.20	25
Post Motivation to play and learn[4]	115.27	10.38	2.04	26
Pre Motivation to play and learn[4]	112.35	11.94	2.34	26
Post-Interest (subscale)[5]	25.65	3.06	.60	26
Pre-Interest (subscale)[5]	24.38	2.79	.55	26
Post Value (subscale)[6]	41.27	4.64	.91	26
Pre Value (subscale)[6]	38.46	5.20	1.02	26
Post Felt Pressure/tension (subscale)[7]	13.58	3.98	.78	26
Pre Felt Pressure/tension (subscale)[7]	14.00	4.36	.86	26
Post Perceived Competence (subscale)[8]	34.77	5.22	1.02	26
Pre Perceived Competence (subscale)[8]	35.50	5.08	.99	26
Post expectancy[9]	48.35	4.98	.98	26
Pre expectancy[9]	49.50	6.46	1.27	26
Post value[10]	66.92	6.38	1.25	26
Pre value[10]	62.85	7.29	1.43	26

1. Knowledge of game/*RCT3* scored out of 17
2. Knowledge of Economics and Social Studies scored out of 31
3. Transfer – scored out of 10 points

3a. Near Transfer – scored out of 7 points

4. Overall Motivation 25 items with 4 subscales – Likert type scale with a range from 1 to 6
5. Interest – Subscale of Overall Motivation assessment (5 items) - out of 30
6. Value – Subscale of Overall Motivation assessment (8 items) - out of 48
7. Felt Pressure/tension - Subscale of Overall Motivation assessment (5 items) - out of 30
8. Perceive Competence - Subscale of Overall Motivation assessment (7 items) – out of 42
9. Expectancy derived from perceived competence and pressure/felt tension scale
10. Value derived from interest/enjoyment and valuing scale

What did Participants Learn: Knowledge Test Findings

For the research question pertaining to what the participants learned the result is presented in three parts. 1) For the knowledge of technology and development of information literacy, 2) the knowledge of *RCT3* (including knowledge of the game – technology and information literacy), and 3) the transfer of disciplinary knowledge – economics and social studies, the following hypotheses was tested:

1. Ho: there is no difference in students' disciplinary knowledge and skills after playing *RCT3*.

   H1: there is a difference in the students' disciplinary knowledge and skills after playing *RCT3*.

   H_o: $\mu_1 = \mu_2$;

   H_1: $\mu_1 \neq \mu_2$;

   μ_1 = mean disciplinary knowledge and skills before playing *RCT3*

   μ_2 = mean disciplinary knowledge and skills after playing *RCT3*

The results indicate there was a significant difference in the participants' disciplinary knowledge and skills from pretests (M = 18.04, SD = 2.96) to posttests (M = 20.64, SD = 3.51) playing *RCT3* to learn economics and social studies, t (24) = -3.67, $p < .05$, d = 0.80 (See Table 7). Thus, the null hypothesis that there is no significant difference in students' disciplinary knowledge and skills after playing *RCT3* was rejected. The sign of the t-statistic (pretest – posttest) indicates that there was a higher post test score as a result of playing the simulation-strategy game *RCT3*. The test examined questions about opportunity cost, supply and demand, and other basic economic principles. Despite participants having no formal education in basic or

foundational economics principles, results of the study indicate knowledge gains. The effect size indicates that the game had a large effect, $d = 0.80$, $r^2 = .37$.

2. Ho: There is no difference in the participants' knowledge of the game (*RCT3*) after the gaming experience.

   H1: There is a difference in the participants' knowledge of the game (*RCT3*) after the gaming experience.

   H_o: $\mu_1 = \mu_2$;

   H_1: $\mu_1 \neq \mu_2$;

   μ_1 = mean of participants' knowledge of the game (*RCT3*) (including technology and information literacy) before the gaming experience

   μ_2 = mean of participants' knowledge of the game (*RCT3*) (including technology and information literacy) after the gaming experience.

Results indicate a significant difference in the participants' game knowledge from pretest ($M = 13.20$, $SD = 2.47$) to posttest ($M = 15.48$, $SD = 2.92$) after they experienced the game, $t(24) = -3.77$, $p < .05$, $d = 0.84$ (See Table 7). Thus, the null hypothesis that there is no significant difference in participants' knowledge of the game after engaging in it is rejected. The sign of the t-statistic indicates that the posttest score is higher than the pretest score and that the difference came after playing the simulation-strategy game *RCT3*. This is an indication that the game had an effect on the participants and that effect came after the participants acquired the technology knowledge and information literacy in developing an understanding of the game. The effect size indicates the game had a large effect, $d = 0.84$, $r^2 = 0.39$.

Participants were able to develop game knowledge, including technology knowledge. This is an important variable because playing the game and increasing game knowledge including technology knowledge is needed to make progress, understand the game, and develop disciplinary knowledge. This indicates that the participants were able to understand and use the icons, tools, and symbols to progress through the game and develop game knowledge in order to play.

3. Ho: There is no difference in students' transfer of knowledge from the game and about theme parks to other settings after playing *RCT3* to construct disciplinary knowledge and skills.

   H1: There is a difference in students' transfer of knowledge from the game and about theme parks to other settings after playing *RCT3* to construct disciplinary knowledge and skills.

   H_o: $\mu_1 = \mu_2$;

   H_1: $\mu_1 \neq \mu_2$;

   μ_1 = mean of transfer knowledge (from the game and about theme parks to other settings) before playing *RCT3* to construct disciplinary knowledge and skills.

   μ_2 = mean of transfer knowledge (from the game and about theme parks to other settings) after playing *RCT3* to construct disciplinary knowledge and skills.

The results from the analysis indicated that there was a statistically significant difference in the participants' transfer of knowledge from pretest ($M = 6.08$, $SD = 1.70$) to posttest ($M = 6.81$; $SD = 1.33$), $t\ (24) = -2.38$, $p < .05$, $d = 0.48$ (See Table 7). Thus, the null hypothesis that there is no significant difference in the transfer of student knowledge from the game to other settings after playing *RCT3* to construct disciplinary

knowledge and skills is rejected. The sign of the t-statistic indicates that there is a higher posttest score than a pretest score, and the difference may have come as a result of playing the simulation-strategy game *RCT3*. Transfer questions included a range of concepts that demonstrated understanding of using opportunity cost in settings unlike theme parks. They also included understanding scarcity, dealing with resources, and supply and demand. Responses to the questions indicate the study had an effect on influencing the participants' transfer of knowledge after the experience. The effect size is moderate, $d = 0.48$, $r^2 = 0.23$.

Participants demonstrated transferred knowledge to real world settings by answering questions that dealt with use of resources such as money in non-game settings. The effect size was moderate. This suggests that although there is evidence of transfer, the claims about transfer are not as strong as expected. Nonetheless, this represents a step in a positive direction about transfer and learning with digital games.

4. Ho: There is no difference in students' near transfer of knowledge from the game and about theme parks after playing *RCT3*.

   H1: There is a difference in students' near transfer of knowledge from the game and about theme parks after playing *RCT3*.

   H_o: $\mu_1 = \mu_2$;

   H_1: $\mu_1 \neq \mu_2$;

   μ_1 = mean of near transfer knowledge (from the game and about theme parks) before playing *RCT3*.

   μ_2 = mean of near transfer knowledge (from the game and about theme parks) after playing *RCT3*.

The results of the analysis indicated that there was no statistically significant difference for near transfer from the participants from pretest ($M = 5.08$, $SD = 1.00$) to posttest ($M = 5.44$, $SD = 1.04$) by playing the game, $p = .14$, $d = .35$.

Table 7: *Match Paired t-tests Analysis of Knowledge Test*

Source	*df*	*t*	*p*	*d*	δ
Pre-Post Knowledge of Econ & Social Studies	24	- 3.67**	.001	0.84	.93
Pre-Post Knowledge of *RCT3*	24	- 3.77**	.001	0.80	.93
Pre-Post Transfer	24	-2.38*	.025	0.48	.64
Pre-Post near Transfer	24	-1.52	.142	0.35	.26

Note: *$p < .05$. **$p < .01$

Summary of Knowledge Test Findings

Despite no formal education about basic economics principles, overall there was a significant difference in the gain in disciplinary knowledge and skills by the participants. The game had an effect on the participants' knowledge and skills, and the effect came after playing the game. In addition, analysis indicates that, after playing the game, participants were able to perform far transfer to other settings. It should be noted that near transfer was not found, and this may be related to the fact that there were only four questions, worth seven points, measuring that variable. The effect size indicates that far transfer was moderate. Thus, claims about transfer from the game must be guarded until further interpretive analysis.

Participants Motivation and Valuing: Motivation Assessment Findings

For the research questions asking, "What did the participants value in the game and content," the following hypotheses were tested. The research questions provided

answer to participants overall interest and attitude towards the valuing of the content. Further, answers indicated identity development as the participants developed a personal interest or valuing of the game and content as a social practice. It has been shown that during gaming, the process of gameplay is the way to construct knowledge. Thus the overall motivation to play and to learn disciplinary knowledge cannot be separated.

1. Ho: There is no difference in the participants overall motivation to play and to learn disciplinary knowledge and skills.

   H1: There is a difference in the participants overall motivation to play and to learn disciplinary knowledge and skills.

   H_o: $\mu_1 = \mu_2$;

   H_1: $\mu_1 \neq \mu_2$;

   μ_1 = mean of overall motivation (interest, value, and competence) to play games and learn disciplinary knowledge and skills before playing *RCT3*

   μ_2 = mean of overall motivation (interest, value, and competence) to play games and learn disciplinary knowledge and skills after playing *RCT3*

The results indicate that there was no statistical significant difference in the participants' motivation to play and learn disciplinary knowledge (social studies and economics) and skills (technology and information literacy) from pretest (M = 112.35, SD = 11.94) to posttest (M = 115.27, SD=10.38), t (25) = -1.07, p = .29, d = .26 (see Table 8). Since there is no significant difference in the participants overall motivation to play and to learn disciplinary knowledge and skills, the null hypothesis is retained. The participants' overall motivation including interest, valuing of the content and game, and perceived competence was *fairly high before* (M = 112 out of 150) they played *RCT3* and

increased slightly after (M = 115 out of 150) playing game (see Table 6). Thus, it is not surprising that there was no statistically significant difference in the participants' intrinsic motivation; however, it is possible that their motivation did not lessen as indicated by the mean pretest to posttest.

2. Ho: There is no difference in the participants' valuing of the game and the disciplinary knowledge and skills after experiencing *RCT3*.

   H1: There is a difference in the participants' valuing of the game and the disciplinary knowledge and skills after experiencing *RCT3*.

   H_o: $\mu_1 = \mu_2$;

   H_1: $\mu_1 \neq \mu_2$;

   μ_1 = mean of participants' valuing of the game and the disciplinary knowledge and skills before experiencing *RCT3*.

   μ_2 = mean of participants' valuing of the game and the disciplinary knowledge and skills after experiencing *RCT3*.

The results of the analysis for the motivation assessment subscale for valuing indicated that there is a statistically significant difference in the participants' valuing of the game and the disciplinary knowledge and skills from pretest (M = 38.46, SD = 5.20) to posttest (M = 41.27, SD = 4.64) experiencing *RCT3*, $t(25) = -2.28$, $p < .05$, $d = 0.57$ (See Table 8). The null hypothesis that there is no difference in the participants' valuing of the game and the disciplinary knowledge and skills after experiencing *RCT3* is rejected. The sign of the t-statistic indicates that there is a higher post test than pretest score, and the difference came after playing the simulation-strategy game *RCT3*. This also indicates the game had an effect in influencing the participants' internalization of

content and aiding in self-regulation with respect to playing the game and learning the disciplinary knowledge and skills that they experience as useful or valuable for themselves. The effect size is moderate, d =.57, r^2 = .27.

The participants valued the content of and the playing of the game. Although, valuing had a moderate effect size, this represents some evidence that playing this simulation strategy game allowed the participants who had no formal education in the content area, and who believed that learning was not possible from games, to value the content and playing the game.

3. Ho: There is no difference in participants' interest and enjoyment for learning school content while playing games after experiencing *RCT3*.

   H1: There is a difference in participants' interest and enjoyment for learning school content while playing games after experiencing *RCT3*.

   H_o: $\mu_1 = \mu_2$;

   H_1: $\mu_1 \neq \mu_2$;

   μ_1 = mean of participants' interest and enjoyment for learning school content while playing games before experiencing *RCT3*.

   μ_2 = mean of participants' interest and enjoyment for learning school content while playing games after experiencing *RCT3*.

The results of the analysis for the interest/enjoyment motivation subscale data indicated that there was no statistically significant difference in participants' interest and enjoyment for learning school content while playing games from pretest (M = 24.38, SD = 2.79) to posttest (M = 25.65, SD = 3.06), t (25) = -1.60, p =.12, d = .43 (see Table 8). The null hypothesis is retained that there is no significant difference in participants'

interest and enjoyment for learning school content while playing games. The participants' interest and enjoyment was fairly high before they started the study, M = 24.38 out of 30 and increased slightly after experiencing *RCT3*, M = 25.65. The fact that they volunteered to be in the study and were able to maintain their interest is a positive sign of their enjoyable experience.

4. Ho: There is no difference in participants' felt pressure and tension after experiencing *RCT3*.

   H1: There is a difference in participants' felt pressure and tension after experiencing *RCT3*.

   H_o: $\mu_1 = \mu_2$;

   H_1: $\mu_1 \neq \mu_2$;

   μ_1 = mean participants' felt pressure and tension before experiencing *RCT3*

   μ_2 = mean participants' felt pressure and tension after experiencing *RCT3*

The results of the analysis for the participants' felt pressure or tension while playing the game under the conditions of the study was not statistically significant. The null hypothesis that there is no statistically significant difference in participants' felt pressure and tension pretest (M = 14, SD = 4.36) to posttest (M = 13.58, SD = 3.98) experiencing *RCT3* is retained, t (25) = .56, p = .58, d = -.10 (See Table 8). The participants felt pressure or tension while playing the game, and constructing disciplinary knowledge and skills decreased from pretest subscale felt pressure/tension mean = 14 to posttest subscale felt pressure/tension mean = 13.58, both out of 30 (see Table 6). Thus, the gaming experience may not have been stressful nor had enough pressure to adversely influence participant experience.

5. Ho. There is no difference in participants' perceived competence in playing a game to learn disciplinary knowledge.

   H1: There is a difference in participants' perceived competence in playing a game to learn disciplinary knowledge.

   H_o: $\mu_1 = \mu_2$;

   H_1: $\mu_1 \neq \mu_2$;

   μ_1 = mean participants' perceived competence in playing a game to learn disciplinary knowledge before playing *RCT3*

   μ_2 = mean participants' perceived competence in playing a game to learn disciplinary knowledge after playing *RCT3*.

The results of the analysis for the participants' perceived competence in playing a game to learn disciplinary knowledge and skills was not statistically significant. Thus, the null hypothesis that there is no statistically significant difference in participants' perceived competence in playing a game to learn disciplinary knowledge pretest (M = 35.50, SD = 5.08) to posttest (M = 34.77, SD = 5.22) playing the game is retained, t (25) = .71, p = .48, d = -.14. The participants had a fairly high belief (pre-perceive competence subscale mean = 35.50 out of 42) in their abilities to do well in the game, but they did not know what disciplinary knowledge they were going to learn. After experiencing the game, their perceived competence or confidence in their own abilities decreased slightly, post- perceive competence subscale mean = 34.77. This may be due to the fact that they did not know that they were going to be learning basic economics principles and develop social studies knowledge. Nonetheless, they started the study with high expectations to learn the game content in order to be successful at the game;

however, they did not believe that school content was possible to be learned from "a game." After playing the game, they may have realized that learning school content was possible. This is counter to the participants' beliefs that learning is not possible in games. This may be the reason why their perceived competence remain stable. Had they expected that the content was to be learned or believed that school content could be learned from games, then theoretically there could have been a statistical significant difference.

Expectancy x Value

In assessing the motivation assessment using the Expectancy x Value model the following hypotheses were tested.

1a. Ho: There is no difference in participants' expectation for learning disciplinary knowledge.

H1: There is a difference in participants' expectation for learning disciplinary knowledge.

H_o: $\mu_1 = \mu_2$;

H_1: $\mu_1 \neq \mu_2$;

μ_1 = mean of participants' expectation for learning disciplinary knowledge before playing *RCT3*

μ_2 = mean of participants expectation for learning disciplinary knowledge after playing *RCT3*

The result of the paired t–test analysis for the participants' expectations (combination of the subscales of pressure tension and perceived competence) to do well

was not statistically significant. Thus, the null hypothesis that there is no significant difference in participants' expectations for playing the game well and learning disciplinary knowledge and skills pretest (M = 49.50, SD = 6.46) to posttest (M = 48.35, SD = 4.98) is retained, t (25) = .94, p = .36, d = -.20 (See Table 8).

2a. Ho: There is no difference in participants overall valuing the gaming experience and learning disciplinary knowledge and skills.

H1: There is a difference in participants overall valuing the gaming experience and learning disciplinary knowledge and skills.

H_o: $\mu_1 = \mu_2$;

H_1: $\mu_1 \neq \mu_2$;

μ_1 = mean of participants' overall valuing the gaming experience and learning disciplinary knowledge and skills before playing *RCT3*.

μ_2 = mean of participants' overall valuing the gaming experience and learning disciplinary knowledge and skills after playing *RCT3*.

There was a statistically significant difference in the results of the analysis for the overall valuing in the expectancy x value model (combination of interest/enjoyment and value subscales) for the participants valuing the gaming experience and learning disciplinary knowledge and skills. The null hypothesis is rejected because there is no significant difference in the participants' overall valuing the gaming experience and the learning of disciplinary knowledge and skills from pretest (M = 62.85, SD = 7.29) to posttest (M = 66.92, SD = 6.38) playing *RCT3*, t (25) = -2.24, $p < .05$, d = .59 (See Table 8). The sign of the t-statistic indicates that there is a higher post test score than a pretest score. This indicates that the game had an effect in influencing the participants' valuing

of the gaming experience and disciplinary knowledge by seeing it as positive and useful for themselves. The effect size is moderate, $d = .59$, $r^2 = .29$.

The participants' expectations were positive for gaming and due to this they developed a positive attitude in the experience. Although there was no statistical difference for the expectations to learn the expected content in the game, the means show that the expectations were high even with their belief that learning as not possible in games.

Table 8: *Source Table for Motivation Assessments*

Source	*df*	*t*	*p*	*d*	*δ*
Pre-Post Overall Motivation	25	-1.07	.29	.26	.17
Pre-Post Valuing	25	-2.28*	.03	.57	.44
Pre-Post Interest/Enjoyment	25	-1.60	.12	.43	.22
Pre-Post Felt Pressure/Tension	25	.56	.58	-.10	.10
Pre-Post Perceived Competence	25	.71	.48	-.14	.96
Pre Expectancy	25	.94	.36	-.20	.15
Pre-Combined Valuing	25	-2.24*	.03	.59	.40

Note: *$p < .05$.

Like the subscale for valuing, in the expectancy x value model, the participants' valued the experience of learning in a game, but their expectations to learn was not statistically significant. Qualitative results will show that the participants did not believe learning was possible in games. This may be the reason why expectancy and perceived competence was not significant, but valuing was significant because it allowed the participants to experience learning in a novel and engaging environment.

Summary of Motivation Assessment Findings

There was no significant difference in the participants' motivation to play and learn disciplinary knowledge (social studies and economics) and skills (technology and information literacy). There was a significant difference in the participants' valuing of the game and the disciplinary knowledge and skills and this valuing came after playing *RCT3*. There was no statistically significant difference for the participants' interest and enjoyment for learning school content while playing the game. There was no statistically significant difference in the participants' feeling of pressure and tension. There was no statistically significant difference in the participants' perceived competence in playing a game to learn disciplinary knowledge and skills.

Overall analyses indicated that the participants statistically gained significant knowledge of microeconomic principles and social studies that included supply and demand, opportunity cost, and scarcity. They were able to transfer the disciplinary knowledge and skills to real world settings. Participants also learned about the game using game knowledge that included technology knowledge and information literacy. In addition to knowledge and skills gained in playing the game, the participants valued playing the game and learning economics and social studies principles. High pretest and posttest means indicated that participants had high perceived competence, interest, and expectations to do well in the study and this may have affected chances of getting a statistically significant difference for those constructs on the motivation assessment. The means of these constructs, however, indicate that the participants maintained their interests and perceived competence. It was a positive sign to see that felt pressure and tension did not significantly affect the participants' experience. What the participants

valued in the experience, why they learned, details about the specific content they learned, their attitudes towards learning in a game as well as their play strategies will be illuminated by the qualitative findings in the next chapter.

Chapter 5

Results: Mixed Methods

This chapter reports both quantitative and qualitative findings. The quantitative findings are based on emergent player types generated from qualitative findings. The chapter reports a more interpretive understanding of the empirical questions by examining learning and motivation by the emergent player types, rather than the whole group and it provides a view of how the participants progressed in the game. The chapter is divided into sections that address the research questions, what strategies did participants use to navigate in the game, what participants learned, and what did participants value in the game and content. Results are shown from data sources namely the knowledge tests, motivational assessments, participant interviews, observations, and log sheets. The mixed methods section shows the results of play strategy as well as how and why participants learned and valued the disciplinary knowledge and skills.

Beginning in December 2007 and concluding in February 2008, students were observed during gameplay and interviewed after every session as a group. Occasionally, the researcher would ask participants questions during gameplay about what they were doing. During gameplay the participants used a log-sheet to document their progress by game levels, game achievements within levels, and the time of each achievement using the in-game technology that tracks the length of time a park is in operation in years and months. Individually, participants were interviewed intermittently while the whole group was interviewed after every session throughout the seven weeks of the study. Throughout those seven weeks the game was played for a total 24 hours. Each participant was interviewed one to three times from the 4th week onward.

Data sources for the qualitative analysis results included log-sheets, interviews, and observation (participant, written notes, and video taped). In addition, paired-t tests analyses of the pretest posttests knowledge tests and motivational assessments were conducted on the qualitatively emergent player types to help elucidate learning and motivation in the game using the emerging groups for the participants' play styles.

The purpose of those data sources was to provide results concerning play progress and strategy, and how and why participants learned and valued the disciplinary knowledge and the information and technology literacy in the game. The results of the qualitative section are presented using player characteristics to address the study's questions. Research question 4 asked what strategies did participants use to navigate in the game, question 2 asked what did the participants learn, and question 3 what did the participants value in the game and content. In this section, for the interpretive analysis, questions 2 and 3 are explored to provide more support for the quantitative findings. Play characteristics are believed to be related to the process of learning by way of navigational strategy and attitudes toward gameplay and learning.

What Strategies did Participants use to Navigate in the Game?

Using the constant comparative method of grounded theory analysis to analyze the observation, log-sheets, and interview data, two main categories of players emerged the *explorers* and the *goal seekers*. The two general categories of player types emerged from the coding of data for play characteristics such as being social, strategies such as planning ahead, personal goals such as objective oriented, attitudes toward the school content and game such as valuing the game and content or not, and what was learned in the form of disciplinary knowledge and skills. A short profile of each participant was

created based on observation notes (video taped and written), log-sheets data, and interview data. From the short profiles of the 26 participants that were created and combined, play characteristics of the participants included 17 *explorers* and 9 *goal seekers*. Further coding revealed two sub-categories within the *explorers* group, the *localized explorers (attraction builders)* and the *comprehensive explorers (park developers)* and two further sub-categories within the *goal seekers* group, the *competitors (beating other players)* and the *achievers* (*beating the game for personal achievement).* From both the *explorers* and *goal seekers* categories, player differed in their play strategies, personal goals, and attitudes when gaming; however, each of the participants had a similar general valuing attitude toward the school content and the game by indicating interest and liking of the game and the content, economics and social studies (See Table 9). Player characteristics were related to the process of learning using the participants navigational strategies and their attitudes to the game and content.

The groups were not mutually exclusive as the characteristics for each category were based on what participants mostly displayed. Participants were placed in the group for which they displayed the most characteristics. Sometimes a *goal seeker* explored to find something new or to learn a new strategy, and likewise an *explorer* took on the characteristics of a *goal seeker* to achieve some tasks. Players are not solely one way or the other. The characteristics do not define the players' personalities, but indicate how they played this game. The game is influenced by the game genre and design. The characteristics are the players dominant play styles or preferred way to play this game.

The researcher was the sole person collecting the data for the qualitative data analysis. Thus, there is no inter-rater reliability score for analyzing the log sheets,

interviews, observational data, or incremental scenario tests for scoring. Instead, the researcher relied on triangulation of data from all the data sources. Based on the type of information that was collected to support the findings for learning, motivation, and player strategies for navigation, redundancy was apparent. Table 9 illustrates player characteristics and attributes in the game.

Table 9: *Players Characteristics and Attributes*

Player Type	**Characteristics**	**Some Contrasting Attributes**
Explorers	Localized Explorers (attraction builders)	1.Primarily ride and attraction developers 2. Not concerned with managing all the necessary resources or observing and intervening for navigation 3.Concerned with mainly exploring their personal preferences in the esthetics of the design of what they are building 4. Most helpful and also the ones to seek the least amount of help (gaming extroverts)
	Comprehensive explorers (park developers)	1. Primary aim was to use resources in a balanced way in their park while working diligently to meet game objectives 2. Focused on trying to manage everything in the park by aiming to develop a broad understanding of tools while exploring tools that were not necessary to advance to new scenarios 3. Did not help or socialize much (gaming introverts) 4. Focus on observation and intervention with drop down screen to fix immediate problems and navigate
Goal Seekers	Competitors (beating other players)	1. Mostly focused on completing the game and less on exploring to understand problems they may have had in their park, which was secondary to game objectives 2.Play solely to meet the game objectives and goals in order to reach the next scenario 3.Used game objectives window to plan ahead before using drop-down screen for observing and intervening 4. Very social, even if it was dysfunctional at times - "fun sabotage" among peers – (gaming extroverts)
	Achievers (beating the game for personal achievement)	1.Individualistic game player, rarely sought help unless in dire circumstances (gaming introverts) 2. Actively developed their knowledge and skills for finding out the fastest ways to complete scenarios 3. Employed more strategies for playing the game fast - they tended to fast forward the game in order to gain cash because the game speeds up and guests spend more money per ride.

Table 10 gives an overview for how the two general categories of emerging player types, the *explorers* and the *goal seekers*, are related to learning disciplinary and skills on the pre-post knowledge test.

Table 10: *General Emerging Player Categories and Learning Disciplinary Knowledge and Skills*

Participants	**Tests**	**Statistical Results**
Explorers Disciplinary Knowledge: Economics and Social Studies	Paired t	Statistically significant finding for economics and social studies
Goal-Seekers Disciplinary Knowledge: Economics and Social Studies	Paired t	Statistically significant finding for economics and social studies
Explorers Skills: Information and Technology Literacy	Paired t	Statistically significant finding for game knowledge (technology knowledge) and information literacy
Goal-Seekers Skills: Information and Technology Literacy	Paired t	Statistically significant finding for game knowledge (technology knowledge) and information literacy
Explorers Transfer: Near Transfer	Paired t	No statistical significant finding for transfer of knowledge from game to real world contexts about theme parks
Goal-Seekers Transfer: Near Transfer	Paired t	No statistical significant finding for transfer of knowledge from game to real world contexts about theme parks
Explorers Transfer: Far Transfer	Paired t	No statistical significant finding for transfer of knowledge from game to real world contexts beyond theme parks and business
Goal-Seekers Transfer: Far Transfer	Paired t	No statistical significant finding for transfer of knowledge from game to real world contexts beyond theme parks and business

Table 11 illustrates gives an overview for how the two general categories of emerging player types, the *explorers* and the *goal seekers*, are related to motivation and valuing of the game and content on the pre-post motivation assessment.

Table 11: *General Emerging Player Categories for Motivation and Valuing*

Participants	**Tests**	**Statistical Results**
Explorers Overall Motivation: Intrinsic Motivation	Paired t	Not statistically significant for having intrinsic interest for the learning the content in the game. They had believed that learning was not possible in the game.
Goal-Seekers Overall Motivation: Intrinsic Motivation	Paired t	Not statistically significant for having intrinsic interest for the learning the content in the game. They had believed that learning was not possible in the game.
Explorers Motivation: Valuing	Paired t	Statistically significant for valuing the content (Economics) and the game
Goal-Seekers Motivation: Valuing	Paired t	Not statistically significant for valuing the content (Economics) and the game
Explorers Motivation: Perceive Competence	Paired t	Not statistically significant for having perceived competence in the game and content, but increased pre to post means
Goal-Seekers Motivation: Perceive Competence	Paired t	Not statistically significant for having perceived competence in the game and content, but increased pre to post means
Explorers Motivation: Felt pressure/tension	Paired t	Not statistically significant for felt pressure while playing the game. Pre –Post means show decreased in tension
Goal-Seekers Motivation: Felt pressure/tension	Paired t	Not statistically significant for felt pressure while playing the game. Pre –Post means show decreased in tension
Explorers Motivation: Interest	Paired t	Not statistically significant for having interest in the game and content, but increased pre to post means.
Goal-Seekers Motivation: Interest	Paired t	Not statistically significant for having interest in the game and content, but increased pre to post means.

