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Learning by Game Design for Library Instruction: A Multiple Case Study

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ABSTRACT

Despite the importance placed on information literacy in fostering lifelong learning, helping students develop the skills required of critical thinkers and independent learners are limited. This study contributes to the burgeoning discourse on alternative instructional approaches to teaching information literacy and focuses on the use of game design in learning environments.

The appeal of gaming among the younger generation of learners has led to the increasing use of games in learning environments. Within recent years, some innovative academic libraries have begun adopting games as a platform for information literacy instruction. While the literature recognizes game design as fostering higher-level learning in educational contexts, it is not commonly adopted in the classroom. Typically, there is a preference among instructors to have students play games. Therefore, a more thorough understanding on the ways game design best facilitate learning is needed to assist towards its more frequent adoption. This study focuses on the use of game design within library spaces.

The purpose of this study is to explore the experiences of undergraduate students learning by game design in information literacy classes. The overarching research question looks at how an instructor can incorporate motivational theories into an information literacy class through learning by game design and how students engage with the content and each other in this environment. More specific supporting questions address: How can an instructor incorporate motivational theories into an information literacy class through “learning by game design”? How does the “learning by game design” approach within information literacy classes foster the

sharing of knowledge among undergraduate students? How do undergraduate students represent information literacy concepts in the game-based artifacts they design? What were undergraduate students' motivations to use information literacy practices they were exposed to throughout their class experiences?

Applying a descriptive multi-site case study methodology, this study draws upon the theories of social constructivism, experiential learning, and motivation to explore the phenomenon of learning by game design in information literacy classes. Data was collected from two sites using various methods to provide a comprehensive view of the phenomenon. Data sources included: student's artifacts, submitted class assessment materials, recorded observation, participant observation, items from the Intrinsic Motivation Inventory (IMI) and interviews. Analysis was done by drawing meanings across the multiple instances of data.

Findings from this study show that learning by game design is a viable option for teaching information literacy classes, when effectively scaffolded into the classroom. Students were able to draw upon a higher order of cognition and described situated instances where information literacy skills were applied, such as use in complex assignments and real world situations.

LEARNING BY GAME DESIGN FOR LIBRARY INSTRUCTION
A Multiple Case Study

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CHAPTER I

INTRODUCTION

1.0 Introduction

This chapter introduces the phenomenon that will be addressed in this study and discusses the study's research problem. The nature of this problem is elaborated, and then the major concepts informing the research questions are discussed. The general and specific research questions is presented, followed by a list of operational definitions. The significance of this research is then explained, and audiences who have an interest in the research will be identified. Finally, this section will conclude with an overview of the chapters that follow in this document.

1.1 Problem Statement

The primary purpose of this research is to observe undergraduate student experiences in designing games in information literacy classes. This descriptive multi-site case study draws upon the theories of social constructivism, experiential learning, and motivation in order to explore the phenomenon of learning by game design in bridging the achievement gap in information literacy classes.

As information literacy has come to be seen as a vital requirement for lifelong learning, the teaching role of librarians has become increasingly important (Breivik, Gee, & Gordon, 1989; Rader, 1997; Breivik, 1998, Bruce, 2000; Rockman, 2002; Kuhlthau, 2004; Walter, 2006; Katz, 2013). This "instruction movement" began in academic libraries in the early 1970s (Zurkowski, 1974) and was spurred on by the increasing diversity of the student population, technological sophistication, and the rise of interdisciplinary approaches to academic research (Budd, 1998). As such, the importance of librarians' instructional roles became more and more critical over time (see Section 2.4 for further discussion). The goal of information literacy instruction is to help students become critical thinkers and independent learners. More specifically, it instills a readiness to question, the ability to function as an independent researcher, and a confidence in one's own ability to locate, identify, access, evaluate, and ethically use valid information in both physical and digital formats (Eisenberg and Berkowitz, 1990; Kasowitz-Scheer & Pasqualoni, 2002; Lindsay, 2004; Albitz, 2007). It also teaches students how to internalize these practices in order to transform themselves and society (Lupton & Bruce, 2010). The goal of information literacy instruction, therefore, is not merely to teach skills, but to teach the ability to build mental models for analyzing information and solving problems. This researcher believes that, in order to help information literacy instruction meet this goal, accepted manners of instruction needs to be revisited and alternative instructional methods need to be explored.