Table 12: *Descriptive Statistics for Knowledge Test and Motivational Assessment for Explorers*

Explorers	Means	S.D.	Std. Err	N
Post Knowledge *RCT3*[1]	15.56	3.05	.76	16
Pre Knowledge *RCT3*[1]	13.06	2.41	.60	16
Post Knowledge Econ & Social Studies[2]	20.69	3.30	.83	16
Pre Knowledge Econ & Social Studies[2]	17.94	2.67	.67	16
Post Transfer of disciplinary knowledge[3]	6.94	1.12	.28	16
Pre Transfer of disciplinary knowledge[3]	6.31	1.20	.30	16
Post Near Transfer[3a]	5.50	1.03	.26	16
Pre Near Transfer[3a]	5.19	1.05	.26	16
Post Motivation to play and learn[4]	113.12	11.27	2.73	17
Pre Motivation to play and learn[4]	108.76	12.30	2.98	17
Post-Interest (subscale)[5]	25.06	3.03	.74	17
Pre-Interest (subscale)[5]	23.29	2.52	.61	17
Post Value (subscale)[6]	40.82	5.21	1.26	17
Pre Value (subscale)[6]	36.88	5.44	1.32	17
Post Felt Pressure/tension (subscale)[7]	14.29	4.47	1.08	17
Pre Felt Pressure/tension (subscale)[7]	14.53	4.71	1.14	17
Post Perceived Competence (subscale)[8]	32.94	5.25	1.27	17
Pre Perceived Competence (subscale)[8]	34.06	5.33	1.29	17
Post expectancy[9]	47.24	4.96	1.20	17
Pre expectancy[9]	48.59	6.81	1.65	17
Post value[10]	65.88	7.29	1.77	17
Pre value[10]	60.18	7.21	1.75	17

1. Knowledge of game/*RCT3* scored out of 17
2. Knowledge of Economics and Social Studies scored out of 31
3. Transfer – scored out of 10 points

3a. Near Transfer – scored out of 7 points

4. Overall Motivation 25 items with 4 subscales – Likert type scale with a range from 1 to 6
5. Interest – Subscale of Overall Motivation assessment (5 items) - out of 30
6. Value – Subscale of Overall Motivation assessment (8 items) - out of 48
7. Felt Pressure/tension - Subscale of Overall Motivation assessment (5 items) - out of 30
8. Perceive Competence - Subscale of Overall Motivation assessment (7 items) – out of 42
9. Expectancy derived from perceived competence and pressure/felt tension scale
10. Value derived from interest/enjoyment and valuing scale

Explorers

This group consisted of 17 participants. *Explorers* are defined as the players who focused primarily on four areas: (a) learning about the game's intricate details such as

researching, marketing, or advertising; (b) discovering supplemental tools such as terrain for landscaping, contouring for helping in designing a park, and exploring the interactions and feedback from guests by meeting their needs for rides, amenities, and the theme park; (c) honing their skills in building theme parks by exploring with various layout styles for the rides in their park, such as thrill rides in one section, gentle rides in another section, and high excitement rides in another section, and (d) focusing on building particular rides or attractions, such as roller coasters, rather than purchasing or building particular displays, such as fireworks. They explored by building various types of parks that are predominantly made up of rides and/or animals or mainly for certain types of visitors who like high intensity and excitement level rides or more moderate and low nauseated rating rides. Although they want to advance, and do seek to advance to new levels (from Apprentice, to Entrepreneur and finally to Tycoon level) and scenarios, it is not their primary goal. Their primary goal is to build the best possible park, build the biggest roller coaster or some other attraction, and to explore with various designs and layouts of their parks while trying to meet their needs for a well-designed park and the needs of guests for certain amenities and rides. They did not focus actively on achieving the objectives or goals of each scenario in *RCT3*.

The primary strategy of *explorers'* for navigating the game is to explore the game by building and focusing on all aspects of the game while observing gameplay and actions, and then intervening based on feedback from the guests about the price of rides, food, and other amenities. They also focus on the feedback from the park inspector about the state of their park in terms of ride reliability, park cleanliness, and other park conditions related to maintenance. How *explorers* chose to play the game was

determined not only by their play characteristics, but also by their attitude to the game and content, and this influenced what they learned and how they learned it.

Log-sheet analysis showed that *explorers* completed fewer scenarios than *goal seekers*, resulting in less exposure to different scenarios and learning opportunities for game knowledge and disciplinary knowledge than their counterparts. Interview reports indicated that *explorers* had a positive attitude toward the game and content. Of the 17 explorers (of whom 77% or 13 completed at least one scenario), all said they would recommend the game to a friend and that they would play the game again. They like the concept from the game of full control of business, it allowed them to socialize and help, and it had features to help support their progress. The motivation assessment showed that *explorer*s statistically significantly valued the game and content pretest ($M = 40.82$, $SD = 5.21$) to posttest ($M = 36.88$, $SD = 5.44$), $t\,(16) = -2.26$, $p < .05$. There was a large effect size, $d = .74$, $r^2 = .35$ (See Table 14).

When asked what they learned after the second week of game play, 70% or 12 of the explorers said they were learning how to save money and make decisions about how to run a business, their theme park. From interviews and the knowledge tests, by the last session of game play each participant including *explorers* understood the basics of what it meant to be an Apprentice, an Entrepreneur, and a Tycoon from playing the game, and they knew more about managing resources and making decisions with regard to scarcity, opportunity, cost-benefit, pricing, and supply and demand. There was a statistical significant difference pretest ($M = 17.94$, $SD = 2.67$) to posttest ($M = 20.69$, $SD = 3.30$) in disciplinary knowledge gain, $t\,(15) = -2.67$, $p < .05$, (See Table 13). The effect size was large, $d = .92$ with $r^2 = .42$. *Explorers* were also able to statistically significantly

gain information and technology literacy skills pretest (M = 13.06, SD = 2.41) to posttest (M = 15.56, SD = 3.05) on the knowledge test, t (15) = -2.83, $p < .05$. The effect size was large, d = .91 with r^2 = .41 (See Table 13). There was no statistical difference for near or far transfer knowledge (See Table 13). One explorer was removed from the knowledge test analysis as an outlier because the participant did not complete the pretest. The result of the pretest score was very low because the pre-knowledge test was incomplete. This made the score numerically distant from others that were based on a completed test.

Table 13: *Match Paired t-tests Analysis for Explorers on the Knowledge test*

Source	*df*	*t*	*p*	*d*	*δ*
Pre-Post Knowledge of Economics & Social Studies	15	- 2.67*	.02	0.92	.34
Pre-Post Knowledge of *RCT3*	15	- 2.83**	.01	0.91	.23
Pre-Post Transfer	15	-1.91	.08	0.54	.19
Pre-Post near Transfer	15	-0.92	.37	0.29	.41

Note: *p < .05. **p < .01

Table 14: *Match Paired t-tests Analysis for Explorers on the Motivation Assessment*

Source	*df*	*t*	*p*	*d*	*δ*
Pre-Post Overall Motivation	16	-1.11	.28	37	.93
Pre-Post Valuing	16	-2.26*	.04	.74	.59
Pre-Post Interest/Enjoyment	16	-1.80	.09	.64	.33
Pre-Post Felt Pressure/Tension	16	.23	.82	-.05	.70
Pre-Post Perceived Competence	16	.74	.47	-.21	.83
Pre Expectancy	16	.78	.45	-.23	.75
Pre-Combined Valuing	16	-2.25*	.04	.79	.40

Note: *p < .05.

Explorers were able to relate the microeconomics principles to their lives and they commented about playing the game differently next time (which is similar to their *goal seekers* counterparts) only to test their skills for advancing deeper into the game to play more scenarios. One *explorer* participant said it was "like being at school on my hockey team and working with the available skills we have, which is managing those skills, right? These skills are like resources, and the decisions each player makes as part of the hockey team affect how those skills are used and if we win….I could have given you another example of selling lemonades, but that would be easy." These participants discovered how to gradually play the game better and constructed knowledge by seeing relationships to their lives. This is seen in the statistical significant findings for disciplinary knowledge and skills.

Figure 4: Example of a Localized Explorer Park-*Vanilla Hills*: Two Giant Rollercoasters

Figure 5: Water Park Under Construction by a Comprehensive Explorer

Localized explorers

Localized explorers are defined as explorer players who are more narrowly focused on constructing particular rides or technologies in their park rather than actively seeking to develop their park holistically and meet objectives within scenarios. They are not concerned with managing all the necessary resources in the game, such as limited park space and money, or efficiently using time to get their park operating in a timely manner to make money, or train workers to achieve the game objectives. They are concerned mainly with exploring their personal preferences in the esthetics of the design of what they are building, such as a rollercoaster or a waterfall, and how it affects guests. They do not focus on the overall park management or focus on impact of the decisions they make in managing the resources such as money, workers, and land space.

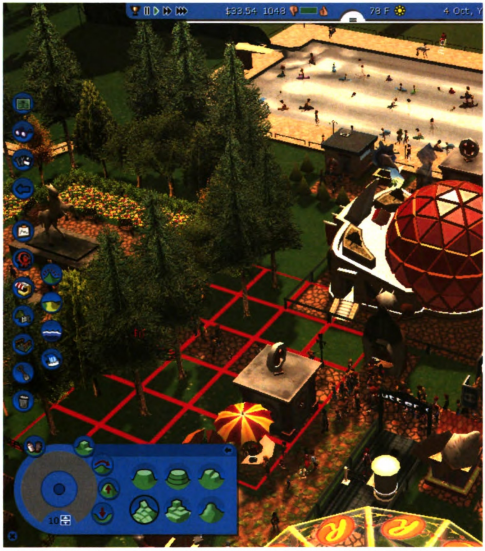

Figure 6: Explorer *Vanilla Hills* Park Under Construction With Terrain Tool

Of the seven participants in this group, five completed at least the first scenario, *Vanilla Hills*. Two completed the third scenario, *Checkered Flags*, but none completed all six scenarios. *Localized explorers* showed a statistically significant gain on the knowledge test for disciplinary knowledge, pretest (M =17.29, SD = 3.30) to posttest (M = 21.00, SD = 3.00), t (7) = -2.39, $p < .05$. There was a large effect size, d =1.18, r^2 =.51. A significant difference was shown in game knowledge, including technology and information literacy skills for the game pretest (M = 12.57, SD = 2.76) to posttest

(M=15.86, SD = 2.48), t (7) = -2.67, $p < .05$ on the knowledge test. There was large effect size, d = 1.25, r^2 =.53 (See Table 16).

Localized explorers completed the fewest number of scenarios and focused on the least number of areas in the scenarios. They focused on the details of individual artifacts in creating rides and attractions. They were resilient and coped with design and building struggles even though it hindered their chances to advance quickly. Among all the groups, background reports showed that *localized explorers* had the highest average number of hours playing video games each week, M = 9hrs 34mins/wk outside of the study. In the study, they actively developed their knowledge and skills for building the biggest and best roller coasters, extravagant fireworks, waterfalls, and pools. Their knowledge gain as shown in Table 16 may be related to their navigational strategies and attitudes towards the school content and game, which influenced how they gained knowledge in *RCT3*.

Table 15: *Descriptive Statistics for Knowledge Test and Motivational Assessment for Localized Explorers*

Localized Explorers	Means	S.D.	Std. Err	N
Post Knowledge *RCT3*[1]	15.86	2.48	.94	7
Pre Knowledge *RCT3*[1]	12.57	2.76	1.04	7
Post Knowledge Econ & Social Studies[2]	21.00	3.00	1.13	7
Pre Knowledge Econ & Social Studies[2]	17.29	3.30	1.25	7
Post Transfer of disciplinary knowledge[3]	7.00	1.16	.44	7
Pre Transfer of disciplinary knowledge[3]	6.00	1.53	.58	7
Post Near Transfer[3a]	5.43	.54	.20	7
Pre Near Transfer[3a]	4.86	1.07	.40	7
Post Motivation to play and learn[4]	116.00	12.73	4.81	7
Pre Motivation to play and learn[4]	110.00	4.20	1.59	7
Post-Interest (subscale)[5]	26.00	3.00	1.13	7
Pre-Interest (subscale)[5]	23.43	1.81	.69	7
Post Value (subscale)[6]	41.71	5.82	2.20	7
Pre Value (subscale)[6]	37.29	4.68	1.77	7
Post Felt Pressure/tension (subscale)[7]	13.86	5.15	1.95	7
Pre Felt Pressure/tension (subscale)[7]	12.71	4.82	1.82	7
Post Perceived Competence (subscale)[8]	34.43	5.32	2.01	7
Pre Perceived Competence (subscale)[8]	36.57	3.36	1.27	7
Post expectancy[9]	48.29	5.65	2.14	7
Pre expectancy[9]	49.29	3.45	1.30	7
Post value[10]	67.71	7.65	2.89	7
Pre value[10]	60.71	5.50	2.07	7

1. Knowledge of game/*RCT3* scored out of 17
2. Knowledge of Economics and Social Studies scored out of 31
3. Transfer – scored out of 10 points

3a. Near Transfer – scored out of 7 points

4. Overall Motivation 25 items with 4 subscales – Likert type scale with a range from 1 to 6
5. Interest – Subscale of Overall Motivation assessment (5 items) - out of 30
6. Value – Subscale of Overall Motivation assessment (8 items) - out of 48
7. Felt Pressure/tension - Subscale of Overall Motivation assessment (5 items) - out of 30
8. Perceive Competence - Subscale of Overall Motivation assessment (7 items) – out of 42
9. Expectancy derived from perceived competence and pressure/felt tension scale
10. Value derived from interest/enjoyment and valuing scale

Table 16: *Match Paired t-tests Analysis for Localized Explorers on Knowledge Test*

Source	*df*	*t*	*p*	*d*	*δ*
Pre-Post Knowledge of Economics & Social Studies	6	- 2.39*	.05	1.18	.80
Pre-Post Knowledge of *RCT3*	6	- 2.67*	.04	1.25	.66
Pre-Post Transfer	6	-1.87	.11	0.73	.42
Pre-Post near Transfer	6	-1.08	.32	0.68	.61

Note: *p < .05. **p < .01

Table 17: *Match Paired t-tests Analysis for Localized Explorers on the Motivation Assessment*

Source	*df*	*t*	*p*	*d*	*δ*
Pre-Post Overall Motivation	6	-.99	.36	.63	.85
Pre-Post Valuing	6	-1.32	.24	.84	#
Pre-Post Interest/Enjoyment	6	-1.54	.18	1.03	.82
Pre-Post Felt Pressure/Tension	6	-.79	.46	.23	.89
Pre-Post Perceived Competence	6	1.15	.30	-.48	.73
Pre Expectancy	6	.65	.54	-.21	.54
Pre-Combined Valuing	6	-1.51	.18	1.05	.98

Note: *p < .05. # - too few cases to compute power

Snapshot of a Typical Localized Explorer

RCT317 was one *localized explorer* who epitomized a player within the category. He was helpful and empathetic. He focused on local developments, such as building the biggest and best fireworks. He commented that learning was not possible in games, so he played the game at a pace that satisfied his own needs, and the needs of the guests in his park, not focusing on the requirements to meet the goals of each level or scenario. He was the most helpful participant among his peers. He spent numerous hours helping other

participants to build rollercoasters and fireworks, and in the process he learned more about playing the game and about economics based on observing other participants who were advancing farther into the game. During gameplay he focused on building particular attractions, such as fireworks and waterfalls, and progressed by mainly observation and intervening to fix developing problems based on feedback from the drop down screen (See Figure 9). *RCT317* said, "One reason I want to build rollercoasters is because my dad told me I was afraid of rollercoasters. My dad is afraid of rollercoasters." *RCT317* does not believe he is afraid of rollercoasters, but says that "this will help me because I talk to my dad every time about this game." *RCT317* like other *localized explorers* played the game to satisfy some immediate personal need, not to learn the content. He had explicitly said, "I don't think learning is possible in games; it is not like school;" however, during the interviews, he displayed knowledge about scarcity and opportunity cost when discussing how building fireworks affected his overall park development and progress in the game and what he gave up to focus on his goals as well as to meet the needs of the guests in his park. To this end, he realized that he learned from the game and was surprised.

Localized Explorers: Navigation Strategies for Game Progress

Localized explorers navigated using four broad strategies. First, as described above by observing and intervening, they built attractions and rides while observing the game screen and by intervening to fix broken down rides or changing prices and amenities. Second, they listened to the requests of the guests and the park inspector in their park. This was done by using game icons to observe guests' thoughts about particular rides, the animals, or the park, and by the drop-down window of the game that

provided information about the park from the park inspector. Using these tools effectively required *localized explorers* to master the game language of icons and symbols and the relationship of each to actions that must be taken for progress in gameplay. *Localized explorers* were less skilled at using the tools effectively for progressing, but they were more skilled on specific rides for building. They had early problems as did other participants, but they did not overcome them. This stalled their progress and created problems, such as building small hills in their park which they tried numerous times to flatten with the terrain tool. Rather than starting over as many of the *goal seekers* did, *localized explorers* coped with their problems while slowly advancing.

Third, while money was being generated from rides *localized explorers* explored secondary tasks so that they could build or pursue their own ambitions. For instance, one participant always said it was his strategy to play "a waiting game helping others while money is generated in his park," while another says he explores with tools such as marketing and advertising or ensuring his park is reliable by setting and creating set work paths for workers. *Localized explorers* adopted a strategy of firing, hiring, and disciplining workers rather than training them to perform better. They commented that these tasks were secondary to their goal of building a giant roller coaster or water ride, but necessary for gaining and spending less money on things such as workers. This is because *localized explorers* are usually concerned with personal design and tend to charge default prices of $1.00 even with high exciting rides that could easily garner a higher price. When interviewed, one participant said it was unfair to charge more than a dollar because guests "do not have a lot of money" and they wanted guests to go on their

well-designed rides. *Localized explorers* were compassionate and empathetic to guests in their park.

Fourth, *localized explorers* used a strategy of helping others and learning in the process. This helped them to affirm their own navigation strategies learn new ones through insight into what the other participants were doing, and learn content knowledge. Two *localized explorers* spent 4 weeks or 16 hours learning how to master fireworks construction and creating beautiful fireworks. *RCT317* said his dedication to the creation of the most beautiful fireworks was why he spent 4 weeks going through frustration and happiness. He said, "I really wanted to understand how to make the fireworks work. So I tried my best not to give up when it was not working, but I tried and tried until it worked; now I can build any type of fireworks." *RCT317* helped *RCT303* to get started on his fireworks and after two weeks of working together, *RCT303* built a spectacular fireworks light show. After helping and learning from each other, both had the best fireworks display as voted by their peers.

As with all the participants these strategies were perfected through trial and error or through an iterative process of designing, making mistakes, learning from it, and trying again because there were no serious consequences for making mistakes for these participants. *Localized explorers* had a strong sense of commitment to their designed product whether it was a park under development or a type of ride. For instance, one participant, *RCT312* asserted that the commitment involved in caring for an ostrich in his park was reflective of his commitment to learn a lot and to care for his real life dog. He commented that "my ostrich is having a baby, now I have to take care of her like my puppy. My puppy is three months old. I had to learn a lot about dogs to take care of

mine." Of all the four subgroup of players, *localized explorers* were the most helpful and empathetic and also the ones to seek the least amount of help.

These strategies though helpful for socializing and learning were not the most effective and efficient for helping participants advance progressively through scenarios; however, these strategies reflected a genuine sense of commitment to ethical and social decisions and learning based on personal interest in exploring artifacts and designing rides. They were social, helpful, and talkative and, along with observing and intervening, *localized explorers* declared these strategies were needed in order to be successful in *RCT3* and to learn. In this sense *localized explorers* could be considered to be extroverts.

Localized Explorers: Attitudes Toward the School Content and Game and what was Learned

Localized explorers valued playing the game and generally said they were going to learn information that could help them in school and out-of-school though, not necessarily by way of the content areas of economics and social studies. There was no statistical significant finding for *localized explorers* valuing of the game content shown between pretest ($M = 37.29$, $SD = 4.68$) to posttest ($M = 41.71$, $SD = 5.82$) on the motivation assessment $t\ (6) = -1.32$, $p > .05$, $d = .84$ (See Table 17). Nonetheless, interviews and observations indicated that what participants valued as a navigational strategy aid what they learned. These strategies involved: (1) observing and intervening, (2) listening to or following up on the feedback from guests and the park inspector, (3) exploring secondary tasks while generating money to focus on primary goals, and (4) mentoring and apprenticeship to learn the skills overlapping with each other in the areas of valuing and learning for builders.

Observing, intervening, and listening to guests and the park inspector are forms of feedback that helped to scaffold participants' learning. It was viewed as an arduous task, and it was usually frustrating for *localized explorers* because participants often did not have immediate feedback on their actions. These strategies were valued because it allowed participants to learn about how to manage their money, manage park space resources, and gradually make better decisions about money and other resources. Delayed feedback is one reason none of the *localized explorers* completed all six game scenarios. The main reason for the slow progress was that all seven of the *localized explorers* said that the most important thing for them while playing the game was observing actions not only in the game, but also from peers, learning from them, and then taking steps to reorganize resources such as rides, park space, managing workers, and trying to make better decisions with the little money they had after building big rides.

Exploring secondary tasks was a highly valued task by six of the seven participants. The one exception was a female participant who did it because it was "just a strategy." This allowed participants to develop an understanding of the role of managing resources and dealing with opportunity cost. *Localized explorers* commented that they were gaining more in building their favorite ride rather than focusing on using the minimal resource of money to focus on the game objectives. By focusing on the needs of guests and their personal goals, they were better able to focus on making good decisions about how to wisely use their money and the park space. Resources such as money were used to support guests rather than to directly meet scenario objectives. During interviews, when asked what they thought about the people who visited their park, they felt that the guests were ordinary people with little money, and they knew that information based on

guests' thoughts and how much money the guests had, which "averaged about $50 dollars." This is reflected in their thoughts about buying an expensive popular toy versus buying three cheaper and less popular toys, or their choices about locations of rides in their park versus locations of stores in a shopping mall by importance. They were not focused on the importance of rides to the park or the importance of store locations in a shopping mall to optimize sales or that of buying an expensive popular toy; rather they were focused on meeting their personal goals of building or buying cheaper items as well as customers' needs and not store owner's sales. It appears that personal needs were favored over guests' needs as players tended to focus only on putting a few rides in their park, thus reducing the number of people who may visit their park at any one time. Toward the end of the study, *localized explorers* valued and learned that it was important to manage all their resources including time, money, park space, and workers. They also observed after seeing that though some participants completed all of the scenarios, *localized explorers* knew more about parts of the game unknown to other participants.

Mentoring and apprenticeship, the idea of helping other less knowledgeable players to build or work through a problem, learn from those participants being helped, develop a better understanding of what they were teaching, and learn new skills and content was mainly experienced by *localized explorers* more than any other subgroup. Of the seven *localized explorers*, one was predominantly a rollercoaster builder, two were mainly fireworks and light show builders, three were waterfalls builders, and one was focused on building gentle rides. They were all helpful in aiding their peers in building these rides or amenities. They spent an average of three hours sitting and helping their peers, and they were willing to help without being asked to help. They seemed to have an

extroverted personality. They also learned from their peers in these situations. *RCT302* learned by helping and observing *RCT316* that the key to being successful in completing scenarios was to achieve the game objectives and to make decisions about how to allocate workers in the park in efficient numbers because having too few workers resulted in the theme park remaining dirty and having too many workers resulted in workers quitting and in money loss. In addition, *RCT302* said he learned how to help park VIPs' though he did not advance that far into the game. He also learned the value of using park money on the game objectives as well as understanding that guests would like those things even though decisions were made to meet the game objectives. Nonetheless, *RCT302* commented that way of playing was one type of success, and it was equally valuable to focus on the guests' needs and building big rides. At the end of the study, builders understood how to work within the affordnaces of the game by trying to manage all resources to run an efficient park; however, they preferred to focus on their personal goals or interests.

Localized explorers expressed interest and enjoyment in learning microeconomic principles and social studies concepts. Although one participant initially did not believe he was learning anything related to school content until after the third week, he enlightened himself during questioning from his peers. The participants were interviewing each other, and he eventually saw that he learned much about managing resources, such as using his park cash to meet guests' immediate needs, but also ensuring there was some left to continue building his fireworks. All the *localized explorers* and many of the other participants associated learning school content with stress and high-stakes situations such as testing. Thus, the idea of playing a game to learn school content

was foreign to them. Further, they did not know they were going to learn "school stuff." The *localized explorers'* strategy of playing for themselves and the guests in the park was related to the fact that they had nothing to lose, a low risk situation unlike in school. Exploration in play, trial and error in testing tools, and designing rides or layouts allowed them to discover and understand some constraints in the game because of the design. Participants explained they would not do exploration in school because they have to get things right the first time or else their future could be jeopardized. They explained about not being afraid of hard work, but they were afraid of the high stakes related to schools if they tried to explore and failed. They liked *RCT3* because it required hard work, but as one participant said, "you could take chances since the risks and consequences were low." This feature aided these participants testing, exploring, and discovering through an iterative process the unrealistic nature of some rollercoaster designs and problems with game glitches that allowed guests to walk through walls, but they also said the game was realistic in terms of how it "dealt with animals or how you have to build roller coasters."

Comprehensive Explorers

Comprehensive explorers are defined as explorer players who were focused primarily on learning more about the game in order to: (1) create theme parks that are clean and beautiful, (2) build rides that are reliable, (3) ensure that workers are happy and reliable, (4) meet the needs of guests, and (5) meet personal needs related to playing the game. The primary aim of these players was to use resources in a balanced way in their park while working diligently to meet game objectives. They were concerned with ensuring that they learned as much as possible about game play and content while

creating a product to be proud of and at the same time meeting game objectives. They were not concerned with trying to beat other participants to complete all the scenarios.

Whereas *localized explorers* focused on building grandiose rides, attractions, and amenities in order to satisfy personal needs for having the best and biggest attractions and did not have a broad focus on all aspects of the game for progress, *comprehensive explorers'* primary strategy for game progress was to focus on all aspects of gameplay by learning as much as possible about the game. In doing this, it afforded the most opportunity per scenario to learn about economics and social studies, and information and technology literacy. Nonetheless, there was no statistical significant difference from pretest (M = 18.44, SD = 2.13) to posttest (M = 20.44, SD = 3.68) on the knowledge test by participants in the areas of disciplinary knowledge, skills, and transfer knowledge, t (8) = -1.42, $p > .05$, d = .67 (See Table 19). There 10 participants in this group. One was removed during the statistical analysis to make the analysis more conservative because the pre-knowledge test was not completed. Of the 10 participants in this group, 80% or 8 completed at least the first scenario, *Vanilla Hills*, and 40% or 4 completed at least the third scenario, *Checkered Flags,* during gameplay. None of these participants completed all 6 scenarios, and 10% or one advanced to the penultimate scenario, Fright Night. Among all the subgroups, they averaged 7hrs and 25mins of gaming each week.

From interviews, written notes, log-sheet analysis, and observations *comprehensive explorers* exhibited knowledge of opportunity cost, supply and demand, scarcity, profit, pricing, and ethical and social decisions related to employees. By selectively choosing where to place rides based on space availability, guests needs, and balancing resources to achieve a well-designed and efficiently run park, they developed

knowledge about scarcity, opportunity cost, supply and demand, and others. They displayed social skills related to valuing, critical thinking skills related to problem solving, and self-reflection as they helped others. In interviews with participants from this group they valued learning about all aspects of gameplay for managing resources, having an efficiently run park, and empathy toward workers and guests. Nonetheless, there was no statistical significance between the motivational valuing pretest (M = 36.60, SD = 6.15) and the posttest (M = 40.20, SD = 4.96) on the motivational assessment, t (9) = -1.82, $p > .05$, d = .64 (See Table 20). They considered their theme park and made changes to the parks in order to make them more beautiful based on what they learned through helping other participants. Their technology skills grew as they became more familiar with the game tools and by building small rides that utilize space and accommodate more people over time per park than a few big rides that accommodate fewer people over time per park. They were able to progress faster from scenario to scenario, owing to the fact that the same skills were required in each scenario, but applied to different game content areas. Their understanding of the disciplinary knowledge and their skill development was influenced by their navigational strategies or play styles which afforded the greatest number of opportunities per scenario through a holistic focus approach to gameplay.

Table 18: *Descriptive statistics for Knowledge test and Motivational assessment for Comprehensive Explorers*

Comprehensive Explorers	Means	S.D.	Std. Err	N
Post Knowledge *RCT3*[1]	15.33	3.57	1.19	9
Pre Knowledge *RCT3*[1]	13.44	2.19	.73	9
Post Knowledge Econ & Social Studies[2]	20.44	3.68	1.23	9
Pre Knowledge Econ & Social Studies[2]	18.44	2.13	.71	9
Post Transfer of disciplinary knowledge[3]	6.89	1.17	.39	9
Pre Transfer of disciplinary knowledge[3]	6.56	.88	.29	9
Post Near Transfer[3a]	5.56	1.33	.44	9
Pre Near Transfer[3a]	5.44	1.01	.34	9
Post Motivation to play and learn[4]	111.10	10.33	3.27	10
Pre Motivation to play and learn[4]	107.90	15.98	5.05	10
Post-Interest (subscale)[5]	24.40	3.03	.96	10
Pre-Interest (subscale)[5]	23.20	3.01	.95	10
Post Value (subscale)[6]	40.20	4.96	1.57	10
Pre Value (subscale)[6]	36.60	6.15	1.95	10
Post Felt Pressure/tension (subscale)[7]	14.60	4.20	1.33	10
Pre Felt Pressure/tension (subscale)[7]	15.80	4.42	1.40	10
Post Perceived Competence (subscale)[8]	31.90	5.22	1.65	10
Pre Perceived Competence (subscale)[8]	32.30	5.90	1.86	10
Post expectancy[9]	46.50	4.60	1.45	10
Pre expectancy[9]	48.10	8.60	2.72	10
Post value[10]	64.60	7.14	2.26	10
Pre value[10]	59.80	8.50	2.70	10

11. Knowledge of game/*RCT3* scored out of 17
12. Knowledge of Economics and Social Studies scored out of 31
13. Transfer – scored out of 10 points

3a. Near Transfer – scored out of 7 points

14. Overall Motivation 25 items with 4 subscales – Likert type scale with a range from 1 to 6
15. Interest – Subscale of Overall Motivation assessment (5 items) - out of 30
16. .Value – Subscale of Overall Motivation assessment (8 items) - out of 48
17. Felt Pressure/tension - Subscale of Overall Motivation assessment (5 items) - out of 30
18. Perceive Competence - Subscale of Overall Motivation assessment (7 items) – out of 42
19. Expectancy derived from perceived competence and pressure/felt tension scale
20. Value derived from interest/enjoyment and valuing scale

Table 19: *Match Paired t-tests Analysis for Comprehensive Explorers on Knowledge Test*

Source	df	t	p	d	δ
Pre-Post Knowledge of Economics & Social Studies	8	-1.42	.19	.67	.18
Pre-Post Knowledge of *RCT3*	8	-1.48	.18	.64	.70
Pre-Post Transfer	8	-.82	.44	.32	.48
Pre-Post near Transfer	8	-.24	.81	.10	.46

Note: *p < .05. **p < .01

Table 20: *Match Paired t-tests Analysis for Comprehensive Explorers on the Motivation Assessment*

Source	df	t	p	d	δ
Pre-Post Overall Motivation	9	-.59	.57	.20	#
Pre-Post Valuing	9	-1.82	.10	.64	#
Pre-Post Interest/Enjoyment	9	-.98	.35	.40	.99
Pre-Post Felt Pressure/Tension	9	.86	.41	-.28	.81
Pre-Post Perceived Competence	9	.18	.86	-.07	.99
Pre Expectancy	9	.57	.59	-.23	.99
Pre-Combined Valuing	9	-1.59	.15	.61	.73

Note: *p < .05. # Too few cases to compute

Comprehensive Explorers: Navigation Strategies for Game Progress

Comprehensive explorers used several navigational strategies. They set personal goals for each session, observed and intervened in the game primarily using the drop-down window in the game as a guide and a way to manage game-wide actions related to feedback from the park inspector and guests, focused on management of everything in the park by aiming to develop a broad understanding of tools to advance to new scenarios while exploring tools that were not necessary, and consulted books, peers, and parents to

better understand the game and make decisions that were optimal to their success during gameplay.

Goal setting in each play session allowed *comprehensive explorers* to focus on specific targets in order to accomplish their tasks. This allowed developers to work towards reaching the game's objectives while knowing that they could work wholly to create a park that utilizes resources efficiently and symbolizes success for them. *Comprehensive explorers* averaged 16 hours 36 minutes in the first scenario with 80% or 8 of them completing it. 70% or 7 of them had an initial strategy of exploring the game while trying to meet game objectives, while three struggled from the outset with how to manage their resources including money and workers and with various tools, such as 'terrain,' that ruined their park. Participants in the study who encountered park disasters because of a lack of game knowledge at the outset, either did not advance past the first scenario or struggled with gameplay progress because of their play strategies.

A typical *comprehensive explorer, RCT307,* who epitomized how the group played said, "I started simple exploring with low excitement level rides, gentle rides and then started attempting to build rides, but I gave up on building." Like many of the participants, she struggled with building rides early in the initial weeks and chose to abandon that task to focus on beautifying, managing, and catering to guests. This is a crucial difference from that of *localized explorers* who coped and adapted during the building of rides and attractions. *RCT307* like the other *comprehensive explorers* wanted to have a good command of all the tools in the game and this meant taking risks, but not expending too much time on building. They were capable of building but did not command the same building skills or interest in building rides like as that of their

localized explorers counterparts. In doing so, *RCT307* and the other *comprehensive explorers* had the opportunity to focus on trying to manage park operations and resources more efficiently by aiming to develop a broad understanding of tools while exploring tools that were not necessary to advance to new scenarios. It also meant that they took chances as did builders in having their park being ruined because of the steep learning curve for some things, such as landscaping or building roller coasters.

Comprehensive explorers aimed to create holistically, tended to talk-aloud to themselves when playing, and they sought help from peers, books, and parents only when needed. *RCT308* mentioned how his father made him afraid of rollercoasters, so it was his goal to build a beautiful park and explore rollercoasters designs in order to build his confidence. Three other group members discussed and asked their parents directly for help on how to generate constant cash flow in the game. However, developers did not offer help unless asked, nor did they socialize by walking around and observing what their peers were doing. They focused on gaming. In this sense, *comprehensive explorers* could be classified as introverts during gaming.

Interestingly, generating money was a problem for developers. They tended to want to build/buy many rides or amenities, requiring money to purchase materials to build rides or to buy pre-built rides or amenities. The *comprehensive explorers'* strategy to navigate widely and to learn as much as they could about a scenario hindered their ability to generate sufficient money to maintain their heavy spending on park development. They did focus on generating money. Another reason for the low income was that they did not charge prices for rides based on the rides' level of intensity or

excitement. They, like the *localized explorers*, were very sympathetic to guests and the amount of money guests have, so they tended to charge as little as possible.

Observing game actions and intervening to fix problems based on feedback from the drop-down window was used as a primary navigational strategy for developers (see Figure 7). Concerns with the overall look of their park, the broad approach on how business is conducted to focus on guests, and concerns with solving the design or default design problems to meet how their park looks and feels led them to mostly use the drop-down window to focus on only immediate problems that occur. These problems sometimes include a broken-down "whirling dervish" or a dirty pool house that needs a more powerful cleaning agent. The *comprehensive explorers*' strategy was to use the drop-down window to fix immediate problems, while developing or modifying the existing park infrastructure to be beautiful, to be safe through reliable rides, to have happy workers, and to have well kept animals. For them, this was a key strategy for effective use of resources for progressing and for learning about the game. *Comprehensive explorers'* reported that strategies in gameplay helped them to appreciate the game using explorative ways without totally ignoring the required game objectives. These participants facilitated their personal needs and interests as well as the game needs using guests' requests and game objectives.

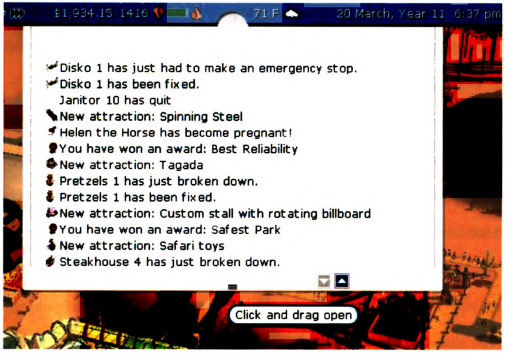

Figure 7: Drop-down Window in the Second Scenario Gold-Rush

Comprehensive Explorers: Attitudes Toward the School Content and the Game and What was Learned

From interviews and observations, the strategy used *comprehensive explorers'* in gameplay was related to the attitude that they adopted towards playing the game and the learning of school content. Both their strategy in gameplay and their attitude towards the game and its content were related to what was learned and the process by which they learned. This was influenced by having a broad encompassing approach to the need for managing as many resources as possible in their par. It included managing workers' satisfaction and assigning workers to patrol specific locations in their park. They utilized park space by placing specific types of rides in set locations, managing a limited amount of money to get the job done, and paid attention to feedback from guests and the park inspector. They worked by exploring tools and developing beautiful, safe, and clean parks. Finally, they tried to meet the game's objectives. Learning multiple aspects of the

game may have helped these participants to value the game more because they were able to satisfy multiple and competing needs, learn, and transfer some of what they learned.

These participants exhibited transfer knowledge. During interviews, they showed an understanding of microeconomic principles such as supply and demand, scarcity, opportunity cost, and pricing. They explained how they designed their park by allocating rides based on types, such as gentle rides in one section and thrill rides in another. For instance, *RCT306* commented that after her second week she "observed that the people would go to certain rides, such as high intensity or gentle rides, so I designed my park [dividing] it into ride types and with big and small rides." Along with this design strategy *RCT306* and other *comprehensive explorers* placed food and drink stalls away from thrill rides and other rides with high intensity in order "to prevent riders from eating and then going on the thrill rides which have a high nausea rating and make them vomit." *RCT327* explained that this decision helped to "keep her parks clean and beautiful because people like clean places and clean parks will attract more people." This was a sentiment that was unanimously shared by *comprehensive explorers* as a strategy that they used. This was connected to the increase in their park rating and the number of guests. It also demonstrated their game knowledge as it related to technology and information literacy.

In interviews, participants spoke about their park not only as a game, but as connected to a larger world, explaining what is happening in their parks by including factors that are external to the game but found in their own lives, or what they imagined would affect their game such as the guests not having much money or about attracting people to the park because it is clean, safe, and beautiful. These were all factors that these participants incorporated in order to create a complete world. For *comprehensive*

explorers as well as *localized explorers*, their theme park was more than a game. It was a world that had rules as well as ethical and social behaviors as in the real world. Their experience was embodied and connected to the real world.

They were aware about their sacrifices when making decisions. What they gave up may have hindered their chances of doing everything they wanted to do in the park and being able to complete the game. Nonetheless, they valued how effectively they used scarce resources such as money, space, and time. This is exemplified by *RCT327, RCT306,* and *RCT307* who commented frequently during group interviews about how much they liked using the space in the park like a puzzle by deciding how to design it to be beautiful as well as making sure they put in rides that will make money and increase the number of guests that visit their park. Observations and interviews reported from these participants indicated that park space was used prudently in laying out rides in a limited area and money was used to buy the best of simple rides to maximize space and increase the number of guests in their park. Upon generating sufficient money from these simple rides, they would use the money to buy a thrilling rollercoaster, which they knew was used by fewer guests because fewer seats were available. They commented that they were aware of the limitations of fewer seats meaning less money immediately, but "some guests like thrill rides." The following statement was echoed by these participants as explained by one *comprehensive explorer*, "in the long run I could make more money because people will love thrill rides more than many small or gentle rides that are less exciting." Participants showed an understanding of opportunity cost and scarcity though they were not aware of the terms in discussions at the end of the study with the researcher.

They explained how they used existing real world knowledge and applied it to the game. By using prior knowledge from outside the game about real world artifacts and applying it to the game, these participants believed that the game was mostly realistic in what can be applied to it and how these things played out in the game. For instance, the fact that if a player did not properly care for their animals, and animal protection services would confiscate the animal, or the animal would die led the participants to believe that the game had realistic actions. They also learned that the game was a like a laboratory for them to test their hypotheses about what they thought to be true in real life in the game, such as how they treated and designed their theme park for guests.

All the participants did not grasp the idea of pricing and how profit was made, even though the game clearly had a finances window that showed items from which profit was made (in black), how much money was spent (in red) and how pricing affected profit (see Figure 8). This was due to participants relying on their own understanding of using trial and error to arrive at good prices, using guest comments that stated the price is "a good value," or their real world views that prices and profit are only due to the large number of people spending or buying, and they do not need to increase prices past a certain point because it would have burdened guests. 23% or 6 of 26 participants, including one of the *comprehensive explorers,* and five of the *goal seekers* used the finance window to make decisions about profit and pricing rides. Most of the overall decisions by participants about pricing and profit were not based on mathematical feedback from the game "finances" window (see Figure 8). *Comprehensive explorers* struggled with satisfying the need for conducting a successful profit making business and

the need of not charging overwhelming prices that guests will have to bear, or finding an objective method to do pricing.

In interviews, when the participants were asked about the their views for what was real in the game, more than half of them believed realism was a factor for them to value the game; however, they also realized some of the game was unrealistic. One participant said, "People can walk through walls." Nonetheless, the idea of realism in *RCT3* led to the participants in all of the groups mostly valuing the game and the content. In addition, participants valued the disciplinary knowledge and skills because they were helping guests to enjoy the park. They perceived the activity as valuable and useful to being successful in the game and also something they could apply outside of the game to their lives. This is evident in the *comprehensive explorers'* responses on the log-sheets, responses in interviews, and responses to their peers when helping them or receiving help. For instance, they would make references to the guests in most of their explanations and statements about achievements such as "best value means that people can come to [the] park, spend little money, and enjoy themselves" or "a park needs to be reliable so that people can feel safe, and it will benefit my park in the long run." This group of participants understood the implications of their decisions, opportunity cost, and scarcity. Their decisions were in part based on the need to satisfy their needs and needs of guests while knowing they were giving up completing all the scenarios in the study.

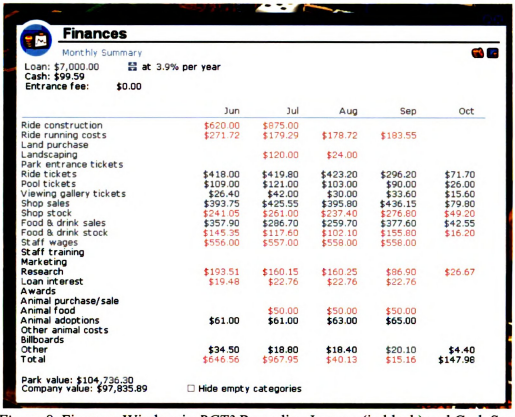

Figure 8: Finances Window in *RCT3* Regarding Income (in black) and Cash Spent (in red) for Each Type of Attraction in a Theme Park.

Goal Seekers

Constant comparative analysis of the participants' log-sheets and observation data indicated that there were nine *goal seekers*. Interviews and observation data showed that *goal seekers* were players who focused primarily on the following play and navigation strategies: (a) playing solely to meet the game objectives and goals; (b) starting by setting low prices at popular rides, and when there is a long queue, increase the prices significantly; the guests tend to stay in line because of how the game was designed; (c) always building a platform for a queue to a ride so that guests may get in line (exploiting the game design), allowing large numbers of guests to wait in an orderly fashion for a ride; (d) using the drop-down screen only for significant problems that demand immediate attention; (e) planning ahead using the game objectives window before

observing and intervening in game actions; (f) placing best and higher priced rides near the entrance of the park regardless of design or esthetics, and (g) purchasing rather than building rides.

The primary purpose for *goal seekers* to play the game was to "beat it." They tended to focus *less* on exploring and honing their skills in any particular area of the game, usually doing just enough to move to the next level and scenario. Rarely did they do any exploration, except at the beginning of the study when they were learning how to play the game and averaged 9½ hours to get out of *Vanilla Hills* and into Gold Rush. After *Vanilla Hills*, they did not do any exploration to learn about new tools that were secondary to the game play or secondary to advancing to a new level or scenario. Nonetheless, on the knowledge test goal seekers had statistically significant difference between the gain on the pretest (M = 18.22, SD = 3.60) and the posttest (M = 20.56, SD = 4.07) for disciplinary knowledge, t (8) = -2.92, $p < .05$. There was a moderate effect size, d = .60, r^2 = .29.They also had significant gains for information and technology literacy pretest (M = 13.44, SD = 2.70) to posttest (M = 15.33, SD = 2.83), t (8) = -2.98. There was a large effect size, d =.68, r^2 = .32 (See Table 22).

These participants completed the most scenarios. As a result, they had more opportunities to learn different microeconomics principles related to social studies. For instance, Gold Rush, the second scenario, demands that participants have to deal with repaying loans. In that situation participants have the opportunity to see how loans affect their income, spending, and their park. Gold Rush also asks participants to manage prices and profit for dealing with ride income, another learning opportunity, while Box Office, the fifth scenario asks players to understand managing employees to keep a clean park

and maintaining ride efficiency in order to meet the needs of a VIP. If a player did not advance to Box Office, that opportunity would not be gained for that specific requirement in a scenario. The task would not be demanded unless participants chose to focus on that specific task while exploring. *Goal seekers* played more scenarios. It appears that covering more scenarios is related to more learning opportunities as there was significant disciplinary knowledge and skills gained by *goal seekers* (See Table 22). The same is the case for technology and information literacy as both *explorers* and *goal seekers* played the game for 24 hours and both had significant gains for skills. While *goal seekers* progressed and had opportunities to gain game knowledge and skills by covering more scenarios, *explorers* had a similar opportunity for game knowledge and skills in playing and exploring with tools and gaming opportunities secondary to the main game objectives.

Both *explorers* and *goal seekers* had significant knowledge gains, though *goal seekers* covered more scenarios than *explorers*. This may be related to both playing the game for 6 to 7 weeks. It is logical to infer that playing to cover more scenarios in beating the game as well as playing the game while focusing on building rides and attractions or focusing on all aspects both facilitated learning the content and skills. Strategies used by both *explorers* and *goal seekers* helped to facilitate learning in this game; however, neither *explorers* nor *goal seekers* transferred this knowledge statistically significantly. In addition, *explorers* statistically significantly valued the experience of gaming and learning content while there was no statistical significance valuing for *goal seekers*. Further analysis of the *goal seekers* revealed that there were two types, those focused on beating the game while competing with others (hereafter

referred to as *competitors*), and those focused on beating the game solely for personal achievement or validation of success based on completing the study (hereafter referred to as *achievers*).

Table 21: *Descriptive Statistics for Knowledge Test and Motivational Assessment for Goal Seekers*

Goal Seekers	Means	S.D.	Std. Err	N
Post Knowledge *RCT3*[1]	15.33	2.83	.94	9
Pre Knowledge *RCT3*[1]	13.44	2.70	.90	9
Post Knowledge Econ & Social Studies[2]	20.56	4.07	1.36	9
Pre Knowledge Econ & Social Studies[2]	18.22	3.60	1.20	9
Post Transfer of disciplinary knowledge[3]	6.89	1.45	.48	9
Pre Transfer of disciplinary knowledge[3]	6.33	1.23	.41	9
Post Near Transfer[3a]	5.33	1.12	.37	9
Pre Near Transfer[3a]	4.90	.93	.31	9
Post Motivation to play and learn[4]	119.33	7.38	2.46	9
Pre Motivation to play and learn[4]	119.11	8.01	2.70	9
Post-Interest (subscale)[5]	26.78	2.95	.98	9
Pre-Interest (subscale)[5]	26.44	2.07	.70	9
Post Value (subscale)[6]	42.11	3.41	1.14	9
Pre Value (subscale)[6]	41.44	3.17	1.06	9
Post Felt Pressure/tension (subscale)[7]	12.22	2.54	.85	9
Pre Felt Pressure/tension (subscale)[7]	13.00	3.67	1.23	9
Post Perceived Competence (subscale)[8]	38.22	3.07	1.02	9
Pre Perceived Competence (subscale)[8]	38.22	3.31	1.10	9
Post expectancy[9]	50.44	4.56	1.52	9
Pre expectancy[9]	51.22	5.70	1.90	9
Post value[10]	68.90	3.80	1.26	9
Pre value[10]	67.90	4.26	1.42	9

1. Knowledge of game/*RCT3* scored out of 17
2. Knowledge of Economics and Social Studies scored out of 31
3. Transfer – scored out of 10 points

3a. Near Transfer – scored out of 7 points

4. Overall Motivation 25 items with 4 subscales – Likert type scale with a range from 1 to 6
5. Interest – Subscale of Overall Motivation assessment (5 items) - out of 30
6. Value – Subscale of Overall Motivation assessment (8 items) - out of 48
7. Felt Pressure/tension - Subscale of Overall Motivation assessment (5 items) - out of 30
8. Perceive Competence - Subscale of Overall Motivation assessment (7 items) – out of 42
9. Expectancy derived from perceived competence and pressure/felt tension scale
10. Value derived from interest/enjoyment and valuing scale

Table 22: *Match Paired t-tests Analysis for Goal Seekers on Knowledge Test*

Source	*df*	*t*	*p*	*d*	*δ*
Pre-Post Knowledge of Economics & Social Studies	8	-2.92	.02	.60	.86
Pre-Post Knowledge of *RCT3*	8	-2.98	.02	.68	.65
Pre-Post Transfer	8	-1.35	.21	.42	.36
Pre-Post near Transfer	8	-1.51	.17	.42	.48

Note: *p < .05. **p < .01

Table 23: *Match Paired t-tests Analysis for Goal Seekers on the Motivation Assessment*

Source	*df*	*t*	*p*	*d*	*δ*
Pre-Post Overall Motivation	9	-.08	.94	.03	.71
Pre-Post Valuing	9	-.60	.57	.20	.86
Pre-Post Interest/Enjoyment	9	-.24	.81	.13	.88
Pre-Post Felt Pressure/Tension	9	.70	.51	-.25	.55
Pre-Post Perceived Competence	9	.00	1.00	0	.74
Pre-Post Expectancy	9	.57	.52	-.15	.71
Pre-Post Combined Valuing	9	-1.59	-.52	.25	.25

Note: *$p < .05$.

Goal Seekers: Competitors

Analysis of video taped and participant observation, interview data, and log-sheet data indicates that 56% or five of the *goal seekers* were classified as *competitors*. On a normal week, they averaged 6hrs 48mins of video gaming. This group of *goal seekers* was focused on beating other players and racing to complete the game. They were interested in the game and had interest in the content, especially in managing money and making decisions about their business. Nonetheless, they were mostly focused on

completing the game and less focused on exploring to understand problems they may have had in their park, which was secondary to game objectives. 60% of *competitors* completed all of the scenarios in the study while the other 40% completed one scenario.

Table 24: *Descriptive Statistics for Knowledge test and Motivational Assessment for Competitors*

Competitors	Means	S.D.	Std. Err	N
Post Knowledge *RCT3*[1]	15.40	2.61	1.17	5
Pre Knowledge *RCT3*[1]	14.00	2.35	1.05	5
Post Knowledge Econ & Social Studies[2]	20.40	3.36	1.50	5
Pre Knowledge Econ & Social Studies[2]	18.80	3.11	1.39	5
Post Transfer of disciplinary knowledge[3]	6.40	.89	.40	5
Pre Transfer of disciplinary knowledge[3]	6.40	.89	.40	5
Post Near Transfer[3a]	5.40	1.34	.60	5
Pre Near Transfer[3a]	5.00	.71	.32	5
Post Motivation to play and learn[4]	121.20	8.56	3.83	5
Pre Motivation to play and learn[4]	122.20	5.22	2.33	5
Post-Interest (subscale)[5]	27.80	2.49	1.11	5
Pre-Interest (subscale)[5]	26.00	1.23	.55	5
Post Value (subscale)[6]	42.00	2.74	1.23	5
Pre Value (subscale)[6]	42.00	2.35	1.05	5
Post Felt Pressure/tension (subscale)[7]	12.20	2.59	1.16	5
Pre Felt Pressure/tension (subscale)[7]	14.20	4.55	2.04	5
Post Perceived Competence (subscale)[8]	39.20	2.28	1.02	5
Pre Perceived Competence (subscale)[8]	40.00	1.23	.55	5
Post expectancy[9]	51.40	4.51	2.02	5
Pre expectancy[9]	54.20	4.60	2.06	5
Post value[10]	69.80	4.87	2.18	5
Pre value[10]	69.00	2.00	.89	5

1. Knowledge of game/*RCT3* scored out of 17
2. Knowledge of Economics and Social Studies scored out of 31
3. Transfer – scored out of 10 points

3a. Near Transfer – scored out of 7 points

4. Overall Motivation 25 items with 4 subscales – Likert type scale with a range from 1 to 6
5. Interest – Subscale of Overall Motivation assessment (5 items) - out of 30
6. Value – Subscale of Overall Motivation assessment (8 items) - out of 48
7. Felt Pressure/tension - Subscale of Overall Motivation assessment (5 items) - out of 30
8. Perceive Competence - Subscale of Overall Motivation assessment (7 items) – out of 42
9. Expectancy derived from perceived competence and pressure/felt tension scale
10. Value derived from interest/enjoyment and valuing scale

Table 25: *Match Paired t-tests Analysis for Competitors on Knowledge Test*

Source	*df*	*t*	*p*	*d*	*δ*
Pre-Post Knowledge of Economics & Social Studies	4	-2.14	.10	.49	a
Pre-Post Knowledge of *RCT3*	4	-2.06	.11	.56	.93
Pre-Post Transfer	4	.00	1.00	.00	.14
Pre-Post near Transfer	4	-.78	.48	.37	.35

Note: a – no variance within group to compute power

Table 26: *Match Paired t-tests Analysis for Competitors on the Motivation Assessment*

Source	*df*	*t*	*p*	*d*	*δ*
Pre-Post Overall Motivation	4	.30	.78	-.14	.56
Pre-Post Valuing	4	.00	1.00	.00	.98
Pre-Post Interest/Enjoyment	4	-1.37	.24	.92	.68
Pre-Post Felt Pressure/Tension	4	1.58	.19	-.54	.70
Pre-Post Perceived Competence	4	.75	.50	-.44	.04
Pre Expectancy	4	2.26	.09	-.62	#
Pre-Combined Valuing	4	-.79	.48	.48	.11

Note: # too few cases

On the knowledge test competitors did not significantly gain disciplinary knowledge and skills, and they did not transfer the knowledge. Competitors did not significantly value the game and content (See Tables 25 and 26). Despite no statistical significant findings for areas of disciplinary knowledge, skills, transfer knowledge or valuing of the game and content, interpretive analysis from interviews, observations and log-sheets indicated that *competitors* learned the content, valued it, and transferred it.

Competitors: Navigating Strategies in RCT3

Competitors' main strategies for progressing through the game were all related to getting to the next scenario by any means. They were achieving, but their explicit goal was mainly to beat other participants. They played solely to meet the game objectives and goals and did not do much exploration except when they faced problems that they could not ignore because the problem had to be solved in order to reach the next scenario. For instance, in Box Office, the fourth scenario, RCT316 was competing with RCT305 to see who could complete all the scenarios first and had difficulty in figuring out how to keep his park clean. One requirement in this scenario was that a VIP who had low tolerance for dirty parks was visiting, and it was the owner's job to ensure that the park was kept clean. He did not want to explore to find different ways or amenities that could keep his park clean, such as placing bathrooms and garbage bins, or design his park as *explorers* did by placing high nausea rating rides away from food stalls to reduce vomiting. Instead, he hired an overwhelming number of janitors who began cleaning his park, but most quit before the park was in a condition to please the VIP. He did not advance past the scenario before RCT305 (see Figure 11). This resulted in RCT305 completing all the scenarios before RCT316. RCT316 then began exploring and found out that his janitors quit because there was not enough work for all of them to do, so they got bored and quit. In addition, he was not paying enough money for them to be happy. He also learned by seeking help that he could have placed garbage bins and done other things, but he did not want to explore to discover those amenities and tools because that was not his strategy.

This group of participants was good at getting guests to do what they wanted and this helped them to progress quickly. They would always build platforms for queues to rides so that guests could line up. They adopted this strategy from parks they visited in the real world and said it allowed for large numbers of guests to wait in an orderly way for a ride. They employed another strategy of starting with low prices at popular rides, and when the queue became long they increased the prices significantly. They exploited a design flaw in the game in that the guests tend to stay in line if they were there before the prices went up (see Figure 9). This strategy helped these participants to progress quickly through scenarios because they were able to gain large sums of cash to spend on buying rides and other park attractions or amenities, such as bathrooms or souvenir stalls, though their park values suffered because their parks were usually not well kept, and rides were usually not very reliable. They developed knowledge of gameplay and exploited design flaws in the system in order to be successful. They employed real world knowledge and used the feedback from the game "finances" window to understand profit (See Figure 8).

These participants engaged in a dysfunctional, yet "hard fun" activity of sabotaging each other and other competitors by delaying their gaming. RCT314, RCT319, RCT305, RCT316, and RCT323 usually sat close to each other or walked over to each other's computers, fast-forwarding the game timing feature which sometimes causes park values to decrease and rides to break down (among other problems), or they would try to tell each other false strategies such as "when your VIP enters and does not follow the path you set for her, put her in water, and she will do it next time." This ploy would irritate the VIP and have a negative impact on park value. Park value would decrease and guests would leave the park. *Competitors* had many problems when

working within the two scenarios that required them to meet the needs of a VIP, primarily because they knew little about how to meet the needs of guests, including VIPs. This play strategy hindered all of them as well as other participants.