A large portion of the literature regarding information literacy reflects on the professional education concerns of academic librarians, the faculty views of librarians as instructors, instructional challenges like the struggle to maintain student interest, and programs that improve instructional effectiveness (Rader, 2000; Walter, 2006; Grassian & Kaplowitz, 2009; Saunders, 2012; Freedman, 2014). A librarian's opportunity to formally study different pedagogies are limited; because of this, many librarians rely on self-study, workshops, short courses, experimentation, and on-the-job training (Grassian & Kaplowitz, 2009).

Academic libraries are regarded as learning centers that assist the educational process of institutions by supporting their curricula; they are considered to be responsible for instruction in information literacy and for fostering critical thinking skills (Adams, 2009). Information literacy skills are regarded as the foundation of the democratic ideals to which libraries contribute, and the deficiency of these skills is regarded as a critical issue of national and international concern (Breivik, 2005; UNESCO, 2006; Andretta, 2007; Amudhavalli, 2010; Head, 2012). The recognition of the significance of information literacy as a learning outcome can foster greater opportunities for instructional collaboration between librarians and faculty; therefore, it can increase the demand for direct instruction (Kasowitz-Scheer & Pasqualoni, 2002; Badke, 2008; Saunders, 2012; Freedman, 2014).

Despite the importance placed on information literacy, it is not a requirement in the curricula of many colleges and universities; when taught, sessions in many cases are limited to single-hour sessions (Gross & Latham, 2007). These are commonly referred to as one-shot sessions. However, new opportunities (and, in some cases, requirements) have been created at certain institutions for librarians to develop and teach credit-bearing courses that concentrate on information literacy skills (Rader, 2002; Badke, 2008). These courses also focus on broader campus initiatives such as instruction in critical thinking, instruction in writing across the curriculum, and first-year-experience programs (Hollister, 2010; Rebmann, Molitor, & Rainey, 2012).

Despite some successes in the effort to increase the number of information literacy classes, keeping students engaged remains a challenge. Many librarians tend to employ a teacher-centered form or traditional form of instruction in the classroom, and many attest that keeping students' attention is a chronic problem (Head, 2012). Librarians note students signs of boredom by not following along, reading e-mails, sleeping, or just choosing not to participate in class activities (Eisenberg & Berkowitz, 1990; Gross & Latham, 2007; Head & Eisenberg, 2009; Head, 2102; Felker, 2014). Reasons for the lack of interest may vary among students; some might think that they are already skilled at finding information, while others might see the material as dull and tedious (Holman, 2000; Gross & Latham, 2007). This disinterest is reflected in the manner in which many college students locate, utilize, and internalize information relevant to the topics that they are studying (Asher, Duke, & Green, 2010; Kolowich, 2010; Felker, 2014). As reflected in their assignments, some students complete their undergraduate degree without ever achieving information literacy skills (Holman, 2000; Maughan, 2001; Gross & Latham, 2007; Katz, 2013). Typically, many college students tend to be satisfied with finding just enough information and expending just enough effort to fulfill the requirements of their assignments; they rarely see the need to seek assistance from librarians or other information professionals who are available at their institutions (Head & Eisenberg, 2009). An Educational Testing Services (ETS) study showed that only 13% of students from sixty-three institutions could be regarded as information literate (Katz, 2013). These figures are of great concern for librarians and educators, especially since information literacy is integrated into the educational standards for kindergarten through 12^{th} grade students (American Association of School Librarians, 2007). Despite this integration, college freshmen are still ill-equipped to analyze and synthesize information (Fitzgerald, 2004; Varlejs, Stec & Kwon, 2014).

The approach to information literacy instruction varies across libraries. Traditional approaches to instruction tend to common among libraries. Hepworth (2000) describes information literacy instruction as a continuum. At one end are discrete activities (for example searching a specific online database) that are done in isolation. At the other end, information literacy is integrated and contextualized in the curriculum of a discipline. There is a distinct bias towards ‘discrete’ activities, which are not part of a credit-bearing curriculum (Hrycaj and Russo, 2007; Head and Eisenberg, 2009). Despite this predominance, few librarians have explored social constructivist approaches that help in making the experience more situated.