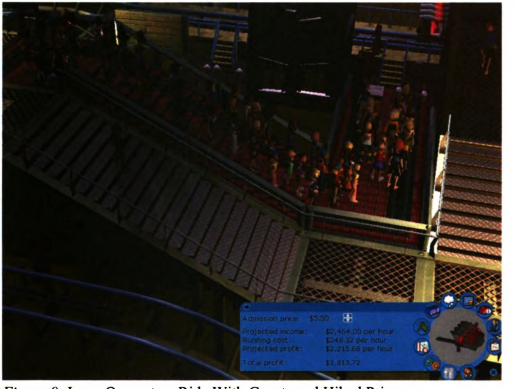

Figure 9: Long Queue to a Ride With Guests and Hiked Prices

Competitors used critical information windows such as the drop-down window with park information, and the game objectives screen with objectives to be met in order to advance past a scenario. Like all the other subgroups, this group used the drop-down screen, but unlike the other groups they used it only for significant problems that demanded immediate attention. RCT305, who completed all of the scenarios before all of the other participants in the study, said that the drop-down window "was my guide, it told me what was going on in my park, but I ignored everything that was not relevant to me for completing the game and fixed the ones where I did not have a choice." RCT305 knew the information from the window was important, but not relevant to be successful

within the rules of the game. He said that his strategy, which he shared with other participants, was good because it was used with "others" and that was the reason he finished the game ahead of everyone in the study. The "others" RCT305 was speaking about referred to planning or looking ahead using the game objectives window before observing and intervening in game actions with the drop-down screen. By observing the objectives and looking at the requirements for all three levels, especially Tycoon status, they realized that rather than working to meet each level requirement one by one, they could aim to meet the requirements of Tycoon status. To meet the Tycoon status, players had to satisfy both Apprentice and Entrepreneur statuses (see Figure 10). For example, an objective at a Tycoon level may ask that participants have 5 rollercoasters of particular ride intensities and lengths, while the two prior levels may ask for 3 rollercoasters with less intensity and a smaller length. Thus by meeting the Tycoon requirements, a player satisfies the requirements for both of the prior levels.

This subgroup of participants with huge sums of cash purchased rides rather than built them because it was more beneficial to them for progressing quickly through scenarios. They had large sums of cash that were accrued because of their pricing strategy. RCT323 said that he was concerned initially in the first scenario about spending too much money on buying rides because it was expensive. He did not want his cash to disappear quickly but when he had accrued large cash sums he spent it to advance because that was what he wanted, even though he liked saving.

Competitors used effective strategies to help their progress through the game levels and scenarios. These strategies helped three of the participants in this group to finish the study first by completing all six game scenarios.

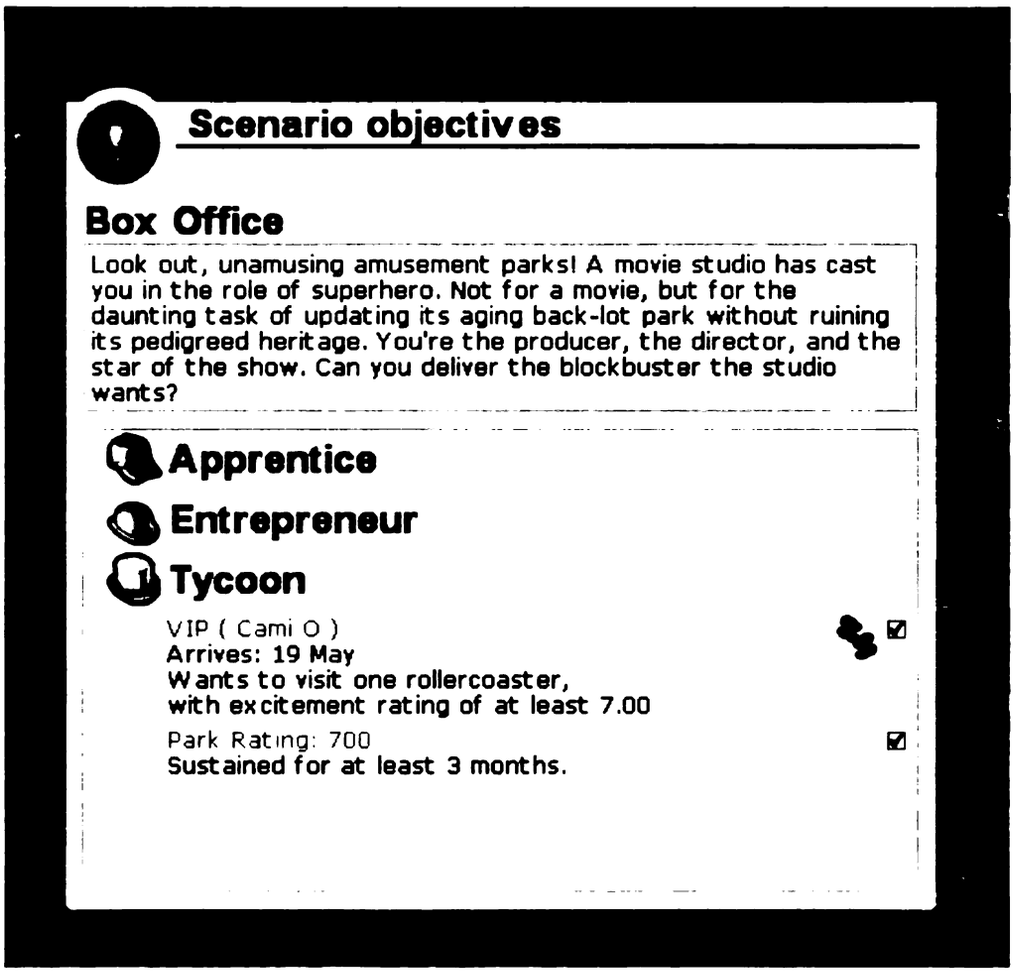

Figure 10: Scenario Objectives to be met by Participants

Competitors included two participants who struggled because of "fun sabotage" as they called it, which was personally destructive as they competed with each other. They tried to sabotage other players, as was the case with the two participants in this subgroup who only completed one scenario each. RCT314 was forced to begin his game at least two times because he tried to sabotage RCT319, and she in turn sabotaged his game by fast-forwarding it and allowing his park value to decrease until eventually he became bankrupt. He began his game again. According to RCT319, "I did not have the patience to again work my way out of that debt, and I wanted to beat the others, so I started over. I fast forward, gain money, but just enough not to go bankrupt, and I still try to sabotage

[RCT319]. It's all fun though." Both players hindered each other's progress while at the same time hindering their own progress because they focused so much on each other and less on their own gaming. The attitude applied by *competitors* to the strategies they employed for progressing through the game was related to their attitude toward the game and content. One evident finding about *competitors* is that they were very social, even if dysfunctional at times. Like *localized explorers,* they could be classified as being extroverts during gaming.

Competitors: Attitudes Toward the School Content and Game and What was Learned

The willingness of *competitors* to beat the other participants allowed them to progress further than other participants but also hindered their chances for exploring the game. This affected their attitude toward trouble-shooting and solving problems that they encountered. For instance, the following is a dialogue between one *competitor* participant and the researcher when the participant asked for help in *Vanilla Hills*:

> Participant: "The high flier is broken down; it's smoking. I need money and they say the maintenance people won't do it. So how do you fix it?"
>
> Researcher: "Perhaps you should explore the game some more and see what tools you can use and what the icons mean. You may also ask one of the other players."
>
> Participant: "I could ask the janitor." – referring to hiring a janitor for his park
>
> Researcher: "Perhaps. But think about who you would go to in real life to fix your car?"

The participant then investigated the icons and learned that he had to go to the "park management" resource in order to employ mechanics and have them work in his

park and not use janitors to fix his rides when they were broken down. The participant was unwilling to explore, but with some urging to investigate, he prevailed. This indicated the attitude toward navigation and influenced their views for testing, trouble-shooting, and exploring. They were focused on getting from one stage to the next. Having mishaps in gameplay was not an option for them.

Participants had insightful learning moments when forced by the game to explore through objectives that required some exploration. For instance, RCT316, like other members in this subgroup, was forced to explore. They provided an opportunity for gaining new knowledge. In one moment, RCT316 was forced to engage in problem solving and thinking about crucial ways to meet the needs of a VIP, if only to move to the next level. He had to learn how to plan the VIP itinerary and ensure the needs of the VIP were met by using the rides and attractions that she liked. After spending one week trying to figure out how to meet the needs of the VIP, RCT316 sought help and eventually learned how to design an itinerary and fulfill the VIP needs. He commented that he valued that experience because he also learned from his peers how to organize his park space more efficiently, though he did not get to beat RCT305. RCT305 and RCT316 were competing with each other to finish first.

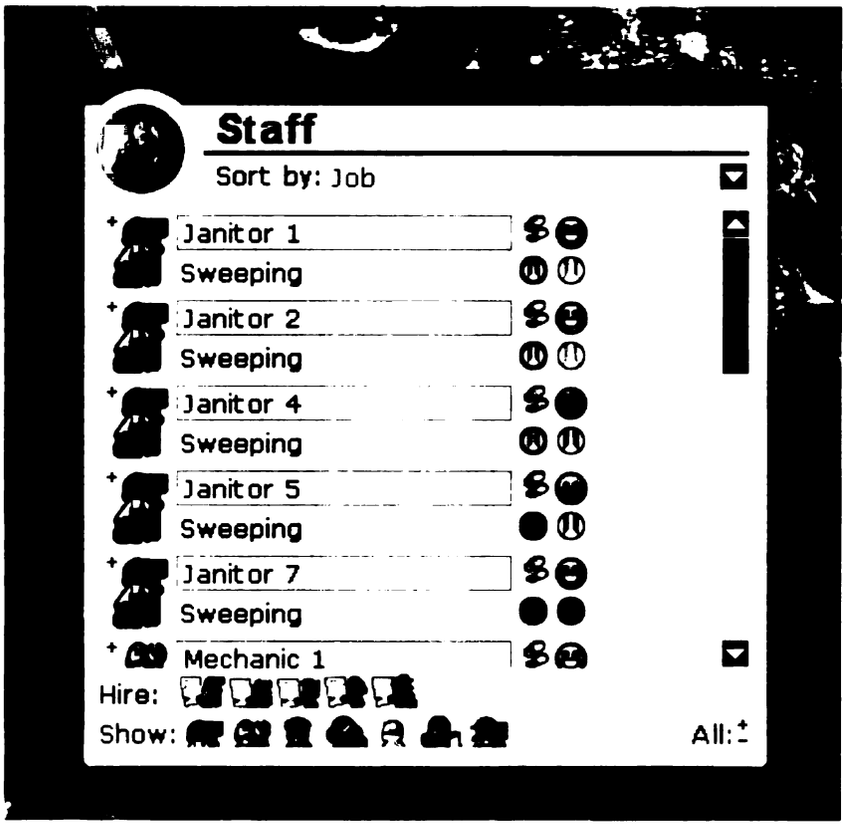

Figure 11: Hiring and Managing Staff Through Park Management

During gaming, participants in the subgroup for *competitors* spoke about how much they liked the realistic nature of the game, such as managing resources and applying their "business minds" to gain money, but acknowledged the unrealistic virtual nature such as disciplining workers to make them happy or hiking prices on guests without thinking about the guests' needs. They declared the game was helpful for them in thinking about other people when making decisions that could affect those people. However, it was not part of their strategy in the game. They considered other participants, who mostly helped guests, as not being focused on the game. *Competitors* also commented that although it may have been a good strategy to help guests and have a better park, their aim was to beat the game and the other participants. This attitude influenced their actions of both ignoring guests and working to try to balance all resources to achieve an optimally operated park, although all the members in this

subgroup said it was not a reflection of what they would do in real life. Thus, not only did participants distinguish between virtual and real life issues, they also indicated that their persona in the game for a specific purpose was not the same if applied to real world similar situations. They exhibited different ethical and social decision making attitudes in this particular situation when taken from virtual to real world contexts.

Competitors valued the opportunity to gain huge sums of cash by exploiting a design flaw in the game. They did not value the points of view of guests unless it meant to meet the game objectives. In doing so, their park value suffered even though they had large sums of cash. Park value is influenced by how well a park is kept in terms of beauty, cleanliness, workers' happiness, types of rides and variety, and ride reliability. These characteristics influence the number of people in the park and eventually how much cash is gained, so when these participants gained cash in another manner, they mostly ignored the guests' point of view. They commented about being aware of the cost of not managing their park completely and that the guests in their park liked it. They explained that business long term was not good, but they were playing to win the game and the long term did not matter. This suggests it is plausible that they valued competition in gaming over exploring and trying to learn the content, though they comment otherwise in interviews arguing that they valued the game and the content. It indicated they were focused on beating others rather than doing other peripheral activities related to exploration. Their understanding of opportunity cost was shown when they explained what they gave up by not exploring, such as marketing and beautiful parks, which were important, but they preferred to be among the first to complete the game.

The lack of exploration may be one reason these participants did not significantly show knowledge gain for disciplinary knowledge, skills, and transfer and did not value the game and content. Nonetheless, interpretively the strategy of the *competitors* to progress in the game did not hinder the valuing of the game and content, and they learned economics and social studies principles such as opportunity cost, supply and demand, and pricing. RCT305, as well as others in the group, showed the ability to focus on relevant information to complete the scenarios quickly, despite being bombarded with information from multiple sources in *RCT3*. Interpretively, they were able to focus, and they acquired disciplinary knowledge, skills, and value of the game and content, though it cannot be ignored that narrow focus may be related to one reason why there was no statistical significance for these variables during quantitative analysis for the group.

Goal Seekers: Achievers

This subgroup of *goal seekers* consisted of 4 participants or 15% of the overall sample that completed the study. 50% or 2 *achievers* completed all six of the scenarios for the study, while between the other two participants, one completed two scenarios and the other three scenarios. As a subgroup they completed more scenarios on average than the other subgroups, thus acquiring more learning opportunities.

Participants in this subgroup tended to focus on beating the game, but they did it for personal reasons, seeking gratification in knowing they were able to accomplish the task. They did not play the game to compete with others. They actively developed their knowledge and skills for finding out the fastest ways to complete scenarios and rarely sought help from other participants except under dire circumstances. They did not socialize much with the other participants during gaming unless they were asked for help

or they needed help. In this sense, *achievers* could be considered to be introverted game players. The knowledge they gained was related to their navigational strategies and attitudes toward working with other participants, the school content, and the game.

Table 27: *Descriptive Statistics for Knowledge Test and Motivational Assessment for Achievers*

Achievers	Means	S.D.	Std. Err	N
Post Knowledge *RCT3*[1]	15.25	3.50	1.75	4
Pre Knowledge *RCT3*[1]	12.75	3.30	1.65	4
Post Knowledge Econ & Social Studies[2]	20.75	5.38	2.69	4
Pre Knowledge Econ & Social Studies[2]	17.50	4.51	2.26	4
Post Transfer of disciplinary knowledge[3]	7.50	1.92	.96	4
Pre Transfer of disciplinary knowledge[3]	6.25	1.71	.85	4
Post Near Transfer[3a]	5.25	.96	..48	4
Pre Near Transfer[3a]	4.75	1.26	.63	4
Post Motivation to play and learn[4]	117.00	5.89	2.94	4
Pre Motivation to play and learn[4]	115.25	9.95	4.97	4
Post-Interest (subscale)[5]	25.50	3.32	1.66	4
Pre-Interest (subscale)[5]	27.00	2.94	1.47	4
Post Value (subscale)[6]	42.25	4.57	2.29	4
Pre Value (subscale)[6]	40.75	4.27	2.14	4
Post Felt Pressure/tension (subscale)[7]	12.25	2.87	1.44	4
Pre Felt Pressure/tension (subscale)[7]	11.50	1.73	.87	4
Post Perceived Competence (subscale)[8]	37.00	3.83	1.92	4
Pre Perceived Competence (subscale)[8]	36.00	3.92	1.96	4
Post expectancy[9]	49.25	4.99	2.50	4
Pre expectancy[9]	47.50	5.00	2.50	4
Post value[10]	67.75	1.89	.95	4
Pre value[10]	69.75	6.55	3.28	4

1. Knowledge of game/*RCT3* scored out of 17
2. Knowledge of Economics and Social Studies scored out of 31
3. Transfer – scored out of 10 points

3a. Near Transfer – scored out of 7 points

4. Overall Motivation 25 items with 4 subscales – Likert type scale with a range from 1 to 6
5. Interest – Subscale of Overall Motivation assessment (5 items) - out of 30
6. Value – Subscale of Overall Motivation assessment (8 items) - out of 48
7. Felt Pressure/tension - Subscale of Overall Motivation assessment (5 items) - out of 30
8. Perceive Competence - Subscale of Overall Motivation assessment (7 items) – out of 42
9. Expectancy derived from perceived competence and pressure/felt tension scale
10. Value derived from interest/enjoyment and valuing scale

Table 28: *Match Paired t-tests Analysis for Achievers on Knowledge Test*

Source	*df*	*t*	*p*	*d*	*δ*
Pre-Post Knowledge of Economics & Social Studies	3	-2.10	.13	.66	a
Pre-Post Knowledge of *RCT3*	3	-2.10	.13	.74	.66
Pre-Post Transfer	3	-1.99	.14	.69	a
Pre-Post near Transfer	3	-1.73	.18	.67	.82

Note: a – too few cases

Table 29: *Match Paired t-tests Analysis for Achievers on the Motivation Assessment*

Source	*df*	*t*	*p*	*d*	*δ*
Pre-Post Overall Motivation	3	-.34	.76	.21	a
Pre-Post Valuing	3	-.73	.52	.34	a
Pre-Post Interest/Enjoyment	3	.59	.60	-.48	a
Pre-Post Felt Pressure/Tension	3	-.41	.71	.32	.50
Pre-Post Perceived Competence	3	-.59	.59	.26	a
Pre Expectancy	3	-.65	.56	.35	a
Pre-Combined Valuing	3	.00	1.00	-.42	a

Note: a – too few cases

On the knowledge test, *achievers* did not significantly gain disciplinary knowledge and skills, and they did not transfer the knowledge. *Achievers* did not significantly value the game and content (See Tables 28 and 29). Despite no significant statistical findings for disciplinary knowledge, skills, transfer of knowledge or valuing of the game and content, interpretive analysis of *competitors'* navigational strategies and attitudes used in the game and the content suggests they had a qualitative understanding of the content.

Achievers: Navigating Strategies in RCT3

The strategies used by the participants in the *achievers* subgroup were mostly similar to those used by the *competitors'* subgroup, with a few exceptions and the similarities were many: a) playing solely to meet the game objectives and goals; (b) starting with low prices at popular rides but when lines were long increasing the prices significantly because the guests tended to stay in line; (c) always building a platform for a long line to a ride so that guests would line up, thus allowing large numbers of guests to wait in orderly lines for a ride; (d) using the drop-down screen only for significant problems that demanded immediate attention; (e) planning ahead using the game objectives window before observing and intervening in game actions; and (f) purchasing rather than building rides.

There were some exceptions. *Achievers* tended to be mostly individualistic game players. They commented about getting more done by not asking for much help, although they would ask questions after each gaming session during group interviews. Also, they tended to fast forward the game in order to gain cash because the game speeds up and guests spend more money per ride (see Figure 12). This helped them to gain cash, but it usually resulted in decreased park values because rides, amenities and other attractions usually developed more problems, and participants were unable to fix them in a reasonable time to prevent their park value from depreciating.

Figure 12: Fast Forwarding Strategy Employed by an Achiever Participant

Nonetheless, participants realized the drawback and rectified it by including more workers when they were about to fast forward. Despite this attempt, they realized fast forwarding did not work well for them. This is exemplified in a statement by RCT326 who commented about fast forwarding the game to progress, "It still did not result in advancing faster through the scenarios than when I played without fast forwarding the game. I lost [park] value, and I had to work harder to save my park in order to meet objectives, my workers quit, my VIPs complained more, my animals escaped from their enclosures more, and it was more problems." These participants knew the drawbacks of fast forwarding the game as a strategy as they indicated when 75% or three of the four subgroup's members shared their knowledge about the affordances and constraints of fast forwarding the game with the other participants during group interviews. However, they did not relent and used it as a way to gain cash in short spurts rather than in the extended periods they had used it prior to knowing about the effects of it. Their approach to progress through the game, like their *competitors* counterparts, was focused on advancing through scenarios and beating the game, and this influenced their attitude toward the game and content

Achievers: Attitudes Toward the School Content and Game and What Was Learned

The initial attitude of *Achievers* believing in their ability to achieve victory by completing all the scenarios to meet their needs while not competing against others influenced their navigational strategies. The choices they made were based on actively deciding how to improve their chances to complete the game for validation. The following illustrates how participants' strategies affected their attitude.

These participants sought help only when their chances for advancing were in dire straits, and were concerned that they could not help themselves to move beyond that problem point. For instance, RCT326 stated that while playing he wanted to prove to himself that he is a good game player because it reflects on the kind of person he is when doing something. He wanted to show that he could play games and learn. Like his counterparts in the subgroup, RCT326 believed that because he was proving something to himself, he should not ask for a lot of help unless he truly did not know how to solve a problem in the game. While RCT326 would ask for some help, RCT318 would not and did not seek help when she had problems helping a VIP in the third scenario, *Checkered Flags*. She said that it was like mathematics, her favorite subject, and that she would spend all the time necessary to solve the problem. They had strong beliefs in their ability to achieve and solve problems. They aimed to focus on both first meeting the game objectives and meeting their personal goals for validation. These participants averaged the least number of hours of video gaming each week, M = 4.25 hr/wk.

Achievers found a way to exploit some affordances of the game by using the fast forwarding feature in short bursts and preventing the drawback of ruining their park value. This is an example of the participants' initial attitude influencing their adopted

strategy. They had an unrelenting attitude for beating the game and that influenced their approach to recognize and modify their initial approach. Initially they had used long, continuous fast forwarding techniques to generate money, but this affected their park value negatively, so they used short bursts of fast forwarding which increased cash and did not affect park value adversely. This enabled these participants and others who learned the technique to reflect on the difference between park value and available cash. One participant, *RCT3*10 reflected on that part of gameplay, explaining that it helped her to understand that cash was "what they have to spend, but [park] value was what the park was worth."

Achievers commented that they were not focused on learning school content in the game, but they valued playing the game and figuring out the best strategies to manage their park to meet the game objectives. Like the other group members, they learned through an iterative, reflective, and risk taking approach, though they did not like making mistakes and often restarted the game during the first scenario before they grasped how to play it. Unlike the *localized explorers*, *achievers* were willing to begin the game again if they made a mistake that ruined their park. They did not cope well with disasters.

Messy borders: Player Characteristics

This study indicates that the player employed navigational strategies that related to *achievers, competitors, localized explorers*, and *comprehensive explorers*; however, this represented the point of view of the researcher. One data collector complicates the analysis even though information was taken from multiple data sources to triangulate the results with statistical analysis. These player characteristics represent the adopted play styles for gaming in *RCT3*. There were times when *achievers* adopted the *explorers'*

style because that was what was needed to meet their needs at a particular stage in the game. For instance, RCT326 changed play to the style of a *localized explorer* after he saw how RCT302 built a beautiful gigantic rollercoaster and he wanted to see if he could do the same. This represented a moment where RCT326 wanted to challenge himself to see if he could achieve what RCT302 was doing.

Players adopted different player characteristics, but once they established themselves with a particular set of player characteristics they remained in that mode. Thus, these player characteristics are generalized snapshots of characteristics that defined how participants played *RCT3* to meet their personal needs and how they competed in the game.

Summary of Results for Chapter 4 and 5

These chapters provided results from six of seven data sources used to examine disciplinary knowledge and skills gained by middle school children as they played the simulation-strategy game *RCT3*. The incremental scenario tests were not used in reporting results because of tests alignment and few participants on each test. Each data source provided answers to several questions:

1. What did the participants learn in terms of disciplinary knowledge and skills?
2. What did participants value, that is have or develop value in the game and content?
3. What strategies did participants use to navigate in the game?

The results were separated in two sections: quantitative and mixed methods results. The quantitative section examined learning and motivation of the overall sample. The mixed methods section examined learning, motivation and player strategies by taking amore

interpretive approach followed by statistical analysis. Qualitative analysis was conducted to examine player strategies for progress using emergent player types after which quantitative analysis was conducted using the player types as groups to examine learning and motivation.

Disciplinary Knowledge

Despite not having any formal education in the basic economic principles participants statistically significantly learned microeconomic principles related to social studies for scarcity, opportunity cost, supply and demand, making ethical and social decisions relating to others, and profit pretest to posttest and across the scenarios during gameplay. They learned these principles through an iterative process of trial and error, taking risks, exploring, observing and then intervening, knowing what objectives they need to meet, setting goals, reflecting on their tasks using feedback from the game, and modifying existing choices during their attempts to meet their needs or other needs related to game objectives.

Information and Technology Literacy

Participants acquired information and technology literacy skills including that of focusing on relevant information. *Comprehensive explorers* used holistic skills to focus on the strategies they employed across the scenarios during gameplay. The other participants focused on particular information as an aid to themselves to play the game in unique ways. *Localized explorers* focused on rides, attractions, and amenities to provide for themselves and their guests. The *goals seekers* focused on information that would help them progress quickly through the scenarios and less on exploring. Participants acquired knowledge of technology including reading and understanding the game

language of icons, symbols, and feedback in order to progress in the game. This is related to the skills of critical thinking and problem solving to make appropriate choices to progress or build rides. They were able to use the information from the game using feedback from guests, park inspectors, and sources within the game with information about rides and workers that needed to be understood in order to progress successfully, or build up a park or ride. They evaluated information critically using feedback from guests or the game tools, creatively modified their parks or strategies to get results geared toward their goals, made their parks run efficiently by managing resources that are scarce, and competently executed their tasks by synthesizing information from multiple sources in the game and from peers.

Motivational Valuing in Game and Content

Participants significantly valued playing the game and the content. Participants entered the study with high interest and perceived competence in gaming and their abilities to do well at gaming to learn disciplinary knowledge and skills. They believed in their ability to play the game and had interest in playing the game because it was about building and managing resources, especially money. They valued the game because it allowed them to pursue their own goals in gaming and meet the needs of guests. It had clear objectives, and they could challenge themselves. Participants also valued the game for other reasons: the strategies they employed in navigating the game impacted their attitude toward the content, they accepted the game as realistic in many ways, and it allowed them to socialize, help others, and meet their needs.

Strategies to Progress

Participants progressed fairly well into the game. 85% or 22 of the 26 participants progressed to at least the second scenario, and 19% or five of the 26 participants completed all six scenarios in the study. Their main strategies for progress through the scenarios included observing actions and intervening based on feedback from the game, iterative process of trial and error to test their hypothesis about progressing, exploring, and meeting the needs of guests by addressing their problems which, in turn helped them to progress, and to plan ahead to focus on game objectives. A number of participants were willing to socialize (extroverts, the *localized explorers* and *competitors*) without being asked to help, and some who were more focused on game playing and only helped if asked or sought help only when absolutely needed (introverts, the *comprehensive explorers* and *achievers*). This combination of students helped participants to develop specific skills while learning and helping others to learn those skills and basic economic principles.

Learning and Navigation

Learning and progress in navigation were related in complicated ways. Both *explorers* and *goal seekers* had significant knowledge gains for disciplinary and skills, though *goal seekers* covered more scenarios than *explorers*. This may be related to both groups playing the game for 6 to 7 weeks. It is logical to infer that playing to accomplish more scenarios to beat the game as well as playing the game while focusing on building rides and attractions or focusing on all aspects facilitated both learning the content and skills. Both *explorers* and *goal seekers* strategies are related to learning in this game; however, neither *explorers* nor *goal seekers* transferred this knowledge significantly. In

addition, *explorers* significantly valued the experience of gaming and learning content, while there was no statistical significant valuing for *goal seekers*.

From the subcategories for both *explorers* and *goal seekers*, none of the *goal seeker* subgroups had statistically significant differences for disciplinary knowledge and skills and transfer. This may be related to the *goal seekers* not exploring much but choosing to use game strategies for progressing quickly through the scenarios rather than trying to learn to play the game as the *explorers* did. *Achievers* and *competitors* completed the most scenarios. *Explorers* had the most opportunities per scenario to learn the content and develop skills because they attempted to learn details about designing and developing rides as well to focus on all aspects of gameplay. *Localized explorers* had statistically significant differences for disciplinary knowledge and skills, but not for transfer. *Comprehensive explorers* did not statistically significantly gain disciplinary knowledge and skills.

Another possible explanation why there were overall differences from pretest to posttest for the two general categories of players, but not for the sub-categories of *goal seekers,* is the small sample size.

Chapter 6

Discussion

This chapter explains the results of the study and discusses them through the lens of literature from educational psychology, games, new media, and technology that relates to learning, especially the claims about games and learning. In essence, it connects the results of the study to the theoretical arguments presented by education and about learning from digital games and technologies.