According to Hepworth (2000), the best approach to teaching information literacy is by situating it within a discipline, employing a problem-based approach. Johnston & Webber (2003) disagree, stating this approach increases the likelihood that student's information literacy education will be patchy and incomplete and experienced in a reduced form. Calderhead's (2000), experiences echo similar concerns. She described her collaboration as the science librarian with a chemistry lecturer as a fruitful partnership, but lacking when it came to the information literacy content covered in the classroom. According to Johnston & Webber (2003) with the increasing importance being placed on information literacy, it deserves to be its own area of study. The fact that it fosters lifelong learning has the nuance of self-empowerment, not only associated with the world of work but overall continued self-improvement. As noted by ALA (2000), students are unable to learn everything in their field of study within their college years. A solid understanding of information literacy equips them with the critical skills necessary to become independent lifelong learners and better adapt to their changing world. Johnston & Webber (2003) sees with appropriate instructional methods stand-alone information literacy could help students in recognizing its importance from a personal level. Bruce (2000) sees reflective and experiential approaches that are foundational to constructivist theories to learning as more suited for achieving this form of personalization.

There is strong interest in constructivist approaches in teaching information literacy (Todd, 2002). However, in many cases the use of quizzes and prepared tests for assessments are at odds with constructivist theory. For example, popular teaching models such as Kuhlthau's information seeking model and the Big6 skills model have been criticized as inflexible towards constructivist approaches. While these approaches do advocate problem based learning, they are set in the context of a constraining linear framework, which forces students to move through steps in a specific order to solve problems. Understanding and making sense or creating one's own view of information literacy content within these models are limited. The assumption is that construction of meaning will be addressed in future subject specific classes Limberg, Alexandersson, Lantz-Andersson, & Folkesson (2008). Bawden (2008) saw constructive approaches as offering affordances to students by allowing them to compare and analyze their experiences; engaging in discussions and other reflective activities not necessarily addressed in traditional instruction models.

The incorporation of gaming activities embraces these constructive approaches in fostering construction of meaning and critical and reflective thinking (Prensky, 2008; Peepler & Kafai, 2008; Triantafyllakos, Palaigeorgiou, & Tsoukalas, 2011; Yang & Chang, 2013). Studies have theorized that gaming activities that focus on educational material can serve as effective instructional tools. This approach is regarded as beneficial because it addresses different learning styles, provides immediate feedback, increases student motivation, and enhances experiential learning; attributes which increase the chance of students achieving positive learning outcomes (Randel, Morris, Wetzel, & Whitehill, 1992; Doshi, 2006; Peepler & Kafai, 2008). While there is an abundance of theory regarding the benefits of gaming environments, empirical data is not very common among the studies that have addressed this idea. The benefit of having students design games, furthermore, is an even newer field of research. This study will attempt to help fill that gap by exploring the impact of game-designing activities in learning environments.

1.2 Concepts Informing Research Questions

This section discusses the primary concepts that are addressed by the study’s research questions. The relationships among these concepts will be considered and further elaborated in the literature review (Chapter 2). The effects of theories regarding learning and information literacy instruction will be examined here, followed by a consideration of the process of learning by game design. This section will conclude with a discussion about how these processes influence student motivation.

1.2.1 Guiding Learning Theory

This study is concerned with the social construction of knowledge through the experience of designing games as teams and creating artifacts that are representative of the understanding of content. As such, learning by game design can be understood through both the theoretical and pedagogical perspectives (see Section 2.1).

The social constructivist, constructionist, knowledge as design and experiential learning philosophies embodied in this learning approach encourages students to use their prior knowledge and experiences to learn. Constructing and creating artifacts like games presumably helps students to reformulate their understanding and express their personal ideas and feelings about the subjects and the artifacts (Kafai, 2005; Papert, 1980). By designing games, learners take on many roles; they become users, creators, story-builders, programmers, and even teachers (Robertson & Howells, 2008), since designing these gaming artifacts for others' use presumably improves learning by encouraging teaching (Rieber, Lunk, & Smith, 1998). Within this activity, furthermore, the student becomes an active participant and problem-solver (Resnick, 2007). The student becomes empowered by choosing how to learn the material that is taught (Rieber, Lunk, & Smith, 1998).