The chapter is outlined by first discussing learning, player characteristics or types, and motivation in the study and explaining the results with the support of the literature on games, new media, and technology for learning. Second, it highlights some affordances of games and learning in relation to the claimed affordances about games and learning as discussed by Mishra and Foster (2007). Third, it highlights the role of simulation strategy games such as *RCT3* and their implications for policymakers, parents, teachers, game designers, and researchers. In doing so, recommendations are made to each of the parties about how simulation strategy games and virtual environments could benefit as well as hinder the knowledge construction of learners. Finally, it highlights the limitations of the study, acknowledges the presence of bias in the data, and makes recommendations for further study.

What is Learning in the Simulation Strategy Game RCT3?

In this study, which was conducted with a diverse and representative sample, participants were able to gain disciplinary knowledge and skills, transfer it to new contexts, and value the game and content. In constructing knowledge and being

motivated to learn, the intrinsic motivation of the participants, their perceived competence, and their felt pressure/tension experienced were related to learning.

Participants were highly motivated to play games and learn the content of the game, though, there was no significant change in their overall motivation (intrinsic motivation), interest, perceived competence, or felt pressure/tension while playing *RCT3*. Participants did volunteer for the study with the expectation to have fun playing a game suggesting that their initial interest and motivation would have been high, which was the case. This is supported with the high pre-means for these constructs as well as with participants' comments and reactions before gaming and in gaming. Their motivation was high from the outset and did not change significantly in the end. Participants were able to maintain their motivation and interest levels as indicated by post-means scores on those constructs, a positive sign for using the game as an engaging environment to learn disciplinary knowledge related to economics, social studies principles, and skills related to technology and information literacy.

Nonetheless, participants often complained about the assessments that were given. This was expressed in participants' ontological beliefs in their comments that games were not for learning school content because they did not feel the pressure or stress as is the case in formal schools. This is indicated by the subscale measuring pressure which showed a decrease in felt pressure and tension from pre-gameplay to post-gameplay. Participants said it did not feel like learning to them because there was no high pressure or high stakes situation associated with playing the game as in a formal school setting. They said that *RCT3* was hard, but not boring, and they worked hard to be successful at it. The game was complex and multifaceted, and it had low stress and low-

risk conditions for mistakes as indicated by the low felt pressure and tension gaming experience. The affordance of the game for "on-demand and just-in-time information" for learning and game objectives are difficult and frustrating at times, yet engaging to the point where players would not give up and encouraged participants motivation to learn. The game characteristics and affordances for motivation to learn allowed participants to believe that since they were not under stress or in a high stakes situation such as in schools where "failure could have life consequences," they could not construct useful knowledge or learn in the same way as it is in schools. Perhaps high stakes testing and current high stress environments have indoctrinated students to believe that learning can only be done in such environments; however, this study showed otherwise in a simulated-strategy game environment. These participants learned because of their experiences in the game despite their epistemological beliefs about learning.

Research has shown that students have preconceptions about how the world works before they come to the classroom (Donovan, Bransford, & Pellegrino, 1999). Research also suggests learners start to make sense of the world at a very young age, and at the same time begin to form their own views based on experiences about how people learn (Donovan et al., 1999; Resnick, 1987) as shown with these participants' view of what was realistic in the game as well as initially tending toward the view that learning was not possible in games. Many research experiments show the persistence of preexisting understandings (diSessa, 1982; Driver, Asoko, Leach, Mortimer, & Scott, 1994; Greeno et al., 1996; Resnick, 1987). Therefore, teaching has to integrate the preexisting knowledge of learners in order to be effective. *RCT3* accomplished this by connecting to students experiences, such as students exploring the ideas of transfer

through realism and discussing it by way of connecting it to their own lives as well as allowing students to identify with parts of the activities as possible selves which help them to understand. In this study, though participants initially believed they were not learning school content, they came to realize that they had learned much about basic and foundational economic principles and social studies.

The same is true for participants' perceived competence; it was high from the outset, and their experience in the game did not change that belief (See Table 6). They believed in their ability to do well while playing the game and learning, and their beliefs did not change significantly. Participants did not expect to learn social studies concepts and economics, nor to focus on information and technology literacy, even though they knew they were in a study about games and learning. They did not know what content they were expected to learn. This may have been a small part of why there was no statistically significant difference from pretest to posttest for perceived competence. Nonetheless, the 26 participants had no formal education about the basic economics principles, but they statistically significantly learned the disciplinary knowledge and skills, valued playing the game to learn economics and social studies, and they transferred the knowledge to other settings not dealing with games or theme parks.

This is supported by contemporary theories about learning in virtual environments that suggests when students become active learners in constructing knowledge the focus of learning shifts from covering the curriculum to working with ideas (Greeno et al., 1996; Scardamalia, 2000). The participants learned about opportunity cost, trade-offs, scarcity, supply and demand, cost and benefits, making decisions about managing resources, and dealing with ethical and social decisions. They

were able to gain knowledge about some of the affordances of the game navigation and learning such as observation and intervention, trial and error, exploration, and tools for use for developing information and technology literacy skills. Some skills related to creativity and innovation as they built extravagant roller coasters or developed theme parks strategically located to benefit guests or managed information from multiple sources in the game to meet the needs of guests, game objectives, and their personal goals. During gameplay understanding the in-game text and multimodal context was the way to develop understanding of technology and information literacy such as when participants learned to exploit design features such as fast forwarding or using queues as way to aid the generation of income.

In-Game Text and Multimodal Texts Relationship to Learning

Playing *RCT3* requires the reading of texts. These texts came in the form of instructions in on-screen messages and print descriptions of icons and tools. Players used their traditional reading literacy skills to make meaning from these texts. Additionally, the game's design has other types of texts for players to interpret, such as text for relating information or combining information from different media. These include symbols, icons, sounds, and actions, each with its own unique meaning within the game. The players developed skills in technology and information literacy skills to make meaning from these digital texts as part playing the game. Players had to find meaning in these messages to progress in the game either as *explorers* or as *goal seekers*. Gee (2003) refers to this concept as the intertextual principle for relating information, text principle for reading in context, and multimodal principle for meshing information from different media, and it also highlights how the game as a semiotic domain helped participants to

learn. This is also considered as part of the embodied and situated principle of learning in games as participants adopt the goals, values, and attitudes by becoming attuned to the goals of the game to be successful.

Game Genre Relationship to Learning

Learning was also related to the genre's characteristics that emphasized gameplay around the internal aspects of the game using activities with embedded pedagogy, such as building rides, or meeting level requirements through specific goals while using the observing other actions and intervening pedagogy when necessary from a "gods-eye view" third person perspective controlling a microworld. This was one of the dominant types of interaction used by players for progressing within the simulation strategy game. Most participants also realized that in order to be successful in the game, they must manage all their resources equally and not focus on a primary strategy such as building roller coasters. Thus, the participants who completed the most scenarios and had more knowledge gain tried to manage all their resources and also planned ahead by using in-game tools to satisfy more than one requirement at a time. Successful participants were able to manage land space, money, workers, and time, and ensure they provided a variety of different levels of excitement and intensity rides for park guests while also meeting the needs of VIPs and their personal goals. They used the tools of the game to manage the content around theme park building, which had economics and social studies principles embedded in the gameplay.

Player Characteristics and Progress in Gameplay

In this study there were two general player types, *explorers* and *goal-seekers*. *Explorers* had two sub-categories *localized explorers* and *comprehensive explorers*.

Goals-seekers also had two sub-categories, *competitors* and *achievers*. *Explorers* had statistically significant findings indicating growth in disciplinary knowledge and skills as well as in valuing the game and content. There was no statistically significant difference for transfer (See Tables 12, 13 and 14). *Localized explorers* had the highest knowledge gains and scores among all the groups. There was a statistically significant difference in their acquisition of knowledge for disciplinary knowledge and skills (See Tables 15, 16, and 17). There was no statistically significant difference for motivational valuing or transfer. Interpretive analysis suggests that *localized explorers* valued the game and content and that they progressed mainly by being gaming extroverts as well as by focusing on their personal goals, not the given game objectives. *Localized explorers* were very helpful and talkative; they were empathetic to both in-game characters and their peers. This may be related to helping them learn during their social interactions and understanding more about the game. They focused on developing and designing rides and attractions. There goal was to be the best at building a ride or attraction. They were not concerned with beating the game. *Comprehensive explorer*s showed no statistically significant difference in acquiring disciplinary knowledge, motivational valuing, or transfer (See Tables 18, 19 and 20). Interpretive analysis suggests that they progressed by focusing on all aspects of gameplay. *Comprehensive explorers* focused on developing a comprehensive understanding of the game and were not focused on beating the game. Beating the game was secondary for them. They were also empathetic to in-game characters and only gave help when other players asked. They were gaming introverts because they did not interact much with participants unless asked.

Goal-seekers had statistically significant findings in the area disciplinary knowledge and skills; however there were no statistical significant findings for valuing the game and content as well as for transfer (see Tables 21, 22, and 23). For *achievers* there were no statistically significant findings for growth in disciplinary knowledge, skills, transfer, or valuing of the game and content (See Tables 24, 25 and 26). Interpretive analysis suggests that they progressed through the game by focusing on beating the game for personal achievement. They focused on the objectives of the game and were not concerned with in-game character needs. They focused on exploiting the design of the game to advance quickly through the game. They were considered gaming introverts because they did not socialize much with other participants. The *competitors* indicated no statistically significant finding for disciplinary knowledge, skills, transfer, or valuing of the game and content (See Tables 27, 28, and 29). Interpretive analysis suggests that they progressed through the game by focusing on beating the game and demolishing other players even it meant "fun sabotaging." They were considered gaming extroverts since they were very social in talking to their peers about strategies to meet their needs and also in talking about fake strategies to slow down their peers.

The emergent groups in this study had similarities and differences with past research player types. Heeter's (2009) player types included explorers, achievers, lost, and careless player types. Heeter's (2009) achiever player type would match with *goal-seekers* who played the game fastest to complete it. Heeter's (2009) explorers and lost players match well with the *explorers* in this study. In particular, lost player types could be considered *localized explorers* who appeared lost because they were focused solely on designing and developing and not advancing through the scenarios. They were not

focused on the game's objectives. They had their personal goals. They also played the slowest. *Comprehensive explorers* matched well with Heeter's explorers as they aimed to play holistically and were the next slowest in advancing through the RCT3 scenarios.

For Bartle's (2006) player types, *competitors* would match up well with Killers. An exception is that *competitors* were gaming extroverts, socializing even to promote their play and doing "fun sabotage" with other players. *Localized explorers* would match well with Bartle's *explorers* as they explore the game's inner workings by focusing on building rides and attractions aiming to be best builders. *Comprehensive explorers* also explored the inner workings of the games aiming to comprehensively develop their park and developing their understanding of all aspects of the game. *Localized explorers* were gaming extroverts who were social and empathetic to their peers and in-game characters, while Bartle's explorers were more interested in the game than in socializing. *Goal-seekers* including *achievers* and *competitors* had many of the characteristics of Bartle's achievers where both groups aimed to beat the game. However, *achievers* socialized with peers only when asked and they rarely sought help. Achievers were game playing introverts whereas *competitors* would socialize even if it was "fun sabotage" or giving fake strategies.

From research in motivation on the goal and achievement theory, from a learning progress perspective *explorers* were mastery-goal oriented. For mastery orientation, the students sense of satisfaction comes from the work and is not influenced by extrinsic factors such as scores or grades (Ames, 1992; Grant & Dweck, 2003). It is associated with deeper engagement and perseverance in the face of set-backs (Ames, 1992) . *Explorers* had an intrinsic mastery motivation orientation with their focus on self

achievement and personal goals for success rather than the games objectives determining success for them.

Performance goal orientation defines students as focused on external goals, such as scores and grades, to validate their success (Ames, 1992; Grant & Dweck, 2003). Extrinsic motivation was evident with the *goal seekers* who were focused on meeting the games objectives bottom line for profit or outcomes. *Competitors* were a performance-goal oriented group. Achievers were also outcome goal oriented in wanting a good grade or to do well by the game standards (Grant & Dweck, 2003). In addition, competitors displayed antisocial behavior. Performance goal orientation ability validation goals in gameplay are defined by the achievers (Grant & Dweck, 2003).

Motivational Valuing

The participants who struggled from the outset valued the task, but lost hope that they could complete all the scenarios, though they believed that success for them was in building rides, developing and beautifying theme parks, and catering to the needs of guests. In the game, success meant completing the scenarios and specific tasks for being a Tycoon. Participants who struggled or who did not want to meet the objectives of the game for being a Tycoon coped with struggling to meet their goals of designing and building. Therefore all the participants had personal success at playing the game whether completing the six game scenarios of the study or working within a single scenario. For all the participants, struggle and frustration occurred regardless of their play strategies or characteristics. The value of the activity and the belief that they would be successful at it even though it was hard and frustrating at times made participants cope with the task. They were successful in the end to achieve their personal goals and for some, the game

objectives. Participants found the activity relevant and meaningful. In a study about peer interaction for designing a robot in a science learning activity Rowell (2002) showed that students valued their efforts more when they assumed the identities of the professionals who design robots. In this research, participants could relate parts of themselves to activities such as managing money or making decisions as a future entrepreneur, and this made them recognize it as being useful to them for fun, for learning, and for possible selves, what they would like to become or not become (Foster, 2008; Markus & Nurius, 1986).

Based on analysis from sources in this study, learning was related to several factors: 1) participants valued the activity as being relevant and meaningful, 2) participants worked with each other to solve problems, 3) participants consulted peers or information sources, 4) participants saw themselves as able to be successful, 5) participants related to the activity, that is seeing the activity as connected to characteristics they have now and would like to have in the future, and 6) participants saw the activity as being low stress, hard, and frustrating at times, yet engaging with supports that enabled learning at the right moments to help them move on. In addition, the genre of the game influenced the primary pedagogy of activity-based learning using observation and intervention, and participants saw themselves as controlling a whole world. This allowed participants to have the perceived belief that they could determine the outcome of the activity. Both the internal aspects of the game (the content) and the external aspects (the ways of seeing, believing, acting, interacting, and thinking within the domain) helped participants to better understand basic and fundamental economic

concepts and social studies knowledge and develop information and technological literacy skills.

Not only did participants develop content knowledge, but they developed their ability to think critically and solve problems. *Localized explorers* were able to evaluate and discuss what was real in the game and what elements could be transferred and applied to real world situations, such as how to spend money and how to decide what is important for their personal needs. They were able to explore and work on problem-solving on a single issue for longer periods of time than participants who chose to be more objective/goal seekers. On the other hand, *competitors* believed that many of the strategies used in the game would not change if they applied the same principles to the real world, such as consistently hiring and firing workers or by hiring high numbers of workers to get things done quickly. They believed the same principle could work in the real world, and they could hire and fire people without regard to resources and workers feelings. *Competitors* and *comprehensive explorers* also took real world beliefs or knowledge and applied them to the game and were successful. Thus, *competitors* believed that the same must be true if you used principles learned in the game and applied it to the real world without modifications. This form of thinking is justified considering the purpose of well designed learning games; however for many games today, naïve understandings can easily develop as it was in this case with two groups of participants playing *RCT3,* which was designed for entertainment. In this study, the naivety could have been due to the lack of familiarity with economics principles and social studies content in the game or the lack of understanding by participants. In any case, it was possible for the game to reinforce or enable the development of naïve

understanding in this context about the applicability of principles from games to the real world and vice versa. For these participants, it was their first time working with basic and microeconomics principles and applying them in a learning context. Thus, it is possible that with more familiarity in situations, such as in their parks or with similar contexts, the participants could have been enabled to make more committed statements about using what they learned in the virtual environment in much the same way that the *localized explorers* did. Clearly, it is not only a matter of time spent playing the game, but more a matter of what is focused on while playing the game.

While *competitor* participants were less specific about what could be applied from the real world or from the game world, they had the ability to focus on important details to meet game objectives versus trying to focus on everything as did the *comprehensive explorers*. The consequences of this was that based on the incremental scenario tests *comprehensive explorers* learned more disciplinary knowledge, game knowledge as technology literacy and information literacy, while *competitors* had more transfer knowledge. This may indicate that the multiple scenarios allowed more context and chances to see how principles are applied in different contexts and more chances to transfer despite fewer chances to develop disciplinary knowledge.

The Big Picture: RCT3 and Learning

Many researchers agree that learning is possible from games, but identifying just what players are learning and whether it is related to academic performance is less clear. This study took a step towards addressing this problem in assessing learning in games. In this study, learning was characterized by doing (Schank, Berman, & MacPherson, 1999), and constructing knowledge through gameplay in gaming as part of the actions of

learning the game and advancing through levels and scenarios, consistent with the situative perspective. Through goal-based scenarios in the simulation-strategy game, participants pursued a goal by way of a mission to practice certain skills and using the relevant content knowledge required to achieve their pursued goal.

According to the National Research Council (2005), science processes are more often assessed by asking students to define words such as "hypothesis" and "scientific method." However, knowing the definitions of these words is not synonymous with understanding the processes. Further, game scholars argue that when players go through the iterative process of probe, hypothesize, reprobe and rethink, they develop an understanding of the scientific process (Gee, 2007a; Steven Johnson, 2005). *RCT3* and games of the simulation strategy genre do not explicitly teach students by showing basic microeconomics or fundamental economics principles and concepts, but through playing, students come to understand these economics processes, which is more important than being able only to memorize the definition of these principles and concepts. This moves students beyond developing inert knowledge (Whitehead, 1929) and towards being able to transfer knowledge more competently. With the original knowledge gains from the game, participants understood information from the game and learned the content sufficiently to transfer it (Bransford & Schwartz, 1999). Participants were able to statistically significantly transfer knowledge from *RCT3* to non-game settings. This is because when participants play games, they have the potential to become active participants in shaping their game role and actions and are more likely to develop their knowledge from schemas which makes the information more salient, relevant, and meaningful.

The participants said that they did not view playing a game to learn school content as being the same as learning in school. They said that school learning is associated with high stakes testing such as standardized tests, where if they fail their lives may change. In games, they can take risks, make mistakes, and learn in an enjoyable and engaging way, even if it is frustrating and hard. Thus playing *RCT3* is related to changing students' valuing of the disciplinary knowledge and enabling positive knowledge construction experiences because it allows students to take risks, be innovative, control their learning, and work in a relatively low pressure and low stress situation.

Lave and Wenger's (1991) situated learning theory offers a connection between the social aspect of a person and learning, supporting the idea that knowledge is constructed through participation in a social process. The idea of learning in games whether it is by using *RCT3* in a naturalistic social setting or whether it is alone in a room or online in MMORPGS fits the view of Lave and Wenger's (1991) and the situative view of learning (Greeno et al., 1996; Phillips & Soltis, 1998) including embodied cognition (Barab, Bransford et al., 2007) and offers a connection between the social aspect of a person and learning, supporting the idea that knowledge is constructed through participation in a social process. Mentoring and apprenticeship is the idea of helping other less knowledgeable players to build or work through a problem, learning about those participants being helped, developing a better understanding of the subject being taught, and learning new skills and content. It was mainly experienced by *localized explorers* more than any other subgroup, though all the participants benefited from the social learning and discussions after every game session.

The Field: RCT3 and Education

In accordance with the view of many educational researchers that emphasize connecting cognitive theories of learning with game and simulation based environments, the software or technology was designed to identify learning goals that are clear and authentic, make thinking visible, encourage autonomy, and scaffold learning (Linn, 1998; Vye et al., 1998). Though the game was designed to be focused on building and operating a theme park, it was through the design of the study to focus on disciplinary knowledge and skills that helped support the learning of the content and skills areas assessed. Further, *RCT3* covers many of the standards on the National Educational Technology Standards (International Society for Technology in Education, 2000a), meets Bruce and Levin's (1997) taxonomy for what technology should allow students to learn, and it meets the NCEE standards for basic and microeconomic principles geared for students in upper elementary to middle school. This is not to say that it is without imperfections as clearly it is possible that without sufficient guidance and scaffolding in the content areas, learners/players could develop naïve understandings.

Finally, this study using a simulation strategy game that well represents the genre showed that the claimed affordances of games are indeed related to learning by shaping attitudes, affecting behavior, and influencing understanding (Foster & Mishra, 2009; Mishra & Foster, 2007a). In addition, the study showed that within the psychological scheme for the claims of games related to learning, participants were able to maintain their motivation and develop cognitive, practical, and social skills (Mishra & Foster, 2007a).

Individuals who play video games engage in rapid and complex interaction of self-regulatory, motivational, and goal directed behaviors. The way individuals regulate their cognitive, affective, and behavioral psychological processes while playing video games relates to their abilities to cope with the onslaught of information that video games require for their mastery. The ability to self-regulate is directly related to the students' motivation, player characteristics (explorers versus goal seekers), engagement, experience, and emotions.

Recommendations

This dissertation is one of the first of its kind to use a mixed-method and naturalistic approach to examine learning with games. Based on the results of this study, there are several implications or recommendations that could be made for learning from games or designing games for learning. These recommendations affect teachers, researchers, policy-makers, designers of games, and parents.

Learning from Games: For Teachers, Researchers, Policymakers and Parents

In *Experience and Education*, Dewey (1938) spoke of students learning from situations that are connected to their experiences. Dewey went on to say that traditional educational curriculum is rigid, ignores individuality and the child's interests and capacity while new education ignores the past and welcomes individual interests, capacity, experience and freedom. For Dewey (1938), a combination of the two types of curricula was needed. Simulation strategy games, such as *RCT3,* combine these two types of curricula. It is rigid with its rules, yet it values individual differences, interests, capacities, and experiences with various avenues to success using one set of learning objectives while teaching students during gameplay. This is a humanistic perspective; it

combines traditional education curricula with modern education which recognizes and attempts to embrace various cultures that represents the diversity of the world. It has serious implications for enhancing students' interest and learning in multiple disciplines and content areas in and out of school settings. *RCT3* and games of the sort allows participants to see various aspects of themselves in gaming activities by way of role-playing and allowing individual interests to grow through possible selves.

Based on this study's results, it is recommended that school environments utilize some of the affordances of *RCT3* and games of the genre to enhance learning and motivation to learn, while reducing the perception of being a high stakes and high stress testing environment making students believe that learning should always be de-motivating and stressful. There is no reason why schools cannot be both an environment that nurtures students' interests while simultaneously assessing knowledge gains in engaging ways. In *RCT3*, gameplay and knowledge construction was hard, but not de-motivating. Participants committed themselves to being successful at it and were not afraid of the difficult and sometimes frustrating task. This is what Papert (1997) referred to as hard fun: enjoyment derived from a challenging but meaningful learning experience, or as Gee (2003) said, an experience "that is or should be both frustrating and life enhancing" (p. 6). The complexities of the game, the perceived stress-free and low-risk conditions, the scaffolds or "on demand and just-in-time theories" for learning (Gee, 2005a), the challenging yet doable and engaging activities made participants value the task, cope with the tasks, and remain amenable to learn the disciplinary knowledge and skills afforded by gameplay. Importantly, they perceived the activity as relevant and meaningful and being neither high stress nor in a high stakes situation as in schools. This

would help students to be more open to engage in activities that may require high stakes testing but may promote a positive experience that honors the humanistic perspective. As it is now, students perceive school learning as high stakes testing in high stress environments.

It is also recommended while enacting these affordances in virtual worlds, that careful consideration be made to reduce the chances of students developing naïve understandings of the disciplinary knowledge that relates to virtual worlds and the real-world. Participants constructed knowledge and skills, but they also displayed some naïve understanding about what strategies or principles they applied in the game that could be applied as is in the real-world.

For teachers it is important for them to play games to get closer to students and to help them determine the genre and usefulness of games as their learning goals. This would also help them to use the best available pedagogy to guide students in learning before choosing a game to support a concept they are trying to teach. In the game, the interactivity dictates pedagogy, and some pedagogy are better than others depending on the nature of the content to be learned.

This study highlighted the power of mixed-methods, multidisciplinary studies, and innovative assessments to better understand learning during gameplay. It is recommended that future studies continue to develop the incremental scenario tests which attempted testing for knowledge at natural breaks after levels or scenarios to get an incremental knowledge gain in disciplinary knowledge and skills.

Designing Games for Learning

It is also evident that situated learning when viewed through embodied cognition has implications for transfer knowledge. In this study, multiple scenario coverage allowed for more contexts and opportunities to see how principles are applied in different contexts. Participants played the game for up to 7 weeks and this may have had some impact in developing a better understanding of disciplinary knowledge and skills and transfer. Thus, it is important for researchers and designers to provide multiple scenarios for players to engage in play and that these scenarios focus on learning goals. This is crucial because it also provides an avenue for which designers could build games that do not take much time to play and learn, but are still challenging and engaging.

In addition, the process of learning considering player characteristics, play styles and motivation orientations should also be considered when thinking about designing games for learning. Player characteristics and motivation orientation is related to how players play games and playing the game is how the process of learning takes place.

For both designing games and learning from games or virtual worlds, it is recommended that researchers and designers focus on the genre of the game to determine the type of interactivity that is best for players to play and learn at the same time. The genre of the game is an indicator of the game designer's design stance and can be useful in determining the kinds of choices for interactions, representations, the nature of choices and progress in gameplay. These can be seen as an implicit pedagogical approach with implicit learning theories.

Research on Games for Learning

For research on game-based learning in education, researchers should focus on game genres and disciplinary knowledge. This is supported by work from researchers such as Mishra and Koehler (2006), who argue that any integration of technology in education should consider the relationship of pedagogy and content. The simulation strategy genre dictated game play and hence the pedagogy of the game. Therefore, it is recommended that designers and researchers provide gaming environments that utilize activity based scenarios, focus on learning goals, and combine content and pedagogy seamlessly. More research is needed to explore the nuances of game genres and disciplines in games and learning. In addition, more research is needed to explore activity based scenarios games for gameplay in classrooms and gameplay outside of classroom for longer play times.

The purpose of this study was to examine learning in games using a representative simulation strategy game. The study used one game and had favorable results based on the methods used to address the research questions. It should be replicated and expanded. For future studies, the researcher may use more than one game to represent different genres in order to explain learning in games from multiple genres. The researcher may also examine gender differences in genres while refining the methodology employed in this dissertation. In this study, the researcher found that the incremental scenario tests could be effective, but they require better design to have test alignment.

Another step to be taken is to examine games in the classroom. This would be done for two reasons: 1) in this study students stated that learning in schools was high

stress and high stakes, and 2) to better evaluate games and current education curricula. The researcher plans to write grants to the NSF to start researching and designing games or virtual worlds for learning science from the humanistic perspective. Clearly this game was not designed for use with school curricula; however, it gave insight into how researchers could better understand what characteristics are needed when designing a game for use with the school curricula for any given content area.

Limitations of Study

Like all research, there are several key limitations to note. The study was seven weeks long and qualifies as one of the first longitudinal mixed-methods studies on game-based learning; however, had it been done over a longer duration, the results would have been more conclusive. The study started with 30 participants and concluded with 26. It would be quite beneficial if the study had more participants for quantitative purposes. The pragmatic paradigm of this study (trying to find out what works), dictated that its aim was not to provide universal claims about games and learning. Rather, it sought to examine the claims about learning and game from one representative game of the simulation strategy genre to better understand the role of games in learning within similar games.

This study used one game, but it could easily be expanded to use more than one game of different genres to get a better effect of the genres and games on learning. One game was used rather than multiple games to investigate what works to address the gaps discussed in game-based studies. Thus, the study was not comparing games or game genres. More games with different genres will be studied later. Additionally, the resources within the dissertation such as the duration of the study, the cost of buying

more than one game for a good sample of children, and the required time for one person doing the comprehensive analysis needed for data generated from the study using the discussed games and learning approach made it difficult to examine more than one representative game. One game allowed the researcher to examine how learning occurred with a comprehensive and systematic focus on game genre, pedagogy, and content using the games and learning approach.

The collection of data external to the game changed the notion of typical gameplay because it was not the same as students playing in their basements or data being collected/logged by the game during gaming. The study attempted to be as naturalistic to a typical game playing setting as possible by capturing much of the essential social elements of gameplay when people play together freely, and play whatever way they choose. Test data was collected at natural game intervals, such as after scenarios, and this did not change or interfere with normal gameplay actions.

In addition, in Study 2 the researcher was an observer. Hayes (1992) argues that participant observers are usually visitors because they only come to observe and this causes a researcher effect since they are not insiders, and there is no expectation of loyalty from participants. Hence, they influence the results of the study in that participants may behave differently before them because there is no trust or loyalty expectations (Hayes, 1992). This effect was minimized in this study by the unobtrusive video observation of participants. Also, the researcher spent seven weeks with the participants in nonthreatening situations getting to know them and interacting with them.

One researcher collected data. Ideally having more than one researcher would provide different perspectives on the data and inter-rater reliability. From an executive

view of the overall study, acting as a moderate observer and an interviewer in Study 2, and as a participant in Study 1 is not the most valid way of doing research for some research paradigms (Adams St Pierre, 2002). This could have impacted the validity of the study because the researcher could have been tempted to be biased in getting good results, or the participants may have felt like they had to answer in a certain way to provide the researcher with what he desired. Thus, the researcher was vigilant to be objective and critical. In addition, participants were blind to the content for which the researcher was looking; their assumption was they played the game to learn. However, playing all three roles by the researcher allowed for the researcher to get a comprehensive and reliable view of the big picture as well as to focus on the details for interpretation. It also allowed participants to develop trust with the researcher and reduced reactivity or participant effects (Hayes, 1992). This does not detract from the fact that as interviewers, researchers tend to interpret what participants tell them through their own lens, which paints the world from the researchers' point of view (Johnson, 2002). Thus, being the researcher, moderate observer, and participant in Study 1 who has played the game helped the researcher to draw upon his personal knowledge and experience to present as authentic as possible a representation of what participants experienced and said. This perspective is supported by Johnson (2002), who argues for in-depth interviewing and researchers implicitly drawing upon their stock of knowledge to present the views of participants.