Because it emphasizes social interactions and the personal understanding and knowledge that is constructed by the learner, social constructivism theory serves as the overarching guide to this research. Social constructivism fosters learning that is iterative, lifelong, and active and encourages higher-level thinking and reflection. Most importantly, it is social in nature. Social constructivist methods of education are situated within authentic tasks that address real-life situations. Instructors who take the social constructivist approach assist students to adopt responsibility for their own learning processes. Assessments within social constructivism, focus more on the learners' reflections about their accomplishments than on fact-based assignments like multiple-choice tests. Individuals learn based on interactions between what they already know and believe and new ideas or knowledge (Resnick, 1989). By providing learners with a classroom environment that encompasses social constructivist concepts, it is possible to generate a growth of knowledge, a higher degree of critical thinking, and an overall improvement of skills (Lloyd, 2007).

One of the advantages of using social constructivism in the classroom is that students become actively involved in the learning process. For instructors, social constructivism affords the opportunity to create an environment where students can explore and make discoveries. Students are both learners and teachers in a social constructivist paradigm, and instructors act as guides or facilitators. The fundamental underpinnings of social constructivist pedagogies are discussed further in the literature review.

1.2.2 Information Literacy Instruction

Many librarians are not trained as educators and learn how to teach information literacy on the job (Grassian & Kaplowitz, 2009). Information literacy is about not only teaching students to locate resources related to their assignments; but also internalizing these practices to transform their lives. Despite attempts in the related literature to broaden this definition, many librarians do not develop content that goes beyond this theme (Zhang, 2006). As Maki (2004) notes, information literacy education is about cultivating the kind of thinking and knowledge that leads to an understanding of attitudes, values, and ways of knowing.

Kong (2008) and Kang, Heo, Jo, Shin, and Seo (2010) categorize information literacy education through four perspectives: the cognitive perspective, the meta-cognitive perspective, the affective perspective, and the socio-cultural perspective. The cognitive perspective demonstrates the information skills that are necessary to make informed decisions and solve problems; the meta-cognitive perspective addresses reflection, the affective perspective appreciates the process of inquiry, and the socio-cultural perspective demonstrates the social responsibility of information use.

The challenge for librarians is creating classes that can foster these levels of thinking. Zhang (2007) stresses how important it is for librarians to avoid the lecture approach. She advises them to give students the opportunity to create their own learning experiences. There has been an increased amount of attention within library literature in recent years about integrating more active learning models into the lessons. Wiggins (1998) and Scharf, Elliot, Huey, Briller and Joshi (2007) help to clarify the purpose of authentic assessments, a type of formative assessment that evaluates students' learning by requiring them to solve problems that reflect real-world situations. Unlike the typical tests that offer just a grade or a score, authentic assessments provide critical feedback to students, allowing them to identify and correct their errors. In his highly cited evaluation process, Callison (1998) describes authentic assessment as involving multiple forms of performance measurement to appraise the student's learning, achievements, motivation, and attitude regarding instructionally relevant activities.

The principles of authentic assessment mesh well with the idea of learning by game design. The intent of learning by game design is to help students gain insight into their own thought processes and to gather information about how to approach problems, make judgments, investigate options, and revise strategies. Other librarians who have been exploring problem-based, inquiry-based, discovery-centered learning have had students design activities and games in order to challenge them to actively engage with information and resources in order to solve problems and create knowledge (Owusu-Ansah, 2004; Levine, 2007; Prince & Felder, 2007; Walsh & Cuba, 2009; Moline, 2010; Van Loon & Lai, 2014). The adoption of these approaches to instruction is meant to serve as a precursor to intellectual development and encourage a deeper, more complex approach to learning (Owusu-Ansah, 2004; Prince & Felder, 2007).

It is not always easy for educators to transition from the traditional lecture approach to more experiential approaches (Ulmer & Fawley, 2009), and the emphasis on teaching generic information-seeking skills is still common (Grafstein, 2002; Varlejs, et al., 2014). Lichtenstein (2000) and Smale (2011) note that librarians often design information literacy classes without paying attention to learning theories or pedagogies. Pedagogical approaches that are based on the social constructivist approach make a conscious effort to move from the "traditional, objectivist models" and "didactic, memory-oriented transmission models" to a more student-centered approach. In the social constructivist environment, learning occurs through the construction of new knowledge based on prior knowledge and the acquisition and practice of new skills, new attitudes, and new values, a type of learning that is necessary in a changing world. To achieve this involves the use of teaching strategies that put the student at the center of learning, resulting in active and experiential learning (Kolb & Kolb, 2005). The onus is therefore on the librarian to experiment with different pedagogies in designing classroom tasks; the librarian must attempt to facilitate learning by making the learners responsible for their own progress (McDevitt, 2013). Pedagogical approaches that teach facts and the ability to use them at the same time are consistent with self-directed, independent, active forms of learning (Perkins, 1986). One of these approaches is constructionism, where learners come up with new ideas when actively engaged in creating external artifacts (Papert, 1991). These approaches will be discussed further in Chapter 2.

1.2.3 Integrating Learning by Game Design into Information Literacy Classes

The incorporation of using games to foster experimental and active learning in information literacy classes was discussed as early as 1935 by Willoughby. The idea was again featured in the literature as a step-by-step approach in 1958 (see the School Library Association of California publication “Library Skills: Teaching Library Use through Games and Devices”). Similar ideas were documented by Crump and Crump (1979) and Wilhelm and Wilhelm (1982). These instructional approaches were mainly discussed for use within school library domains. The catalysts for the acceptance of games within library instruction have been support from mainstream spokespersons, the availability of new technologies, the proliferation of game programs in libraries, and the theorized learning style of the 21st century learner. There is a much-debated idea that teaching the 21st century learner requires a large-scale rethinking of learning pedagogies. According to Beetham and Sharpe (2013), however, the theories of Dewey, Vygotsky, and Papert have provided a fundamental understanding of the active, experiential, and collaborative approaches to formal learning that are now considered essential to the classroom. In information literacy instruction, games can be used as part of these learning approaches.

Mainstream spokespersons urge librarians to use games into their curricula (Squire & Steinkuehler, 2005). Many libraries, over the past decade, have incorporated game-based learning; this has been evidenced by the increasing literature on the subject (McDevitt, 2011) and the establishment of the Games and Gaming Round Table at the American Library Association (ALA) , the national professional organization for librarians in the United States which is primarily focused on recreational games in libraries.

Why use games for instruction? As mentioned above, educators are now faced with 21st century learners, also known as “Generation Z”; this is the generation that has grown up with digital technologies, and it now constitutes the majority of undergraduate students. Many higher education institutions are now filled with students who have little interest in learning from the traditional expository point of view (Proserpio & Gioia, 2007; Cuban, 1986). Scholars agree that these learners prefer learning by doing, and being able to address mistakes in a safe space is the crucial part of this method.

The use of game designing within the curricula of libraries is limited; as its potential instructional benefits in promoting creativity and literacy skills are being recognized, however, its acceptance is becoming more widespread (Mulligan, Kelsey, & Davis, 2007; Nelson, Christopher, & Mims, 2009). As a method of instruction, designing games teaches learners how to develop their own problem-solving strategies; in other words, it teaches them to use and evaluate information sources while developing successful strategies for conducting research to solve problems. Students who participate in game designing have the opportunity to become producers of of their own creations that teach information literacy concepts.

Libraries like the Minneapolis Public Library, the McKinley Technology High School in Washington, D.C., and the Broward County Library System in Florida have game designing programs as part of their general game offerings, but is not extended to instruction (Mulligan, Kelsey, & Davis, 2007). Some libraries have taken creative game-designing activities a step further, embracing the phenomenon of “makerspaces.” Makerspaces are spaces that foster maker culture, transforming the traditional understanding of the library space. The maker movement is not only about doing it yourself (DIY): it also brings individuals together around a range of activities (Peppler & Bender, 2013; Halverson & Sheridan, 2014). Shared knowledge and peer-led learning are the fundamental characteristics of maker culture (Sharples et al., 2013, p. 34). However, these activities are not usually held within the formal classroom and do not usually involve learning of information literacy concepts.