Finally, the study did not have inter-rater reliability. This may have impacted the overall results; however, the researcher deliberately provided multiple and competing

data sources for triangulating information that would giving some assurance of qualitative findings during the coding for ground theory and content analysis.

Summary of Acknowledgement of the Presence of Bias in Data

The interview questions and other assessments were written by the researcher and reviewed by consulting faculty members who have experience in creating assessments and content knowledge to help reduce bias. The results of the interviews, observations (video and participant), log-sheet data, and background survey were compiled, organized, and analyzed, and in each case the researcher was careful to reflect on the actions and intent of participants while taking into considerations his own views; however, the writing of the questions and the selections and organization of the results inherently, but unintentionally involves researcher bias.

Conclusions

Games-based learning is a contested terrain with both proponents and opponents arguing about the benefits of games for learning. The findings of this study indicate that learning of core disciplinary ideas from games is possible. However, it is a complex process dependent on player type, and the nature of game play. Thus, one benefit of games is to use it to enhance disciplinary knowledge in motivationally valuing ways.

This study can inform the design of better games for learning and suggest ways in which such games can be integrated into the curriculum. The framework used in this study can influence decision makers and researchers about selecting and designing games for learning. This study is an example of how to focus on games, content, and genres. It used a well known technological framework for integrating technology into curriculum or content and pedagogy (see TPACK.org). Teachers can use it to identify which games

such as *RCT3* would be most appropriate for their classroom in integrating the game as technology into their curriculum (match their learning objectives).

This research supports the arguments for mixed methods research on learning from media. It also provided a comprehensive view of assessing games for learning by highlighting the power of interdisciplinary research using theoretical ideas from media studies, education, and psychology.

Finally, this study showed that despite students' doubts regarding learning "school" content through play, participants developed their knowledge in core economics concepts as well as skills with technology. The combination of quantitative and qualitative analysis of data allowed us to develop a richer conception of just how this learning occurs and the kinds of player characteristics that support learning. Future research needs to build on these findings to develop a more comprehensive understanding of how these powerful digital tools can enhance learning.

Appendices

Appendix A

Affordances for Learning in RCT3

This chapter reports the results from study one – the game analysis done by the researcher in deciding to use *RollerCoaster Tycoon 3: Platinum* (*RCT3*) and determining its affordances for learning disciplinary knowledge (economics and social studies) and skills (information and technology knowledge). The researcher played *RCT3* and analyzed its content and pedagogy within the limits of the game technology to determine the affordances for learning disciplinary knowledge and skills, including social studies, economics, information literacy, and technology literacy. In previous chapters, the researcher outlined the rationale, purpose, literature review and the TPACK framework, and methodology for the study. This chapter reiterates some of the information in the literature review and method sections because it reports results from preparatory work to support those sections using the TPACK framework.

Before choosing the game, the researcher played the game for more than six months, read and made notes about basic microeconomic and foundational economic principles, and read information about *RCT3* relating to its genre, content, and popularity. In addition, the researcher consulted an economics professor who was knowledgeable about the Tycoon series of games with the following general questions in mind: What level of economics and skills are possible to be learned in the game, and what type of questions could be asked to assess knowledge of what students learn about economics and social studies in the game? After the data was analyzed by contextual and

content analysis, the researcher definitively selected the game *RCT3* because of the following reasons:

1) The Tycoon series of games is popular and representative of its genre,
2) It has a good mix of disciplinary knowledge with gameplay,
3) The game has an "E" for everyone rating so children can play it,
4) The simulation strategy genre is very popular in the computer game industry,
5) It caters to both boys and girls via gameplay.

The analysis also aided the researcher in determining an appropriate methodology and assessments for the study.

This chapter is organized by first describing *RCT3* followed by results of the analyses of the content of *RCT3* (primarily economics, social studies, mathematics, and information and technology literacy) and pedagogy (how the game genre allows play to proceed and players to learn). There is also a brief description of the game technology (description of the game's structural elements such as levels, icons, interactivity). Though these three components are described separately, they do not operate that way in the game. In fact, it is the game technology (as used here) that interacts with the simulation strategy genre to determine the pedagogy of the game.

About RCT3

The computer game *RollerCoaster Tycoon 3: Platinum* (*RCT3*) was released on November 7, 2006. It is the latest economic simulation strategy game in the *RollerCoaster Tycoon* series of games which were first designed and developed by Chris Sawyer in 1999 (Sawyer, 1999). Overall the *RollerCoaster Tycoon* series has seen three major games in the series due to its popularity as indicated by sales units. These titles includes *RollerCoaster Tycoon (RCT)* – 1999 (Sawyer, 1999), *RollerCoasterTycoon 2* –

2002 (Sawyer, 2002), and *RollerCoaster Tycooon 3* – 2004 (Frontier Developments, 2004). Each major title spawned expansion packs that were sold as individual games. Overall there are 13 titles in the series with the most recent being *RollerCoaster Tycoon 3: Platinum* which was released on November 21, 2006 (Frontier Developments, 2006). It includes a combination of *RCT3*, which has all the elements of previous RCT games, including new 3-D views of the games, as well as everything from the expansion packs of *Soaked!* – a water park building theme park game - and *Wild!* – a safari-type theme park building game. *RCT3: Platinum* gameplay combines everything from *RCT3*, *Soaked!* and *Wild!*

RollerCoaster Tycoon 3: Platinum was chosen to be used in this study for several reasons. First, it is representative of the other games within the simulation strategy genre such as *Civilization IV* in that it requires an observation and intervention level of interactivity. Second, it is also in a very popular genre as indicated by game sales. According to the Entertainment Software Association (2006; 2007), in 2005 and 2006 the strategy genre of games was the best selling computer game genre, accounting for over 30.8% and 35.4% respectively of the market-share for computer games sold. The percentage of games sold indicates the popularity of the genre. Third, the 'E' for everyone rating of *RCT3* places it in a rating category which accounted for most of the games sold in 2005 and 2006 at 53% and 55% respectively. For the year 2005, the year of relevant statistic based on when the title was released (late 2004), *RCT3* was ranked 5th in overall sales for the number of units sold (Entertainment Software Association, 2006). In addition, it was the only 'E' game ranked in the top five for computer games sold in 2005. Other simulation strategy games in the top five were *The SIMS 2* and *The*

SIMS 2: University expansion pack (Entertainment Software Association, 2006). The top five ranking within a genre that accounted for one-third of the computer games sold in 2005 illustrates the popularity and representativeness of the game with game players. Fourth, the game combines disciplinary knowledge of economics and social studies, and skills including information literacy and technology literacy with gameplay in order to achieve its objectives and eventual goal to build and operate the business of theme parks. It does this without saying explicitly to children that they will be learning economics, social studies, information literacy, and technology literacy. Basic physics principles and mathematics may also be learned while playing the game. This is important because children tend to disengage from games that are explicit in their objectives to teach about some educational content (Laurel, 2003). Fifth, the game caters to both genders because it does not have explicit violence, except for rollercoaster disasters in crashing. It requires players to be empathetic and consider the needs of guests in their park. *RCT3* does not have explicit scoring to measure player performance so both genders may feel at ease in a non-competitive atmosphere. The game tries to simulate a realistic experience and in doing so it places the player in a role as a real human being managing resources and also as a virtual player building in a virtual theme park. These are characteristics that tend to appeal to girls because of the more realistic role and to boys because of the more virtual role. Heeter et al., (In Press) argue that characteristics such as empathy, little violence, no explicit measuring of performance, and having both realistic and virtual roles appeals to both genders in computer games.

The aim of the game is to complete objectives and scenarios while redesigning or building the best amusement park and generating as much profit as possible while

managing other resources such as time, money, workers, and land space. The design and building of the theme park is directly related to game knowledge including technology literacy and information literacy skills. Learning how to play the game, understanding the content, and applying the content is related to knowledge of profit, cost-benefit, opportunity cost, scarcity, supply and demand and pricing. Learning by doing in managing the resources and redesigning or building in *RCT3* requires balancing constraints and affordances in the game while working within a particular scenario.

The game like others in the simulation strategy genre allows players to control whole systems and make decisions about how to manage the system (the virtual world). In *RCT3*, players control the theme park from managing resources, training, disciplining workers, building rides, and trying to maintain a beautiful and clean park by adding amenities while also entertaining visitors and VIP's. Players can design their own theme park with rollercoasters and other rides or they can modify existing parks and purchase existing rides developed from research. Players must also meet the needs of guests visiting their park by building facilities such as food stalls, drink stands, ATMs, information booths, bathrooms, benches and many more amenities. Central to the game is that players must manage their resources (time, land space, money, and workers) and balance their budgets in expenses and income. Players must also consider the affordances of their designs of rides with respect to the in game (virtual ecological) needs as dictated by terrain, space, and available money. In addition, they must meet their personal needs in how they want to design the park and they must also satisfy guests' needs for a certain level of excitement, park type, food, ride intensity, etc. They may also allocate money for

research to develop rides, attractions, and other amenities. They may also do advertising or run marketing campaigns in order to publicize the park and rides.

Technology: RCT3 game

RCT3 is a computer-based economic simulation strategy game for building amusement parks. It has a steep learning curve in the beginning because it requires players to deal with game objectives (see Tables 30, 31, and 32) while trying to understand gameplay tools which have many visual elements. These include: 1) navigating with the use of a computer mouse and keyboard, 2) focusing on a computer screen which has many icons and symbols that each have more icons when clicked (See Figure 4). Each icon represents either a tool or a gateway to many more tools for building or getting information about your theme park. 3) It requires players to quickly grasp the game content in order to be successful. 4) The gameplay changes from scenario to scenario because of different game requirements such as objectives, in specific visual settings (see Tables 30, 31, and 32) but navigation is the same. While gameplay visual information and/or objectives may change, the game is still soliciting the same type of psychological or physiological skills over and over, but with increasing complexity within each scenario. For instance, it requires continual tinkering (trial and error) to figure out how to use the terrain tools, or building waterfalls, or thinking about satisfying guests and yourself while meeting game objectives. The thinking and tinkering required for these processes builds critical thinking skills and problem solving skills as well as design and creativity skills. These skills are required in every level and scenario of *RCT3* but with various objectives. This is what Gee (2003; 2007) calls cycles of expertise, a necessary precursor to enhancing or developing creativity and other skills.

There are 18 scenarios in *RCT3* and each has three levels – Apprentice, Entrepreneur, and Tycoon. Only the first six scenarios were used in this study. The six scenarios used include *Vanilla Hills, Gold Rush, Checkered Flags, Box Office, Fright Night*, and *Go With The Flow* (see Tables 30, 31, and 32). In all of the scenarios, players start in a theme park with a certain amount of money, which they must use in the park to generate more money by adding rides and satisfying the needs of guests in various ways such as keeping the park clean, providing enough food, meeting their ride wants, and setting prices. The aim is always to build the best park in terms of value – park ratings, park profit, number of people in the park, beauty of the park, ride reliability, efficient workers, and prizes or achievements depending on the requirements of the scenario.

Table 30: *Description of Vanilla Hills and Gold Rush Scenarios and Level Requirements*

Vanilla Hills	**Gold Rush**
The *Vanilla Hills* are the starting point on your meteoric – or not – rise to RollerCoaster Tycoon status. Can you turn this plot into the peeps talk of the town? Your rating as Apprentice, Entrepreneur, or Tycoon depends on it.	Now's your chance to hit paydirt by using this unstable, abandoned mining area to showcase low-rise coasters. Over time your coasters must start to make up in adrenaline what they lack in height to keep your claimed stake with the visitors.
1. Apprentice a. Guests in Park: 400 Condition can be achieved at any time b. Minimum park value: $20,000.00 Condition can be achieved at any time	**1. Apprentice** a. Minimum excitement: 3 i. Two coasters b. Minimum Length: 1000.66ft i. Two coasters c. Total Monthly ride income: $300.00 Condition can be achieved at anytime
2. Entrepreneur a. Guests in park: 500 Condition can be achieved at any time b. Minimum park value: $60,000.00 Condition can be achieved at any time	**2. Entrepreneur** a. Repay loan Condition can be achieved at any time. b. Total monthly ride income: $500.00 Condition can be achieved at any time.
3. Tycoon a. Guests in park: 600 Condition can be achieved at any time b. Minimum park value: $100,000.00 Condition can be achieved at any time	**3. Tycoon** a. Minimum excitement: 4 i. Three coasters b. Minimum length: 1213.91 ft i. Three coasters c. Total monthly ride income: $700.00 Condition can be achieved at any time.

Table 31: *Description of Checkered Flags and Box Office Scenarios and Level Requirements*

Checkered Flag	**Box Office**
Formula RCT has made a pit-stop in town! It's not going to be easy taking this crowd for a joyride, but put the pedal to the metal and go for a spin anyhow. Don't forget to buckle up!	Look out, unamusing amusement parks! A movie studio has cast you in the role of superhero. Not for a movie, but for the daunting task of updating its aging back-lot park without ruining its pedigreed heritage. You're the producer, the director, and the star of the show. Can you deliver the blockbuster the studio wants?
1. Apprentice a. VIP (Clint Bushton) i. Arrives: 16 May – wants to visit one rollercoaster, with excitement rating of at least 4.00 b. Total monthly shop profit: $100.00 Condition can be achieved at anytime	**1. Apprentice** a. Park Rating: 300 i. Sustained for at least 1 month b. VIP (Cami O) i. Arrives: 7 May ii. Litter Tolerance: Low
2. Entrepreneur a. VIP (Clint Bushton) i. Arrives 25 July – wants to visit one rollercoaster, with excitement rating of at least 5.00 b. Total monthly shop profit: $150.00 Condition can be achieved at anytime	**2. Entrepreneur** a. VIP (Cam O) i. Arrives: 19 July ii. Breakdown Tolerance: medium b. Park rating: 500 i. Sustained for at least 2 months c. Total monthly shop profit: $100.00 Condition can be achieved at any time
3. Tycoon VIP (Clint Bushton) a. Arrives 13 May – wants to visit one rollercoaster, with excitement rating of at least 6.00 b. Total monthly shop profit: $200.00 Condition can be achieved at anytime	**3. Tycoon** VIP (Cami O) a. Arrives: 8 October b. Wants to visit one rollercoaster with excitement rating of at least 7.00 c. Park Rating: 700 i. Sustained for at least 3 months

Table 32: *Description of Fright Night and Go With The Flow Scenarios and Level Requirements*

Fright Night	**Go With the Flow**
Forget about haunted houses and costumed characters, because cheap thrills just don't scare the teens in this town. You'll need to give them something they can really scream about – like roller coasters that would scare the hair off a werewolf.	Get ready to cool off. Put your park-building skills to work in this watery wonderland to create a park worthy of this spectacular setting – and one that can soak up as much cash from your guests as possible. It's sink or swim!
1. Apprentice a. Minimum excitement: 5 i. Two coasters b. Minimum length: 524.93 ft i. Two coasters c. Total monthly ride income: $200.00 Conditioned can be achieved at anytime	**1. Apprentice** a. Minimum park value: $15,000.00 i. Sustained for at least 1 month. b. Total monthly ride income: $100.00 Conditioned can be achieved at any time
2. Entrepreneur a. Minimum excitement: 6 i. Two coasters b. Minimum length: 1017.06 ft i. Two coasters c. Repay Loan Condition can be achieved at any time	**2 Entrepreneur** a. Minimum park value: $30,000.00 i. Sustained for at least 2 months b. Total monthly ride income: $200.00 Condition can be achieved at any time
3. Tycoon a. Minimum excitement: 7 i. Two coasters b. Minimum length: 1509.19 ft i. Two coasters c. Total monthly ride income: $600.00 Condition can be achieved at any time.	**3 Tycoon** a. Minimum park value: $45,000.00 i. Sustained for at least 3 months b. Total monthly ride income: $300.00 Condition can be achieved at any time

Pedagogy: How does the game teach players and facilitate navigation

Pedagogy, the principles and methods of teaching, in a video game is connected to the genre of the game. The video game genre dictates the interactivity, which is the way the game, is experienced (Apperley, 2006). Researchers contend that the classification of video game genres by interactivity is a good method because video

games have very specific objectives (learning goals) that a player tries to complete, and thus, also have specific interactions, which the player carries out (Apperley, 2006; Wolf, 2001). The intentions of the player are often clear and can be analyzed as part of the game (Wolf, 2001). Wolf argues that video games objectives provide the motivation to play when combined with the various forms of interactivity within a game. A game may fall into multiple genres because the interactivity of the game may be divided into steps with multiple objectives, which influences the fit of the game in various classifications or genres. Thus, due to different actions and multiple objectives in video games, a game may straddle more than one genre.

RCT3 combines simulation and strategy genre features. In addition, it is often described as an economic game. This describes the nature of the content of the game; however, simulation strategy describes the nature of the interactivity, part of the way the game is experienced.

Being an economic simulation strategy game, *RCT3* also falls under the broader genre of strategy games, which consists of turn-based strategy (TBS) games such as the *Civilization* series (Briggs & Johnson, 2001; Soren Johnson, 2005; Meier, 1991; Reynolds, Caspian-Kaufman, & Briggs, 1996) and real-time strategy (RTS) games such as *The SIMS*. In addition, it has some simulation characteristics. Pure simulations try to create real world representations. They are based on a system of expertise development as in many games such as *RCT3*; however, they do not contain rules that guide exploration such as in games. They allow players to make mistakes, but they do not provide immediate feedback about the mistake until the simulation indicates (visually or aurally) that certain desired results are not achievable because somewhere in the progress

of play an error was made. Where the error was made is often not clear and must be discovered by the user or player. *RCT3* does not provide immediate feedback on all decisions; rather, it allows players to progress whether or not a player is making choices that will allow him/her to progress to a new level and scenario. The game, however, does give feedback on mistakes in that if an objective is not fulfilled, a player cannot advance to a new level. Players get this feedback clearly in the game by not advancing. It is also clear to players what goals they should meet to achieve objectives and eventually pass levels (Apprentice, Entrepreneur, and Tycoon); however, it is not clear about the processes involved in achieving these objectives. Therefore, players must learn about the game and the content and how best to solve problems (objectives in RCT3) during gaming.

Caldwell (2004) in his theoretical analysis of TBS games asserted that RTS games and TBS are similar and belong in the same genre as they share a lot of the same characteristics, including similar aesthetics, a general god eye-view and a tendency towards photorealistic depictions. Apperley (2006) asserts that gameplay in strategy games is associated with expert play. He contends that expert players contextualize relationships between certain values within the game world to get the best outcomes, while beginner players are engaged with the play of the game on the level of response. That is, they do not strategize much; rather, they proceed by responding to actions in the game – at the basic observing and intervening pedagogy. That said the genre is also activity based around observation and intervention. That is, simulation strategy games are characterized by visual cues that draw attention in their visual aesthetics (For example, see Figure 13). Rather than facing a constant barrage of information such as in

first-person shooters , players monitor a situation waiting for something that will require their intervention while all the time contextualizing relationships and developing expertise in the game. The level of interactivity in simulation strategy games and their visual aesthetics are the two main elements that characterize the genre and promote gameplay.

Figure 13: Some Visual Cues That Draw Players' Attention While Observing

Players may also plan ahead as a game playing strategy by looking at the requirements for all the levels and then building and satisfying Tycoon level requirements. This may allow players to progress faster through the game since satisfying Tycoon requirements usually means you will also have satisfied Apprentice and Entrepreneur requirements. For instance, to satisfy Tycoon requirements in *Gold Rush* (see Figure 14) a player must build extra rollercoasters that are longer and with higher excitement levels. Thus, by planning ahead, a player may satisfy both Apprentice

and Tycoon requirements. This speeds up their progress. Expert players may plan ahead rather than only play by observation and intervention methods. Time, in terms of speed of building the rollercoasters, is important in *Gold Rush, Checkered Flags* and *Fright Night* because players are given a lot of money at the beginning, but the money is quickly used up on other needs by the game's artificial intelligence to help run the park. Thus, looking ahead and building rollercoasters (usually expensive) saves players time and money. Satisfying these requirements can allow players to learn about the importance of using land space wisely in placing or building rides in good locations and at the same value time and money.

Figure 14: Scenario Objectives for Gold Rush, the Second Scenario

Interactivity in *RCT3* allows progress in the game via an immediate or delayed feedback system in achieving game objectives. The game teaches players in subtle ways, such as when a VIP visits a player's park. If the player did not fulfill the objectives set out to satisfy the VIP, *RCT3* provides immediate feedback to say that "you failed to satisfy the VIP," and you will be given another opportunity in a year (April to November in the game) or the next month. In cases where players are building rides and doing landscaping, the game provides immediate feedback with visual cues that indicate if the ride is completed and in working condition or if the land has been deformed by creating small hills, valleys, or undulating surfaces that disconnect walking paths. In both cases of building rides and landscaping, instructional feedback is given in actions that adversely affect the value of a park and the speed of play in the game. For instance with a ride that is not completed properly, the game tells you it cannot be opened for riders. Three color coded circular visual icons provide feedback on ride readiness (red indicates completed but not ready to be open, yellow indicates you are getting there but some essential part of the ride is still missing, and green indicates the ride is ready to be open) (see Figure 15).

Figure 15: Three Colors Coded Circular Visual Icon for Opening and Closing Rides

In other cases, such as when a player is suppose to generate a certain amount of total sales per month from shops and stalls, let's say $200, if a player cannot find the best way to provide the conditions to get that amount in sales each month, the game does not provide help or feedback. The player must instead engage in problem-solving such as through actions in exploration and/or trial and error until the problem is resolved. That is, the player must use land space wisely to build shops in optimal locations in the park (front vs. rear of park) and ensure that there are a lot of people in the park to purchase goods and services. In order to have a lot of people in the park, the player must have a significant number of rides and other amenities to support a large number of people in a park. Thus, the player must progress through several stages of play in order to meet the objective of $200 in shop sales. This is the sort of play process and approach that is required for each objective and level in *RCT3*. It is in these moments of solving game problems that students are able to learn about supply and demand, the importance of a

good location, scarcity, opportunity cost, pricing, the parts needed to run a system, and managing resources such as time and space. They also have the opportunity to develop information and technology literacy skills through game knowledge.

Table 33: *Example of Analysis of Scenarios*

Vanilla Hills	Gold Rush
Apprentice Level: increase number of rides and company cash which will increase park value and guests in park – requires managing the given $10,000 which includes a $5000 loan at 3.9%/yr by making decisions that will affect the number of patrons in the park and park value. Decisions such as the types of ride- **several smaller ones or one big expensive and exciting ride.** Managing workers, their training and wages; Research, ride ticketing, food and drink sales and stock, loan interest. Patron attitude, park cleanliness, number of workers, loan interest and ride reliability may be overlooked because reaching the goals here is easy with main focus on increasing number of rides and placing food and drink stands.	Apprentice Level: no paid workers: Under $12,000 with $1000 loan at 10.9%/yr. Given three rides including one rollercoaster. Given just under $12000, the level can be achieved by building or buying a rollercoaster from the available ones in the library that are over 1000ft long and have an excitement level of at least 3. More research increases the number of available rides and park tools. By increasing ticket prices for rides, monthly ride ticket sales will go up. Workers will have to be employed and paid. This affects ride reliability, and park cleanliness and value. Food and drinks will have to be provided. **What happens if they are not provided since they are not required to fulfill achievement?**
Entrepreneur level: Same as Apprentice – reiteration of skills but with increased complexity. Taking into consideration ride value, food value, park cleanliness, ride reliability, patrons' attitudes, and ride reliability. More patrons mean more trash in the park – increase budget for park maintenance and amenities - more janitors. More rides means more mechanics, more payment for salary, need for more food and sanitary conditions (bathrooms, bins), better looking park means more patrons and receiving good awards. Bad looking park and also a chance to receive negative rewards. Manage workers attitude. React to patrons views about the rides and your decisions enhance the park value.	Repaying the loan can be achieved easily, but this decrease available cash. **How does repaying a loan affect what you can do in your park? How does it affect available cash?** Increasing the number of rides and the ticket prices will increase monthly ticket sales and money. Good rides
Tycoon level: Same as entrepreneur - reiteration of skills but with increased complexity	Tycoon level: Same as Apprentice level - reiteration of skills but with increase complexity

Table 34: *Example of Possible Economics and Social Studies Concepts to be learned within a Scenario*

Scenario	*Vanilla Hills*
Apprentice Level:	opportunity cost, scarcity (cash), cost-benefits, competition (rides), trade-offs
Entrepreneur level:	opportunity cost, scarcity (cash), cost-benefits, competition (rides), trade-offs
Tycoon Level:	opportunity cost, scarcity (cash), cost-benefits, competition (rides), trade-offs

A crucial pedagogical tool in *RCT3* is the icons or visual aesthetics. Icons play a crucial role as part of video games technology due to their symbolic and interactive nature. They are symbolic because they represent some action or give meaning to an action. For instance in *RCT3*, on the left of the screen is a long list of icons that represent different doorways to tools or information for use in the game such as a Ferris wheel icon that symbolizes or means "rides." It also gives meaning to the action of building rides when thought of in the context of the purpose of *RCT3*.

The interactive nature is based on a feedback loop. In this regard, icons are not only symbolic, but they support or scaffold information via feedback. For instance, the interactive drop down window has icons to the left of the textual information that give hints about what needs attention in a theme park (see Figure 16). The icon to the left of the textual information, when clicked takes you to the location of the park that needs attention or requires fixing. The icon also shows up in the bottom right corner with available tools that gives access to it to be fixed. The textual information tells the player the nature of the problem. The combination of the technology with pedagogy (textual hints, trial and error, exploration, observation and intervention combining with icons that when clicked take the player to area of need) helps to promote a better understanding of the gameplay and content. This may influence players' development of knowledge while playing the game and their speed of progress in the game. Speed of progress should be

important because it gives players a chance to have more exposure to different game content and possibility to learn in multiple contexts.

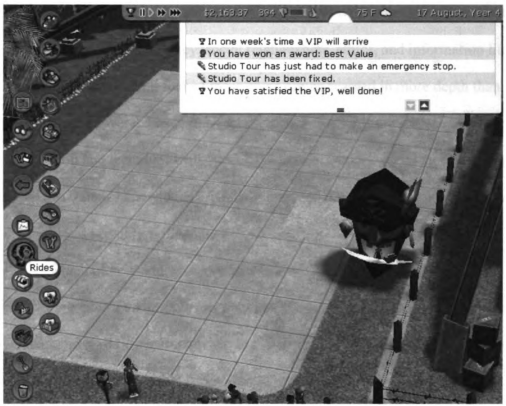

Figure 16: Icons on Left of Screen and Drop-down Screen Provides Information to Guide Players

Interactivity and visual aesthetics individually aid in teaching players about the game, but when combined they provide a very crucial genre characteristic that influences the pedagogy of the game. Gee (2003) describes the pedagogy of the game as being embedded in the design of the game. Observation and intervention is a major pedagogical approach that is a result of the genre of the game that dictates the pace of the game and visual aesthetics enhances the play. The pace and visual aesthetics drive the interactive nature – observe and then intervene or strategize in planning ahead before a problem occurs or to anticipate future needs of guests or to satisfy some design need of the player.

Content and Skills

Content in *RCT3* spans a wide range. It includes information about rollercoasters, business, economics, social studies, capitalist ideals of buying and selling, mathematics, physics, technological literacy, social relationships, ethics, and information literacy. Analysis has shown that four of these areas can be learned in more depth than the others. The four which were chosen to be focused on include economics, social studies, and information and technology literacy skills. Economics and social studies are referred to as the disciplinary knowledge areas, while information and technology literacy are referred to as possible skills to be gained in gameplay.

Much of how and what is possible to be learned was discussed under the preceding topic - *Pedagogy: How does the game teach players and facilitate navigation.* Content and skills are learned when applying strategies to navigate and play the game. Much of the economics that is possible to be learned in *RCT3* are microeconomics principles, such as supply and demand or scarcity. Social studies encompass knowledge of economics including production, managing resources, and helping young people making informed decisions. *RCT3* is a production-economic focus game based on managing resources such as money, time, workers, and space.

Information literacy encompasses being able to evaluate information critically, creatively, efficiently, effectively, and competently. Technology literacy encompasses knowledge about creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem-solving, and decision-making; digital citizenship; and technology operations and concepts. Thus, both overlap and can be learned as a part of gameplay and developing game knowledge.