In the classroom, games can be designed through the use of free software programs or everyday tools and materials. According to Kafai (2006) and Hastie (2010), more emphasis should be placed on making games as a method of learning instead of just playing games. Despite the interest in game design and its purported theoretical potential for fostering a deep engagement in learning, the processes and outcomes of learning when using this approach are not well understood. Learning by game design holds great potential for improving information literacy instruction. It has the potential of helping students learn to use concepts rather than simply memorizing definitions. The traditional approaches of instruction that are commonplace have already proven insufficient in reaching intended learning objectives. Contrary to approaches that integrate games into instructional sessions where the learner is the player, learning by game design places the student in the role of the producer. More specifically, learning by game design is the process of completing a collaborative design task that promotes a high level of engagement with subject content (Kafai, 1995).

This study explores the use of this instructional approach within the library space as a potentially effective way of teaching information literacy concepts. Students work in teams to design and create artifacts that demonstrate their knowledge of information literacy content. According to Sennett (2008), “making is thinking” (p. ix); the act of designing and creating an artifact that represents what learners know might provide evidence of the understanding, consideration, and future use of that content. In other words, these artifacts might represent more than just superficial thinking: They might reflect a deeper level of critical thinking that goes beyond memorization or recall.

1.2.4 Maintaining Motivation in Instructional Activities

The willingness or desire to engage in a task is termed “motivation”; it refers to an individual’s level of engagement and his or her intensity of effort or persistence in that activity (Pintrich & Schrauben, 1992; Wolters, 2003). Individuals are moved by motivational factors that can be either intrinsic or extrinsic. Intrinsic motivations come from within the learner, such as the learner’s curiosity about a subject or drive to excel. Extrinsic motivators, on the other hand, are external conditions such as rewards and grades. Highly motivated individuals are more likely to engage in, devote effort to, and persist with a particular activity. However, the motivation to learn begins to wane during the early learning years and continues to decline thereafter (Lepper, Corups, & Iyengar, 2005). Many students in higher education have an alienated attitude about learning, thinking it confined to school-related activities (Battersby, 1999; Crow, 2007). Crow (2007) indicates that the core of information literacy instruction is fostering that intrinsic motivation towards learning. Additionally, Crow (2007) shows how self-determination theory can be used to develop environments that foster the desire to learn. Self-determination theory explains the psychological needs that must be met in order for intrinsic motivations to be maintained (Ryan & Deci, 2000). This theory is addressed in more detail in Chapter 2.

Many research studies suggest that gaming activities in the classroom can motivate learners (Lepper & Malone, 1987; Malone, 1980, 1983; Malouf, 1988; Dempsey, Lucassen, Gilley, & Rasmussen, 1993; Jacobs & Dempsey, 1993; Dempsey, Rasmussen, & Lucassen, 1994). As early as 1969, Cohen found that 87% of students reported greater interest in the classroom when educational games were used as a pedagogical approach. Pierfy’s (1977) review of twenty-two comparative simulation gaming studies concluded that simulations and games instill greater retention and interest over time than conventional classroom instruction. Randel, Morris, Wetzel, and Whitehill's (1992) meta-study of 68 studies conducted between 1963 and 1991 concluded that game-type activities are consistently perceived as more interesting than traditional instruction. Games are effective at varied education levels because they are fun, appealing, and create learner-centered environments (Ebner & Holzinger, 2007; Prensky, 2001).

It can be argued that part of this increase in motivation may come from the novelty of the gaming activity. However, the primary goal when using games in the classroom is to motivate learners to value the content being learned (Papert, 1997). Researchers such as Gee (2003) and Fletcher and Tobias (2006) see a need for a greater focus on learning outcomes and the value of content (Brophy, 2008). Therefore, one of the intentions of this study is to measure students' intrinsic motivation by identifying levels of learning and valuations of the subject content. The Intrinsic Motivation Inventory (IMI) is selected to accomplish this because of its broad coverage of the concept (Ryan & Deci, 2000). This instrument and its subscales will be explored further in the literature review and methodology chapters.