APPENDIX B

Examples of the Claims about the Affordances for Games and Learning

"Computer and video games can let students learn using the techniques of communities of innovation – ways of learning that stress immersion in a practice, supported by structures that lead to expertise, professional-like skills and innovative thinking" (Shaffer & Gee, 2005, p. 11).
Proficiency at game may afford players a temporary sense of mastery, control, and achievement" that was previously found lacking.(Mitchell & Savill-Smith, 2004, p. 8)
Violent video games increase aggressive cognition, physiological arousal, and aggressive behavior and affect and decrease prosocial behavior (Anderson & Bushman, 2001; Carnagey & Anderson, 2004).
Simulator games can help in the development of all intellectual abilities and *a mind for machines"* (De Aguilera & Mendiz, 2003, p. 11).
Videogame playing empower players in a way that translates into real world activism (civic activism) (Williams, 2004).
"Heavy use of computer games is associated with negative rather than positive outcomes in terms of academic achievement, self-esteem and sociability" (Roe & Muijs, 1998, p. 1).
"Computer games and simulators enhance learning through visualization, experimentation, and creativity of play. Increased learning occurs by problem solving in a complex interactive multidisciplinary environment and by "seeing" causal relationships between individual actions and whole systems" (Betz, 1996).
"Gaming in general is associated with introversion, lower empathic concern and low feminine identity" (Griffiths & Davies, 2002, p. 379).
"Good games *already* possess the major components necessary to meet the needs for sound instruction as outlined by both Gagné and Gardner" (Becker, 2005, p. 2).
"Game users are no more likely than non-game users to be involved in risk-taking behavior" (Bosworth, 1994)

APPENDIX C

Background survey

Please answer the below questions to the best of your ability and as completely as you can.

Name:_____ ID# RCT3____ Date:_____

1. Gender: M ___ F____
2. How old are you? _____
3. What grade are you currently in? 5____ 6____
4. Do you use a computer at home? Yes __ No ___
5. What sort of media do you have in your household?

   TV__
   DVD/VCR___
   MP3___
   Video Game (Xbox, Nintendo, Playstation)____
   Cell Phone____

6. How many hours do you read books each week?
   1-6 hours ____
   7-10 hours ____
   11 or more hours____

7. Name **3** of your favorite books

   _____

   _____

   _____

8. Do you play games (computer, video, and arcade)? Yes ___ No_____
9. How many hours do you play games each week?
   1-6 hours ____
   7-10 hours ____
   11 or more hours ____

10. What types of electronic games do you like to play?-

    _____

    _____

    _____

    _____

11. Name your three favorite games
    1)_____
    2)_____
    3)_____

12. Does your family have rules that limit your daily use of your computer and game playing? If Yes (go to 13, If No go to 15)
    Yes _____, No_____

13. What rules does your family have to limit your use of computer and game playing?

    _____

    _____

    _____

14. If you have rules, how strictly are they followed?

    _____

    _____

    _____

15. When you play games, do you normally play alone or with others?
    Mostly with others____
    Sometimes with others____
    Mostly alone____

16. Have you ever been to an Amusement/ Theme Park?
    Yes _____
    No_____

17. Which subject has been your favorite in school? _____

18. Please check all of the topics you have been taught in school.

Social studies_____	Addition & Subtraction _____
Economics_____	Multiplication & Division _____
Reading _____	Percentage & Fraction_____
Internet_____	Computer & Technology_____

19. What do you like doing in your spare time?_____

    _____

    _____

20. What would like to do as a career when you become an adult?

    _____

APPENDIX D

Knowledge assessment

Name:_____ ID# RCT3____ Date:_____

Ride	Cost to Build a Ride	Maximum Riders per hour	Actual Number of Riders	Cost to pay for a Ride	Current income per hour	Projected income at full capacity per hour
A	$5000	150	150	$4.00	$600/hr	?
B & C	$5000	300	200	$3.00	$600/hr	?

Look at the chart above. It describes two choices that can be made about building new rides at a theme park. Ride A has a longer duration for a ride than Ride B and C, allows 5 riders per turn and is more popular, but costs more. Rides B and C are two moderate level rides which accommodates more riders than Ride A and are less popular.

1. Give or list 4 reasons using evidence from the chart why Ride A could be chosen?

_____
_____
_____
_____
_____

2. Give or list 4 reasons using evidence from the chart why Rides B and C could be chosen?

_____
_____
_____
_____
_____

3. Which ride would make the most money per hour at full capacity?

   A. Ride A
   B. Ride B
   C. Ride C
   D. Ride B and C

4. What is the best way to increase the value of a theme park?

   A. add more expensive rides to gain money in the short term
   B. delete expensive rides to get quick money
   C. add more food and drinks option to satisfy park visitors
   D. add more park facilities and less expensive rides with more capacity

5. You are the owner for a theme park and some people who visit your park prefer bigger and very exciting rides that cost a lot of money to buy or build. What kinds of ride would be most beneficial to build if 60 of every 100 people in the park prefer to pay for cheaper and moderately exciting rides while the other 40 prefer to pay for bigger, very exciting, and expensive rides?

    A. Smaller, moderately exciting, and cheaper rides
    B. Bigger, very exciting rides, and expensive rides
    C. Bigger, moderately exciting, and cheaper rides
    D. Smaller, very exciting and expensive exciting rides

6. If you are the owner of an amusement park, identify the most beneficial thing that should be done if the patrons were not happy with the cost of a ride?

    A. Make the ride more exciting
    B. Advertise how much fun the ride is
    C. Offer them discounts on other rides
    D. Let them ride twice for a higher price

7. You are the visitor to a theme park with all your favorite rides. However, you only have $20.00 to pay for the rides and food. You noticed that the more exciting rides cost more money. You want to go on 4 rides - 2 exciting roller coaster rides that cost $7.00 and $6.00 and also 2 other rides - a race car ride for $4.00 and a cool water rider for $3.00. However, you also have to buy a drink and hotdog for $6.00. If you must ride on at least 3 rides, which combination of rides and food and drinks would you choose to completely spend all your money?

Your Total Money	Roller coaster 1	Roller coaster 2	Race car ride	Water ride	Food and drinks
$20.00	$7.00	$6.00	$4.00	$3.00	$6.00

    A. Roller coaster 1, Roller coaster 2, Race car, Food and drinks
    B. Roller coaster 1, Race car ride, Food and drinks, Water ride
    C. Roller coaster 2, Race Car ride , Water ride, Roller coaster 1
    D. Roller coaster 2, Race car, Food and drinks, Water ride

8. It is **most** important for the rides in a park to be reliable because if they break down

    A. owners lose time and money
    B. riders will go to that ride more often
    C. owners hire more employees
    D. riders will leave the theme park and come back later

9. If you owned an amusement park, which of the following would **not** be an important reason for the rides in your park to be reliable?

    A. Riders may get hurt
    B. Riders will get angry
    C. Riders will want to ride more often
    D. Riders will not come back to your theme park in the future

10. When managing your company selling lemonade, increasing the price of the lemonade will always increase the overall profit you make? Circle the correct response.

    True

    False

11. What happens when the price of a product is increased too high so less people can buy that product?

    A. More people will pay for the product
    B. Fewer people will pay for the product
    C. The product will make more money
    D. The product will make the same amount of money

12. As the owner for Cedar Point amusement park, what do you think will happen in the park if you do not keep the park clean and beautiful?

    A. More people will come for the exciting and cool rides
    B. Fewer people will come to the park
    C. Theme parks are only about great rides; being clean is unimportant
    D. More money is made because more people will go on rides rather than go sightseeing

13. If you are a business person operating your own company, circle 3 things from the list below that you would do to increase the popularity and demand of your product?

    1. Advertise the product
    2. Train workers to be nice about the product
    3. Offer discounts for the product
    4. Make a nice design of the product
    5. Reduce the production of the product and increase prices
    6. Increase the production of the product and reduce prices

14. From the list below circle the four (4) **most** important things you would sell in your own theme park to make the most possible amount of money?

    1. Food
    2. Drinks
    3. Candy
    4. Ride tickets
    5. Souvenirs
    6. Ice cream
    7. Balloons

15. If you are working for a company that makes ice cream why do you think it would be important for the company to train and pay you and other workers well for your job? Circle the **best** 3 choices from the list below:

    1. Make better ice cream
    2. Trained workers perform better
    3. Trained workers are always happier
    4. Well paid workers are usually the best at their job
    5. The company would make more money
    6. Well paid workers are reliable

16. In a shopping center that you own, if the shops and facilities become too busy, what would you do to make sure all the people who visit your shopping center are receiving good service?

    A. Keep the same number of shops and facilities and decrease the prices to increase demand.
    B. Increase the number of shops and facilities to maintain the number of people.
    C. Keep the same number of shops and facilities and increase the prices to increase demand.
    D. Leave the number of shops and facilities the same.

17. As the owner of an animal shelter, what is the most important thing you could do to satisfy customer if the needs of animals and workers are ignored? Choose the best response.

    A. Fire workers and use more money to take care of the animals
    B. Train the workers to increased animal care
    C. Take animals away and reduce the number of workers
    D. Increase the number of animals and workers

Rubric

Transfer – info Ch. 3 – how people learn, page 830-831 of handbook of educational psychology, and Greeno Collins Resnick 1996 article.

Ride A
Q1. 4 point – popular ride, longer ride, more money with less people, more bang for your buck for patrons , rides at full capacity with less people.
Ride B and C – **Game knowledge (opportunity cost, decision making, problem-solving)**
Q2. 4 point – Cheaper to build, costs less to patrons, more money in the long term at full capacity, two rides increases park value more than one - **Game knowledge(opportunity cost, decision making, problem-solving)**
Q3. D - 1 - **Game knowledge (mathematics literacy – algebra, profit)**
Q4. D. - 1 - **Game knowledge**
Q5. C. - 1 – ***near transfer*** **Game knowledge (supply and demand, scarcity, opportunity cost)**
Q6. C - 1 – ***near transfer*** **Game knowledge (social consequences of decisions, incentives)**
Q7. B - 2 – Game Knowledge (scarcity, decision making, problem solving)
Q8. A - 1 – Game Knowledge (Time and Money, reliability, **social consequences of decisions)**
Q9. C - 1 - **Game knowledge (social consequences of decisions - reliability)**
Q10. False - **Transfer** - 1 - (profit,
Q11. B – **Transfer** - 1 – (Supply and demand, opportunity cost)
Q12. B - ***near transfer*** 1 **Game knowledge (social consequences of decisions, supply and demand)**
Q13. Advertise the product (**Transfer**) 3 – (Incentives, discounts, supply and demand)
Offer discounts
Reduce the production and increase e prices
Q14. Food - ***near transfer*** 4 – (goods and services, profit)
Drinks
Ride tickets
Souvenirs
Q15. Make better ice cream (**Transfer**) 3 (**social consequences of decisions – employer-employee)**
Trained workers perform better
The company would make more money
Q16. B – **Transfer** 1 (supply and demand, **social consequences of decisions)**
Q17. B – **Transfer** 1 (**social consequences of decisions, opportunity cost)**

APPENDIX E

Pre - Motivational questionnaire

Name:_____ ID# RCT3____ Date:_____

Please read the following statements carefully and then answer to best of your ability by circling the most appropriate response from 1 for strongly disagree to 6 for strongly agree.

1. I believe playing RollerCoaster Tycoon 3 Platinum will be of some value to me.

strongly disagree strongly agree
1 2 3 4 5 6 (v)

2. I am interested in playing games for learning in school.

strongly disagree strongly agree
1 2 3 4 5 6 (i)

3. I am anxious when playing games to learning school content.

strongly disagree strongly agree
1 2 3 4 5 6 (p)

4. Playing this game is important because it can help me learn about school subjects in better ways.

strongly disagree strongly agree
1 2 3 4 5 6 (v)

5. I think I will do pretty well at this activity, compared to other students.

strongly disagree strongly agree
1 2 3 4 5 6 (c)

6. I think that doing this activity is useful for understanding how to make decisions.

strongly disagree strongly agree
1 2 3 4 5 6 (v)

7. When I play games, I think about how much I am interest in them.

strongly disagree strongly agree
1 2 3 4 5 6 (i)

8. I am very relaxed when playing games.

strongly disagree strongly agree
1 2 3 4 5 6 (p-r)

9. Playing a game to learn school related material will be enjoyable.

strongly disagree strongly agree

1 2 3 4 5 6 (i)

10. I feel able to meet the challenge of performing well in this game.

strongly disagree strongly agree

1 2 3 4 5 6 (c)

11. I enjoy designing and building things.

strongly disagree strongly agree

1 2 3 4 5 6 (i)

12. It is important to me to do well at playing RollerCoaster Tycoon 3 Platinum.

strongly disagree strongly agree

1 2 3 4 5 6 (c)

13. I think playing a game about business activities will help me develop skills in case I want to operate my own business.

strongly disagree strongly agree

1 2 3 4 5 6 (v)

14. I think I am pretty good at playing games.

strongly disagree strongly agree

1 2 3 4 5 6 (c)

15. Playing RollerCoaster Tycoon 3 will be useful for helping me learn good subject matter content.

strongly disagree strongly agree

1 2 3 4 5 6 (v)

16. I feel confident in my ability to play the game and learn the material.

strongly disagree strongly agree

1 2 3 4 5 6 (c)

17. I am nervous when playing games.

strongly disagree strongly agree

1 2 3 4 5 6 (p-r)

18. I believe playing RollerCoaster Tycoon 3 Platinum could be beneficial to me in school and out of school.

strongly disagree strongly agree

1 2 3 4 5 6 (v)

19. I enjoy activities that deal with managing money and other important resources.

strongly disagree strongly agree

1 2 3 4 5 6 (i)

20. I will be satisfied with my performance at playing RollerCoaster Tycoon 3 Platinum.

strongly disagree strongly agree

1 2 3 4 5 6 (c)

21. I think playing RollerCoaster Tycoon 3 Platinum is an important activity.

strongly disagree strongly agree

1 2 3 4 5 6 (v)

22. I am not stressed by playing games.

strongly disagree strongly agree

1 2 3 4 5 6 (p-r)

23. I am good at activities that allow me to create and design environments.

strongly disagree strongly agree

1 2 3 4 5 6 (c)

24. I value the learning of school material in games.

strongly disagree strongly agree

1 2 3 4 5 6 (v)

25. I feel tense when play games to learn school content.

strongly disagree strongly agree

1 2 3 4 5 6 (p)

Post- Motivational questionnaire

Name:_____ ID# RCT3____ Date:_____

Please read the following statements carefully and then answer to best of your ability by circling the most appropriate response from 1 for strongly disagree to 6 for strongly agree.

1. I believe playing RollerCoaster Tycoon 3 Platinum was of some value to me.

strongly disagree strongly agree
1 2 3 4 5 6 (v)

2. I am interested in playing games for learning in school.

strongly disagree strongly agree
1 2 3 4 5 6 (i)

3. I am anxious when playing games to learn school content.

strongly disagree strongly agree
1 2 3 4 5 6 (p-r)

4. Playing this game is important because it helped me learn about school subjects in better ways.

strongly disagree strongly agree
1 2 3 4 5 6 (v)

5. I think I did pretty well at this activity, compared to other students.

strongly disagree strongly agree
1 2 3 4 5 6 (c)

6. I think that doing this activity was useful for understanding how to make decisions.

strongly disagree strongly agree
1 2 3 4 5 6 (v)

7. While I was playing RCT3, I was thinking about how much it increased my interest.

strongly disagree strongly agree
1 2 3 4 5 6 (i)

8. I was very relaxed when playing RCT3.

strongly disagree — strongly agree

1 2 3 4 5 6 (p-r)

9. Playing a game to learn school related material was enjoyable.

strongly disagree — strongly agree

1 2 3 4 5 6 (i)

10. I was able to meet the challenge of performing well in this game.

strongly disagree — strongly agree

1 2 3 4 5 6 (c)

11. I enjoyed designing and building the theme parks.

strongly disagree — strongly agree

1 2 3 4 5 6 (i)

12. It was important to me to do well at playing RollerCoaster Tycoon 3 Platinum.

strongly disagree — strongly agree

1 2 3 4 5 6 (c)

13. I think playing a game about business activities helped me develop skills in case I want to operate my own business.

strongly disagree — strongly agree

1 2 3 4 5 6 (v)

14. I think I was pretty good at playing RCT3.

strongly disagree — strongly agree

1 2 3 4 5 6 (c)

15. Playing RollerCoaster Tycoon 3 helped me learn that running a theme park requires more than just operating rides.

strongly disagree — strongly agree

1 2 3 4 5 6 (v)

16. I felt confident in my ability to play the game and learn the material.

strongly disagree — strongly agree

1 2 3 4 5 6 (c)

17. I was nervous when playing the game.

strongly disagree — strongly agree

1 2 3 4 5 6 (p-r)

18. I believe playing RollerCoaster Tycoon 3 Platinum will be beneficial to me in school and out of school.

strongly disagree — strongly agree

1 2 3 4 5 6 (v)

19. I enjoy activities that deal with managing money and other important resources.

strongly disagree strongly agree

1 2 3 4 5 6 (i)

20. I am satisfied with my performance at playing RollerCoaster Tycoon 3 Platinum.

strongly disagree strongly agree

1 2 3 4 5 6 (c)

21. I think playing RollerCoaster Tycoon 3 Platinum was an important activity.

strongly disagree strongly agree

1 2 3 4 5 6 (v)

22. I am not stressed by playing games.

strongly disagree strongly agree

1 2 3 4 5 6 (p)

23. I was good at the activities that allow me to create and design environments.

strongly disagree strongly agree

1 2 3 4 5 6 (c)

24. I valued the learning of school material in games.

strongly disagree strongly agree

1 2 3 4 5 6 (v)

25. I felt tense when play games to learn school content.

strongly disagree strongly agree

1 2 3 4 5 6 (p)

APPENDIX F

Example of one of six Incremental Scenario tests: Vanilla Hills

Name:_____ ID# RCT3____ Date:_____

Please answer the following questions to the best of your ability with short responses or listing where appropriate.

1. What did you do to increase the number guests in your park?

_____
_____
_____
_____

2. What do you do to keep your workers happy?

_____
_____
_____
_____

3. List 3 things you do in your park to increase its value.
   1. _____
   2. _____
   3. _____

4. How do you know when your park or shops are making a profit?

_____
_____
_____
_____

5. Which ride or park service makes the most money for you? Why?

_____
_____
_____
_____

6. Explain why you would build several cheaper and less exciting rides than one big exciting and expensive ride?

_____
_____
_____
_____

7. List 3 things you do to satisfy the people who visit your park.
    1. _____
    2. _____
    3. _____

8. List 3 things that you are trying to do in the game as you play.
    1. _____
    2. _____
    3. _____

9. List 3 things that you would do to increase the demand of something you are selling if there is not a lot of people interested in it?
    1. _____
    2. _____
    3. _____

10. What did you like or did not like about this game?

_____
_____
_____
_____

11. Was there anything you like about this part of the game? Rate your response by circling the number that matches how much you like this scenario

I hate this part of the game I like this part of the game

1 2 3 4 5 6 7 8 9 10

12. List 5 strategies you use to play the game to achieve the objectives in the scenario
    a. _____
    b. _____
    c. _____
    d. _____
    e. _____

Rubric

Rubric Incremental test – 28pts

1. Vhills

1. Increase guests in park – more rides, mores shops, more food stalls, cleaner park, new attractions, meet the needs of current guests in park, place important things near entrance, bill board (advertise) - 4pts
2. **Employer-workers** - Keep workers happy – trained them, increase their salary, give them varied jobs – 3pts
3. **Park value** - Increase park value – add more rides, clean park, purchase endangered animal species - 3 pts
4. **Profit** - Shop profit making – check the park maintenance log to see how much is being versus how much is being made by the shops. – 2pts
5. **Profit** - Show which ride makes the most money – 1 pt for the name of the show, and another 1pt for explanation of how the show make the money - evidence. 2pts
6. **TRADE-off, opportunity cost** - Explain why you would build several cheaper and less exciting rides than one big exciting and expensive ride? (opportunity cost, trade-off) – 2pts
7. **Ethical value** social consequences - Satisfy people in park - clean park, reasonable priced items, reliable rides, beautiful park, reasonable number of places to get food and other amenities - 3pts
8. **Game play strategy** - 3 things you are trying to do as you play - get rewards, money, rides, satisfy guests, get park ratings up, raise park value, keep workers happy,- 3pts
9. **Supply and demand** - 3 things to increase demand - lower the price, discount coupons, advertise it, design it to look nice, 3pts
10. **Game play** - 5 strategies to achieve objectives – start with smaller rides cheaper rides, get animals, add food and drinks and other amenities, get achievements because they increase park value, 5pts
11. Like about game (not scored)
12. Rate (not scored)

RCT306 – Vhills – like that you can change how you look at your park or rides

All 26 participants liked the game - average score 7 out of 10 for the six scenarios

5 of 26 – building and constructing makes the scenarios engaging (fun).

2. GRush

1. **Employer –worker relationship** - What do you do to keep workers happy – increase salary, train them, give them varied jobs, lower work hours, - 3pts
2. Loans - How does repaying a loan affects what you can do in your park – gain in park value, gain in available cash, stop paying interests, 3pts
3. Goods- Decision making - about goods to sell in park – design (things that match theme of park), things that increase value, things that helps me to get objective, things that help to gain cash, things to satisfy guests, is it affordable, does it look good - 3pt
4. Pricing – customer opinions, ride excitement and intensity level, 2pts
5. **Profit** - Shop profit making – check the park maintenance log to see how much is being versus how much is being made by the shops. – 2pts
6. **Profit** - Show which ride makes the most money – 1 pt for the name of the show, and another 1pt for explanation of how the show make the money - evidence. 2pts
7. **Game knowledge** - 3 things u do when deciding how to meet coaster size and excitement level – cost of coaster, game requirement for objective, length, potential income, number of riders -3pts
8. **Opportunity cost** – given choice to build or buy a big coaster vs. smaller, how would you decide - cheaper rides (more people can ride them), game requirement, 2pts
9. **Game play** - 5 strategies to achieve objectives – start with smaller rides cheaper rides, get animals, add food and drinks and other amenities, get achievements because they increase park value, 5pts
10. **Supply and demand** - 3 things to increase demand - lower the price, discount coupons, 3pts

Most disliked scenario in terms of participants rating - average rated score - 5

3.Chflags

1. **Employer –worker relationship** – why employ & What do you do to keep workers happy – increase salary, train them, give them varied jobs, - 4pts

2. Satisfying VIP – plan route, maintain a good park, don't interfere with VIP's agenda, made rides that the VIP liked – 3pts

3. Decision making – cookies or cakes – which to sell to make a profit – what is market like (what do people prefer), cost of making each product, which one is easier to make, - 2pts

4. Pricing – customer opinions, ride excitement and intensity level, 2pts

5. **Profit** - Shop profit making – check the park maintenance log to see how much is being versus how much is being made by the shops. – 2pts

6. **Profit** - Show which ride makes the most money – 1 pt for the name of the show, and another 1pt for explanation of how the show make the money - evidence. 2pts

7. Game knowledge – does it help meet objectives, would guests like it, will generate a lot of money, s it cheap enough – 3pts

8. Transfer - Opportunity cost, trade-offs – 30yr mortgage vs. 20yr and less comfortable – 2pts

9. **Game play** - 5 strategies to achieve objectives – start with smaller rides cheaper rides, get animals, add food and drinks and other amenities, get achievements because they increase park value, 5pts

10. **Supply and demand** - 3 things to increase demand - lower the price, discount coupons, advertisement, reduce production, 3pts

Most liked scenario – average score - 10

4. Box Office

1. Game knowledge - 3 things to maintain a clean park – garbage bins, janitors, low nauseated rides , bathrooms– 3pts

2. **Profit** - Shop profit making – check the park maintenance log to see how much is being versus how much is being made by the shops. – 2pts

3. **Transfer - Supply & demand** – econ – decision – check market value, check customer opinions , raise prices, - 2pts…

4. Goods - Decision making - about goods to sell in park – design (things that match theme of park), things that increase value, things that helps me to get objective, things that help to gain cash, things to satisfy guests, is it affordable, does it look good - 3pt

5. Time and resources management –Satisfying VIP – plan route, maintain a good park, don't interfere with VIP's agenda, made rides that the VIP liked – 3pts
6. Game knowledge – reliability , customer satisfaction, park value, park ratings – importance of rides working properly – 2pts
7. Game knowledge - 3 things to meet park ratings – build rides, lower prices to increase ridership and value, hire sufficient workers, keep a clean park,
8. **Opportunity cost** – given choice to build or buy a big coaster vs. smaller, how would you decide - cheaper rides (more people can ride them), game requirement, 2pts
9. **Game play** - 5 strategies to achieve objectives – start with smaller rides cheaper rides, get animals, add food and drinks and other amenities, get achievements because they increase park value, 5pts
10. **Supply and demand** - 3 things to increase demand - lower the price, discount coupons, advertisement, reduce production, 3pts

5. FNight

1. Game knowledge - 3 things to maintain a clean park – garbage bins, janitors, low nauseated rides , bathrooms– 3pts
2. **Employer –worker relationship** – why employ & What do you do to keep workers happy – increase salary, train them, give them varied jobs, - 4pts
3. Loans - How does repaying a loan affects what you can do in your park – gain in park value, gain in available cash, stop paying interests, 3pts - is there long term thinking or only short term impact
4. Reliability, business growth impact – importance to do a good job consistently create god toys for your business - 1pts
5. Pricing – customer opinions, ride excitement and intensity level, 2pts
6. **Profit** - Shop profit making – check the park maintenance log to see how much is being versus how much is being made by the shops. – 2pts
7. **Profit** - Show which ride makes the most money – 1 pt for the name of the show, and another 1pt for explanation of how the show make the money - evidence. 2pts

8. **Game knowledge** - 3 things you do when deciding how to meet coaster size and excitement level – cost of coaster, game requirement for objective, length, potential income, number of riders , height -3pts

9. **Game play** - 5 strategies to achieve objectives – start with smaller rides cheaper rides, get animals, add food and drinks and other amenities, get achievements because they increase park value, meet needs of guests5pts

10. **Supply and demand** - 3 things to increase demand - lower the price, discount coupons, advertisement, reduce production, get another item, 3pts

6. Goflow

1. Game knowledge - 3 things to maintain a clean park – garbage bins, janitors, low nauseated rides , bathrooms– 3pts

2. **Employer –worker relationship** – why employ & What do you do to keep workers happy – increase salary, train them, give them varied jobs, - 4pts

3. **Park value** - Increase park value – add more rides, clean park, purchase endangered animal species - 3 pts

4. Goods - Decision making - about goods to sell in park – design (things that match theme of park), things that increase value, things that helps me to get objective, things that help to gain cash, things to satisfy guests, is it affordable, does it look good, feedback from guests - 3pt

5. Transfer - Profit – understanding and explaining how u know when u are making profit 1pt

6. **Profit** - Show which ride makes the most money – 1 pt for the name of the show, and another 1pt for explanation of how the show make the money - evidence. 2pts

7. Profit — list 3 things you do to increase monthly ride income – build more rides, increase ride prices, increase the number of circuits to enable higher pricing, etc. – 3 pts (information literacy)

8. **Ethical value, social consequences** - Satisfy people in park - clean park, reasonable priced items, reliable rides, beautiful park, reasonable number of places to get food and other amenities - 3pts

9. **Game play** - 5 strategies to achieve objectives – start with smaller rides cheaper rides, get animals, add food and drinks and other amenities, get achievements because they increase park value, meet needs of guests -5pts

10. **Supply and demand** - 3 things to increase demand - lower the price, discount coupons, advertisement, reduce production, get another item, 3pts

VHills	Grush		chflags	Bxoffce		Fnight goflow
10	9	9	9	9	9	game play understanding (info lit)
9	10	10	10	10	10	supply demand (transfer)
2	1	1		2	2	employer-workers relationship (near transfer)
4	5	5	2	6		profit
6	8	8	8			opportunity cost, trade-offs (transfer)
	4	4		5		pricing
5	6	6		7	6	profit (info lit)
	3		4		4	goods and services decision (info lit)
			1	1	1	game play knowledge (info lit)
	2			3		loan (understanding long term impact)
3					3	understanding value, game knowledge (info lit)
	7			8		Decision into action (info lit)
7					8	ethical and social consequences of decision making
				3	3	4 5 Transfer question (Tr_OC, TO, SupDem)
1						Strategy (StratGK)

RCT318, RCT307, RCT310, RCT319, RCT326, RCT325–checkered flags#3, RCT327-goldrush, RCT320-boxoffice#3

Code Book for SPSS Data File – Incremental test

1. Game Play – GP
2. Game/Technology Knowledge – GK
3. Disciplinary Knowledge - DK
4. Info Lit – IL
5. Employer-Worker relationship – empwork
6. Transfer – Tr
7. Supply Demand – Sup dem
8. Pricing – pricing
9. Profit – Prof
10. Loan – Lo
11. Ethical and Social consequences of decision making – Eth Soc
12. Decision Making – DM
13. Opportunity Cost – OC
14. Trade-offs – TO
15. Goods - G
16. Services – S
17. Decision – D
18. Understanding long term Impact – ULT
19. Time Management – TM
20. Reliability – Reli

DK out of 23pts – 9Q's
GK out of 11 pts – 4Q's
IL out of 16 points – 5Q's

APPENDIX G

Semi-structured interviews

AIM: to get participants' experiences in the game (cognitive and social) and the about the content.
Interview Questions: After Scenarios – Semi-Structured

1. Describe what are the most important things to you while playing RollerCoaster Tycoon 3 Platinum? Why are these things important to you? (Gen)
2. What are some strategies that you think are needed in this game in order to be successful? (businessperson)
3. What are some things you learned that can be applied to your life? (consumer)
4. What does it take to maintain a good profit-making amusement park? (business)
5. What are some things that you did to maintain your theme park? (businessperson)
6. What did you think about when making choices in the game to win? (businessperson)
7. How did you balance your tasks while maintaining your theme park? (economist)
8. What do you think would be some of the consequences if your school should raise the price of tickets to enter a party and many of the children cannot afford the new cost? What do think will happen if they have relatively cheap price to enter the party? What do you think would happen to your school's profit when they increase the price to enter the party? (economist)
9. What do you think about the people who are buying tickets in your theme park?
10. What did you decide to sell in the park to get money?
11. Are there extra things that you sold to make money?
12. What was your particular objective in the game? (business, consumer, economic)
13. What other objectives did you have?
14. What did you try in the game that worked to meet your goals?
    a. What did not work for you in the game?
15. What are the things that you do in this game that you would if you are running a business?
16. How much money do you charge for your rollercoaster ride?
    a. What is the reason why you charge that amount of money?
17. Why do you think people come to your park?
18. If I visited your park as a character in the game and I have only $50 for the whole day and I like rides with high excitement levels, what would do to let me not leave your park?
19. What do you think about the various rides in your theme park that offer different experiences for the patrons in your park? Do you think one ride causes people not to go another ride? What would you do to make people visit each ride?
20. Why are more people coming to your park? Are the people happy about increases? Are they willing to pay more? What are other things that you thing they do with their money? Shouldn't they come to your park all the time?
21. Given the number of the people coming to your park which prices can you increase and which prices can you lower? Why?