1.3 Research Questions

Designing and implementing strategies to support learning requires understanding the classroom environment and ensuring that learned content will later be utilized. The use of game design or game-based learning approaches for instruction may not always result in an effective learning experience. There are several variables involved in creating a successful learning experience. When incorporating game-design activities, an instructor has to ensure that the format of the lesson is motivating, self-regulated, and appropriately challenging; the process must also offer some level of autonomy that allows the individual to become a builder of knowledge. The theoretical framework (see Figure 2.1) of this study captures these variables and drives the research questions. It was also an integral part of designing the study learning environment. This framework will be discussed in more detail in Chapter 2.

The use of game design activities is considered representative of operational translations of constructivist learning theories. Game design based activities have the potential to situate learning within meaningful contexts and empower students to become self-regulated and draw upon multiple domains of knowledge. There is little consensus among researchers about the aspects of game design that support learning, the process by which designing games motivates and engages learners, or the type of learning that can be achieved through this activity. Therefore, the overarching question of this study is *How can an instructor incorporate motivational theories into an information literacy class through learning by game design and how do students engage with the content and each other in this environment?*

To help is answer this question the researcher visualizes the incorporation of the instructional approach from the lens of system theory input/output behavior (Zeigler, Praehofer & Kim, 2000). The first research question focuses on the input of the learning by game design approach. The second question focuses on the process of students engaging with each other. The third question examines the output of how students embed information literacy concepts into their games. The fourth question explores the outcomes from the learning by game design approach, specifically how students' use their information literacy skills. This framing drives the four key observations of the specific research questions, which are as follows:

RQ1: How can an instructor incorporate motivational theories into an information literacy class through "learning by game design"?

RQ2: How does the “learning by game design” approach within information literacy classes foster the sharing of knowledge among undergraduate students?

RQ3: How do undergraduate students represent information literacy concepts in the game-based artifacts they design?

RQ4: What were undergraduate students’ motivations to use information literacy practices they were exposed to throughout their class experiences?

1.3.1 Specific Research Question 1

The first question emphasizes efforts taken by the instructor to design the class to support student motivation. Game-like environments are appealing to students, but there are indications that this acceptance cannot be taken for granted. Although many students prefer game-related activities, some may be more comfortable in more a traditional classroom environment. Some studies report mixed results regarding the effectiveness of games in the classroom. Before immersing students into nontraditional learning environments, the instructor needs to put the acceptance of the gaming activity into perspective. At times, this approach may not always be embraced. Therefore, the educator needs to consider the degree to which a student believes that designing games can offer him or her learning opportunities. Learners have a diversity of backgrounds, goals, personal and work experiences, and learning styles (Bruffee, 1995; Fleming, 2006; Kemp, Morrison, & Ross, 2004; Kolb & Kolb, 2005; Smith & MacGregor, 1992). Fleming (2006) and Kolb & Kolb (2005) indicate that it is imperative for educators to consider the variety of student learning styles; as these different styles drive the conclusions and judgments that students make about learning as well as influencing how they perceive and interact within the learning environment.

There are certain characteristics that a design-based activity must possess in order to potentially foster learning. Because of the interdisciplinary nature of learning by designing games, this could be problematic. Using the activity of designing games to improve learning may not necessarily work within the same framework as other types of learning activities. Research has shown that the technique is effective, but problems can exist when teaching both subject area content as well as the necessary design-related content (Barbour, Thomas, Rauscher, & Rieber, 2009). The time commitment that is involved is one major concern among instructors with using game designing activities because, in addition to the subject content, students and instructors must also understand how to design the game. This can cause a steep learning curve. It is crucial, therefore, to give learners choices to create relevant games that encourage engagement with the subject content.

In previous studies, the primary goal of making games in the classroom has frequently been to enhance fluency with programming. As such, several game-designing toolkits serve a dual purpose, allowing users to make games by interacting with new media and simplifying programming concepts so that they can be readily grasped. Many of these studies do not address the explicit instructional guidance that was provided to the students in how to design their games. As noted by Razzouk and Shute (2012), the design process is dynamic in nature because of individual differences in prior knowledge; abilities to think critically and the social culture of the design environment (e.g., the division of the cognitive labor).