22. If you are going to a park, will expensive prices keep you away?
23. Why wont people come if you charge too much money for rides?
24. What do you think will happen if you increase ride prices and lower food prices?
25. If you were telling a friend a great strategy to succeed in the game what would you suggest?
26. How do you feel about the game?
27. Would you play this game again?
28. Are you interested in the content of the game – managing resources and making decisions with all the information that you are given?
29. How would use what you learn in the game to make a decision about buying an expensive popular toy versus buying three cheaper and less popular toys?
30. Did you enjoy playing this game? Why or why not?
31. Did you enjoy what you learned while playing the game? Why or why not?
32. When you play the game do you prefer to explore and learning about the game or do you prefer to go through quickly and achieve the objectives

APPENDIX H

Log sheets

Carefully **write down the year and month** when you have reached each level. **On the back of the paper** explain what each of your achievements does to help you in your park. Use these two questions to guide your thoughts and explanation - What does it mean when you have achieved an award such as "best value" park or "most reliable" rides? How does the achievement help you in the game?

Participant ID:	Apprentice Level	Entrepreneur	Tycoon	Achievements
Vanilla Hills	Time: E.g. Yr 1 November			
Gold Rush				
Checkered Flag				
Box Office				
Fright Night				
Go with the flow				

REFERENCES

Aarseth, E. (1997). *Cybertext: Perspectives on ergodic literature. Baltimore.* Baltimore, MD: The John Hopkins University Press.

Aarseth, E. (2003). *Playing research: Methodological approaches to game analysis.* Paper presented at the Digital Arts and Culture conference.

Adams St Pierre, E. (2002). "Science" rejects postmodernism. *Educational Researcher, 31*(8), 25-27.

American Association of School Librarians, & Association for Educational Communications and Technology. (1998). *Information literacy standards for student learning: Standards and indicators* Chicago: American Library Association.

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology, 84*(3), 261-271.

Anderman, E. M., & Wolters, C. A. (2006). Goals,values, and affect: Influences on student motivation. In P. A. Alexander & P. H. Winne (Eds.), *Handbook of Educational Psychology* (2 ed., pp. 369-389). Mahwah, NJ: Lawrence Erlbaum Associates.

Anderson, C. A., & Bushman, B. J. (2001). Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: A meta-analytic review of the scientific literature. *Psychological Science, 12*(5), 353-359.

Anderson, C. A., & Dill, K. E. (2000). Video games and aggressive thoughts, feelings, and behavior in the laboratory and in life. *Journal of Personality and Social Psychology, 78*(4), 772-790.

Anderson, C. A., & Ford, C. M. (1986). Affect of the Game Player: Short-Term Effects of Highly and Mildly Aggressive Video Games. *Pers Soc Psychol Bull, 12*(4), 390-402.

Apperley, T. H. (2006). Genre and game studies: Toward a critical approach to video game genres. *Simulation Gaming, 37*(1), 6-23.

Asgari, M. (2005). *A three-factor model of motivation and game design.* Paper presented at the 2005 International DiGRA Conference, Vancouver, British Columbia, Canada.

Asgari, M., & Kaufman, D. (2005). *Relationships among computer games, fantasy, and learning.* Paper presented at the 2005 International DiGRA Conference, Vancouver, British Columbia, Canada.

Ball, G. H. (1978). Telegames teach more than you you think. *Audiovisual Instruction*, 24-26.

Barab, S. A., Bransford, J. D., Greeno, J. G., & Gee, J. P. (2007). *Embodied cognition: A more meaningful ontological unit*. Paper presented at the 2007 AERA Annual Meeting.

Barab, S. A., Dodge, T., & Ingram-Goble, A. (2007). *Reflexive play spaces: A 21st century pedagogy*. Paper presented at the 2007 AERA Annual Meeting.

Barab, S. A., Hay, K. E., Barnett, M., & Squire, K. (2001). Constructing virtual worlds: Tracing the historical development of learner practices. *Cognition and Instruction, 19*(1), 47-94.

Barab, S. A., Zuiker, S., Warren, S., Hickey, D., Ingram-Goble, A., Kwon, E.-J., et al. (In Press). Situationally embodied curriculum: Relating formalism and contexts. *Science Education*.

Bartle, R. (2006). Hearts, clubs, diamonds, spades: Players who suit MUDs. In K. Salen & E. Zimmerman (Eds.), *The game design reader* (pp. 754-787). Cambridge, MA: The MIT Press.

Baumeister, R. F., Campbell, J. D., Krueger, J. I., & Vohs, K. (2003). Does high self-esteem cause better performance, interpersonal success, happiness, or healthier lifestyles? *Psychological Science in the Public Interest, 4*, 1-44.

Becker, K. (2005). *How are games educational? Learning theories embodied in games.* Paper presented at the 2005 International DiGRA Conference, Vancouver, British Columbia, Canada.

Beckett, K. L., & Shaffer, D. W. (2005). Augmented by reality: The pedagogical praxis of urban planing as a pathway to ecological thinking. *Journal of Educational Computing Research, 33*(1), 31-52.

BECTA. (2006). Computer games in education project: Aspects. *Computer games in education project: Report* Retrieved September 27, 2006, from http://partners.becta.org.uk/index.php?section=rh&rid=11200

Betz, J. A. (1996). Computer games: Increase learning in an interactive multidisciplinary environment. *Journal of Educational Technology Systems, 24*(2), 195-2005.

Bos, N. D., Shami, N. S., & Naab, S. (2006). A globalization simulation to teach corporate social responsibility: Design features and analysis of student reasoning. *Simulation & Gaming, 37*(1), 56-72.

Bosworth, K. (1994). Computer games and simulation tools to reach and engage adolescent in health promotion activities. *Computers in Human Services, 11*(1), 109-119.

Bransford, J. D., & Schwartz, D. L. (1999). Chapter 3: Rethinking Transfer: A Simple Proposal With Multiple Implications. *Review of Research in Education, 24*(1), 61-100.

Briggs, J., & Johnson, S. (2001). Civilization III (Version 3). Hunt Valley, MD: Infogrames, MacSoft, Aspyr.

Brophy, J. E. (2004). *Motivating students to learn* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

Brophy, J. E. (2008). Developing Students' Appreciation for What Is Taught in School. *Educational Psychologist, 43*(3), 132 - 141.

Brophy, J. E., & Alleman, J. (2007). *Powerful social studies for elementary students* (2 ed.). Belmont, CA: Thomson-Wadsworth.

Brown, A. L. (1994). The Advancement of Learning. *Educational Researcher, 23*(8), 4-12.

Bruce, B. C., & Levin, J. A. (1997). Educational technology: media for inquiry, communication, construction, and expression. *Journal of Educational Computing Research, 17*(1), 79-102.

Buchanan, J. (2005). *Experiences, Stories and Video Games.* Paper presented at the Future Play: The International Academic Conference on the Future of Game Design and Technology, East Lansing, Michigan.

Caldwell, N. (2004). Theoretical analysis of turn-based computer. *Media International Australia, 2004*(110), 42-51.

Calleja, G. (2007). Digital game involvement: A conceptual model. *Games and Culture, 2*(3), 236-260.

Carnagey, N. L., & Anderson, C. A. (2004). Violent video game exposure and aggression: A literature review. *MINERVA PSICHIATR, 45*, 1-18.

Chandler, D. (2002). *Semiotics: The basics*. NY: Routledge.

Crandall, R. W., & Sidak, J. G. (2006). *Video games: Serious business for America's economy*. Washington, DC: Entertainment Software Association.

Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods* (2 ed.). Thousand Oaks, CA: Sage Publications, Inc.

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

Csikszentmihalyi, M. (1996). *Creativity: Flow and the psychology of discovery and invention*. New York: Harper Collins Publishers.

De Aguilera, M., & Mendiz, A. (2003). Video games and education (Education in the face of a "parallel school"). *ACM Computers in Entertainment, 1*(1), 1-14.

Deci, E. L., Eghrari, H., Patrick, B. C., & Leone, D. R. (1994). Facilitating internalization: The self-determination theory perspective. *Journal of Personality, 62*(1), 119-142.

Dewey, J. (1938). *Experience and education*. New York: Macmillan.

diSessa, A. A. (1982). Unlearning Aristotelian physics: A study of knowledge-based learning. *Cognitive Science, 5*, 37-75.

Donovan, M. S., Bransford, J. D., & Pellegrino, J. W. (Eds.). (1999). *How people learn: Bridging research and practice*. Washington, D.C.: National Academy Press.

Driver, R., Asoko, H., Leach, J., Mortimer, E., & Scott, P. (1994). Constructing Scientific Knowledge in the Classroom. *Educational Researcher, 23*(7), 5-12.

Egenfeldt-Nielsen, S. (2005). *Beyond edutainment: Exploring the educational potential of computer games*. Unpublished Dissertation, IT-University of Copenhagen, Copenhagen, Denmark.

Emes, C. E. (1997). Is Mr Pac Man eating our children? A review of the effect of video games on children. *The Canadian Journal of Psychiatry, 42*(4), 409-414.

Entertainment Software Association. (2006, May 10, 2006). 2006 sales, demographic and usage data: Essential facts about the computer and video game industry. Retrieved November 1, 2006, from http://www.theesa.com/archives/files/Essential%20Facts%202006.pdf

Entertainment Software Association. (2007). 2007 sales, demographic and usage data: Essential facts about the computer and video game industry. Retrieved November 27, 2007

Fabricatore, C. (2000, September 26, 2006). Learning and videogames: An unexploited synergy. Retrieved September 27, 2006, from http://www.learndev.org/FabricatoreAECT2000.pdf

Facer, K. (2003, September 27). Computer games and learning: why do we think it's worth talking about computer games and learning in the same breath? A discussion paper. Retrieved September 27, 2006, from http://www.futurelab.org.uk/download/pdfs/research/disc_papers/Computer_Games_and_Learning_discpaper.pdf

Federation of American Scientists. (2005). *National summit on educational games: Fact Sheet*. Washington, DC.

Federation of American Scientists. (2006). *Summit of educational games: Harnessing the power of video games for learning*. Washington, DC.

Fletcher, J. D., & Tobias, S. (2006). *Using computer games and simulations for instruction: A research review.* Paper presented at the Society for Applied Learning Technology Meeting: New learning Technologies, Orlando, FL.

Foreman, J. (2003, September 26, 2006). Next generation educational technology versus the lecture. *EDUCAUSE Review* Retrieved September 27, 2006, from http://www.educause.edu/ir/library/pdf/erm0340.pdf

Foreman, J. (2004). Game-based learning: How to delight and instruct in the 21st century. *EDUCAUSE Review*, 50-66.

Foster, A. N. (2008). Games and motivation to learn science: Personal identity, applicability, relevance and meaningfulness. *Journal of Interactive Learning Research, 19*(4), 597-614.

Foster, A. N., Koehler, M. J., & Mishra, P. (2006, June 26-30, 2006). *Game-based learning of physics content: The effectiveness of a physics game for learning basic physics concepts.* Paper presented at the ED-MEDIA 2006--World Conference on Educational Multimedia, Hypermedia & Telecommunications, Orlando, Florida.

Foster, A. N., & Mishra, P. (2009). Games, claims, genres & learning. In R. E. Ferdig (Ed.), *Handbook of Research on Effective Electronic Gaming in Education*: Information Science Reference.

Frontier Developments. (2004). RollerCoaster Tycoon 3 [Computer Game]. NY: Atari.

Frontier Developments. (2006). RollerCoaster Tycoon 3: Platinum [Computer Game]. NY: Atari.

Galarneau, L. (2005). *Authentic learning experiences through play: Games , simulations and the construction of knowledge.* Paper presented at the 2005 International DiGRA Conference, Vancouver, British Columbia, Canada.

Gardner, H. (2006). *Changing minds: The art and science of changing our own and other people's minds*. Cambridge, MA: Harvard Business School Press.

Gardner, H. (2007). *Five minds for the future*. Cambridge, MA: Harvard Business School Press.

Gee, J. P. (2003). *What video games have to teach us about learning and literacy*. New York: Palgrave MacMillan.

Gee, J. P. (2005a). Learning by design: Good video games as learning machines. *E-Learning, 2*(1), 5-16.

Gee, J. P. (2005b). *Why video games are good for your soul: Pleasure and learning.* Australia: Common Ground Publishing.

Gee, J. P. (2006). Why Game Studies Now? Video Games: A New Art Form. *Games and Culture, 1*(1), 58-61.

Gee, J. P. (2007a). *Good video games + good learning: Collected essays on video games, learning and literacy.* NY: Peter Lang Publishing, Inc.

Gee, J. P. (2007b). *Video games and embodiment.* Paper presented at the 2007 AERA Annual meeting.

Glaser, B. G., & Strauss, A. L. (1999). *The discovery of grounded theory: Strategies for qualitative research.* Hawthorne, NY: Aldine de Gruyter.

Gopher, D., Weil, M., & Bareket, T. (1994). Transfer of skill from a computer game trainer to flight. *Human Factors, 36*, 387-405.

Grant, H., & Dweck, C. S. (2003). Clarifying achievement goals and their impact. *Journal of Personality and Social Psychology, 85*(3), 541-553.

Gredler, M. (1996). Educational games and simulations: A technology in search of a research paradigm. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 521-539). New York: MacMilan.

Green, J. L., Camilli, G., & Elmore, P. B. (Eds.). (2006). *Handbook of complementary methods in education research.* Mahwah, New Jersey: Lawrence Erlbaum Associates.

Greenfield, P., & Subrahmanyan, K. (1994). Effect of video game practice on spatial skills in girls and boys. *Applied Developmental Psychology, 15*(1), 13-32.

Greenfield, P. M. (1984). *Mind and media: The effects of television, computers and video games.* Cambridge, MA: Harvard University Press.

Greeno, J. G. (1997). On claims that answer the wrong questions. *Educational Researcher, 26*(1), 5-17.

Greeno, J. G. (2007). *Notes on embodied cognition for AERA 2007.* Paper presented at the 2007 AERA Annual Meeting.

Greeno, J. G., Collins, A. M., & Resnick, L. B. (1996). Cognition and learning. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology.* New York: Simon & Schuster Macmillan.

Greer, J. G., Schwartzberg, I. M., & Laycock, V. K. (1977). *Motivating learners with instructional games*. Dubuque, Iowa: Kendall/Hunt Pub. Co.

Griffiths, M. D., & Davies, M. N. O. (2002). Research Note - Excessive online computer gaming: Implications for education. *Journal of Computer Assisted Learning, 18*(3), 379-380.

Habgood, M. P. J., Ainsworth, S. E., & Benford, S. (2005). Endogenous fantasy and learning in digital games. *Simulation Gaming, 36*(4), 483-498.

Hart, S. G., & Batiste, V. (1992). *Flight test of a video game trainer.* Paper presented at the Human Factors Society 36th Annual Meeting, Santa Monica, CA.

Hatch, J. A. (2002). *Doing qualitative research in education settings*. Albany, NY: State University of New York Press.

Hayes, J. (1992). Reading research reports. In *Reading empirical reserach studies: The rhetoric of research* (pp. 11-39). Hillsdale, NJ: Erlbaum.

Heeter, C. (2009). Play styles and learning. In R. Ferdig (Ed.), *Handbook of Research on Effective Electronic Gaming in Education* (Vol. 2, pp. 826-846). Hershey, PA: Information Science Reference.

Heeter, C., Egidio, R., Mishra, P., Winn, B., & Winn, J. (In Press). Alien games: Do girls prefer games designed by girls? *Games and Culture.*

International Society for Technology in Education. (2000a). National educational technology standards. In R. Pea (Ed.), *The Jossey-Bass reader on technology and learning* (pp. 3-19). San Francisco, CA: Jossey-Bass, Inc.

International Society for Technology in Education. (2000b). *National educational technology standards for teachers*. Eugene, OR: International Society for Technology in Education (ISTE) NETS Project.

International Society for Technology in Education. (2007). National educational technology standards for students: The next generation. from http://www.iste.org/Template.cfm?Section=NETS

Jenkins, H. (2006). *Convergence culture: Where old and new media collide*. NY: New York University Press.

Jenkins, H., & Squire, K. (2005). Theory Theories. *Computer Games Magazine.*

Johnson, J. M. (2002). In depth interviewing. In J. Gubrium & J. Holstein (Eds.), *Handbook of interview research: Context and method.* Thousand Oaks, CA: Sage.

Johnson, S. (2005). Civilization IV (Version 1.61). Hunt Valley, MD: 2K Games.

Johnson, S. (2005). *Everything bad is good for you: How today's popular culture is actually making us smarter.* NY: Penguin Group.

Kelly, H. (2005). Games, cookies, and the future of education. *Issues in science and technology* Retrieved October 18, 2006, from http://www.fas.org/resource/07152005161632.pdf

Kimberley, G. (1995). *Learning in MarketPlace: Economic objects to think with and talk about.* Massachusetts Insitute of Technology, Cambridge, MA.

Kirriemuir, J., & McFarlane, A. (2004). *Literature Review in Games and Learning* (No. 8). Bristol, Canada: Nesta Futurelab.

Klug, G. C., & Schell, J. (2006). Why people play games: An industry perspective. In P. Vorderer & J. Bryant (Eds.), *Playing video games* (pp. 91-100). Mahwah, NJ: Lawrence Erlbaum Associates.

Krzywinska, T. (2006). The pleasures and dangers of the game: Up close and personal. *Games and Culture, 1*(1), 119-122.

Laurel, B. (Ed.). (2003). *Design Research Methods and Perspectives*. Cambridge, Massachusetts: The MIT Press.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* Cambridge, England: Cambridge University Press.

Linn, M. C. (1998). The impact of technology on science instruction: Historical trends and current opportunities. In B. J. Fraser & K. G. Tobin (Eds.), *International handbook of science education* (pp. 265-294). Great Britain: Kluwer Academic Publishers.

Lukkarinen, H. (2004). Methodological triangulation showed the poorest quality of life in the youngest people following treatment of coronary artery disease: a Longitudinal study. *International Journal of Nursing Studies, 42*, 619-627.

Malone, T. W. (1981). Toward a theory of intrinsically motivating instruction. *Cognitive Science, 5*(4), 333-369.

Malone, T. W., & Lepper, M. R. (1987). Making learning fun: A taxonomy of intrinsic motivations for learning. In R. E. Snow & M. J. Farr (Eds.), *Apptitude, learning and instruction. Volume 3: Cognitive and affective processed analysis*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Markus, H., & Nurius, P. (1986). Possible selves. *American Psychologist, 41*(9), 954-969.

McAuley, E., Duncan, T., & Tammen, V. V. (1987). Psychometric properties of the Intrinsic Motivation Inventory in a competitive sport setting: A confirmatory factor analysis. *Research Quarterly for Exercise and Sport, 60*, 48-58.

Meier, S. (1991). Civilization (Version 1). Hunt Valley, Maryland: MicroProse.

Michigan Department of Education. (1996). *Michigan curriculum framework.* Lansing, Michigan: The State of Michigan.

Mishra, P., & Foster, A. (2007a). The claims of games: A comprehensive review and directions for future research. In C. Crawford, D. A. Willis, R. Carlsen, I. Gibson, K. McFerrin, J. Price & R. Weber (Eds.), *Society for Information Technology & Teacher Education: 2007 18th International Conference* (Vol. 2007, pp. 2227-2232). San Antonio, Texas: Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).

Mishra, P., & Foster, A. (2007b). *What is learning from games? A critical review and directions for future research.* Paper presented at the 2007 AERA Annual Meeting.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017-1054.

Mitchell, A., & Savill-Smith, C. (2004). *The use of computer and video games for learning.* London: Learning and Skills Development Agency.

Moreno, R., & Mayer, R. (2005). Role of guidance, reflection, and interactivity in an agent-based multimedia game. *Journal of Educational Psychology, 97*, 117-128.

Moreno, R., Mayer, R., Spires, H. A., & Lester, H. A. (2001). The case for social agency in computer-based teaching: do students learn more deeply when they interact with animated pedagogical agents? *Cognition and Instruction, 19*(177-213).

National Council for the Social Studies. (1994). *Expectations of excellence: Curriculum standards for social studies.* Silver Spring, MD: NCSS Publications.

National Council on Economics Education. (2005). *Voluntary national content standards in economics.* NY, NY: National Council on Economics Education.

National Institute on the Media and the Family. (2002, 11/06/02). Media use. Retrieved October 21, 2005, from http://www.mediafamily.org/facts/facts_mediause.shtml

National Institute on the Media and the Family. (2005). MindGames. Retrieved October 21, 2005, from http://www.mediafamily.org/facts/tips_mindgames.shtml

National Research Council. (2005). *Advancing scientific research in education.* Washington, DC: The National Academies Press.

Oblinger, D. (2004). The next generation of educational engagement. *Journal of Interactive Media in Education, 8*, 1-18.

Papert, S. (1997). *The connected family: Bridging the digital generation gap.* Marietta, Georgia: Longstreet Press.

Peshkin, A. (2000). The nature of interpretation in qualitative research. *Educational Researcher, 29*(9), 5-9.

Phillips, D. C., & Soltis, J. F. (1998). *Perspectives on learning* (3 ed.). NY: Teachers College Press.

Prensky, M. (2001). *Digital Game-Based Learning.* New York: McGraw-Hill.

Rabin, S. (Ed.). (2005). *Introduction to game development.* Hingham, Massachusetts: Charles River Media, Inc.

Randel, J., Morris, B., Wetzel, C., & Whitehill, B. (1992). The effectiveness of games for educational purposes: A reviews of recent research. *Simulation and Gaming, 23*(3), 261-276.

Resnick, L. B. (1987). The 1987 presidential address: Learning in school and out. *Educational Researcher, 16*(9), 13-20+54.

Reynolds, B., Caspian-Kaufman, D., & Briggs, J. (1996). Civilization II (Version 2.42) [Computer Game]. Hunt Valley, MD: MicroProse.

Roberts, D. F., Foehr, U. G., & Rideout, V. (2005). *Generation M: Media in the lives of 8-18 year-olds*: The Henry J. Kaiser Family Foundation.

Rodgers, Y. V., Hawthorne, S., & Wheeler, R. C. (2006). *A state-by-state survey of economics content standards in the primary grades.* New Brunswick, NJ: The State University of New Jersey, Rutgers.

Roe, K., & Muijs, D. (1998). Children and computer games: A profile of the heavy user. *European Journal of Communication, 13*(2), 181-200.

Rowell, P. M. (2002). Peer interactions in shared technological activity: A study of participation. *International Journal of Technology and Design Education, 12*, 1-22.

Sawyer, C. (1999). RollerCoaster Tycoon (Version 1.08.187). Pawtucket, RI: Hasbro Interactive.

Sawyer, C. (2002). RollerCoaster Tycoon 2 [Computer Game]. NY: Atari, Infogrames.

Scardamalia, M. (2000). Can schools enter a knowledge society? In M. Selinger & J. Wynn (Eds.), *Educational technology and the impact on teaching and learning* (pp. 6-10). Abingdon, RM.

Schank, R. C., Berman, T. R., & MacPherson, K. A. (1999). Learning by doing. In C. M. Reigeluth (Ed.), *Instructional-Design theories and models: A new paradigm of instructional theory* (Vol. II, pp. 161-181). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Schiefele, U., Krapp, A., & Winteler, A. (1992). Interest as a predictor of academic achievement: A meta-analysis of research. In K. A. Renninger, S. Hidi & A. Krapp (Eds.), *The role fo interest in learning and development* (pp. 183-212). Hillsdale, NJ: Lawrence Erlbaum Associates.

Schraw, G., Flowerday, T., & Lehman, S. (2001). Increasing situational interest in the classroom. *Educational Psychology Review, 13*(3), 211-224.

Shaffer, D. W. (2004). Pedagogical praxis: The professions as models for postindustrialization. *Teachers College Record, 106*(7), 1401.

Shaffer, D. W. (2006). *How computer games help children learn.* NY: PALGRAVE MACMILLAN.

Shaffer, D. W., & Gee, J. P. (2005). Before every child is left behind: How epistemic games can solve the coming crisis in education (Publication.: http://coweb.wcer.wisc.edu/cv/papers/learning_crisis.pdf

Shaffer, D. W., Squire, K., Halverson, R., & Gee, J. P. (2005). Video games and the future of learning. *Phi Delta Kappan, 87*(2), 104-111.

Sliverman, D. (2000). *Doing qualitative research: A practical handbook.* London: Sage Publications.

Smith, M. L. (2006). Multiple methodology in education research. In J. L. Green, G. Camilli & P. B. Elmore (Eds.), *Handbook of complementary methods in education research* (pp. 457-475). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Squire, K. (2002). Cultural framing of computer/video games. *Game Studies: The International Journal of Computer Game Research, 2*(1).

Squire, K. (2003). Video games in education. *International Journal of Intelligent Simulations and Gaming, 2*(1).

Squire, K. (2004). *Replaying history: Learning world history through playing civilization III.* Unpublished Dissertation, Indiana University.

Squire, K. (2006). From Content to Context: Videogames as Designed Experience. *Educational Researcher, 35*(8), 19-29.

Steinkuehler, C. A. (2006). Why game (culture) studies now? *Games and Culture, 1*(1), 97-102.

The NPD Group. (2008, July 11, 2008). 2007 U.S. video game and PC game sales exceed $18.8 billion making third consecutive year of record breaking sales. from http://www.npd.com/press/releases/press_080131b.html

Thomas, R., Cahill, J., & Santilli, L. (1997). Using an interactive computer game to increase skill and self-efficacy regarding safer sex negotiation: Field test results. *Health education & behavior : the official publication of the Society for Public Health Education., 24*(1), 71-86.

Turkle, S. (1995). *Life on the screen: Identity in the age of the internet.* New York: Simon and Schuster.

Turkle, S. (1997). Seeing Through Computers. *The American Prospect, 8*(31).

Vye, N. J., Schwartz, D. L., Bransford, J. L., Barron, B. J., Zech, L., & The Cognition and Technology Group at Vanderbilt. (1998). SMART enviroments that support monitoring, reflecting and revision. In D. Hacker, J. Dunlosky & A. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 305-346). Mahwah, NJ: Erlbaum Associates.

Whitehead, A. N. (1929). *The aims of education & other essays.* New York,: The Macmillan company.

Wigfield, A., & Eccles, J. S. (2002). The development of competence beliefs, expectancies for success, and achievement values from childhood to adolescence. In A. Wigfield & J. S. Eccles (Eds.), *Development of achievement motivation: A volume in the educational psychology series* (pp. 91-120). San Diego, CA: Academic Press.

Williams, D. C. (2004). *Trouble in river city: The social life of video games.* Unpublished Dissertation, University of Michigan, Ann Arbor, MI.

Williams, D. C. (2005). Bridging the methodological divide in game research. *Simulation & Gaming, 36*(4), 447-463.

Williamson, K. M., Land, L., Butler, B., & Ndahi, H. B. (2004). A structured framework for using games to teach mathematics and science in K-12 classrooms. *The Technology Teacher, 64*(3), 15-18.

Yee, N. (2006). The demographics, motivations and derived experiences of users of massively multi-user online graphical environments. *Presence: Teleoperators and Virtual Environments, 15*(3), 309-329.

Yuji, H. (1996). Computer games and information-processing skills. *Perceptual and motor skills, 83*(2), 643-647.