The task of incorporating game design activities into a class is not a simple one. The creative investment of the game design process by the student should be sufficiently challenging to sustain interest. The instructor has to ensure that students are motivated by alternative forms of instruction, by providing clear and attainable goals within the learner current ability and knowledge. Therefore, best approaches need to be considered in scaffolding content Vygotsky (1978). Therefore, the first research question examines how an instructor can incorporate motivational theories into an information literacy class through “learning by game design”.

1.3.2 Specific Research Question 2

The second research question explores the sharing knowledge among students. When used in a class design, this approach allows students to work together, fostering social exchanges that are underscored by social constructivism. Designing and sharing with others helps students to concretize their ideas and establish personal connections with their creations (Wu, 2001). The game-making process is not just representative of the learner’s personal expression: It is a reformulation of the content covered in the classroom. Additionally, Papert emphasizes how artifacts that have been designed can become resources for both the designers and the rest of their learning communities (1991).

For this study, students will develop game artifacts as a team and collaborate with their peers when testing. Communication and the convergence of ideas are considered critical to support the process of design as a collaborative unit (Stempfle & Badke-Schaube, 2002). Studies suggest that designing, as a team process, is affected by various individual and social factors (Bucciarelli, 1994; Beckman & Barry, 2007). According to Bucciarelli (1994), team members filter the design ideas and solutions according to each individual’s own inherent skills; this process makes it possible for the teams’ output to be indicative of an intersection of individuals rather than a summation. Stempfle and Badke-Schaube (2002) see disagreements, the lack of common understanding, and the challenging of ideas as among the key elements that influence a team’s thinking process. In other words, the collaborative game-designing process provides a learning environment for individual reflection and team discussion, enabling students to gain a deeper understanding of the concepts that are being taught. It teaches them to work together to apply their knowledge to the designed artifact, planning, representing their thinking, and self-assessing and revising their thinking as needed (Barron et al., 1998).

Peer testing is another way that students collaborate. This approach embodies the social process of constructionism, which emphasizes sharing or the peer reviewing of artifacts. By peer testing, students engage in a more collaborative way with their classmates, presenting their games to classmates outside of their teams and play testing other teams' creations. Viewing how others interact with their games helps students to justify such things as rules, game mechanisms, and other aspects of their designs. The teams then recoup in order to decide how to revise their designs based on the feedback received from their peers. Kafai (1996) notes that these testing processes not only assess the educational processes of the games created, but serve as a platform to build a community of practice. To understand how students interact with this process, the second research question explores collaboration and sharing among team members and peers.

1.3.3 Specific Research Question 3

The third research question explores the how students represent information literacy concepts in the games they created. Learning by game design offers a range of activities to help students move their knowledge from an internal to external process (Papert, 1991). In other words, the steps that students go through during game design help them represent their understanding through a sharable artifact.

When designing game artifacts, students can use different strategies. For example, they can choose to be original in their design or to modify a game with which they are already familiar. Constructionism and experiential learning see the design of artifacts as a cyclical process in which acquired knowledge emphasizes the reflection that occurs throughout. The students move from active planning, to design, to sharing, to revision. More specifically:

- Students use their declarative knowledge and skills to plan a design.
- They produce artifacts using available resources and instructor's assistance.
- They peer-test the artifact or share draft ideas with the class.
- They receive feedback from their colleagues.
- They then make revisions as needed and begin the cycle anew.

In this study, students will go through these steps as they incorporate information literacy concepts into their games. To understand this process the third question looks at the representation of information literacy concepts.

1.3.4 Specific Research Question 4

The fourth question examines student's use of information literacy skills by the instructional approach. The challenge faced by librarians is to motivate students to adopt the information literacy skills into their information consumption habits. Studies show that games can motivate students to engage with content that might otherwise be considered tedious. Games that encompass educational objectives and subject matter are believed to hold the potential to render learning of more student-centered, more enjoyable, more interesting, and, therefore effective (Kafai, 2001; Prensky, 2001). Learning by game design encourages active participation, giving students a greater sense of control and responsibility to their learning processes and their creations. This is different from the ubiquitous traditional information literacy classroom where the instructor aims to "transmit" new information to the students. The lesson that is presented through designing a game "avoids a right/wrong dichotomy and suggests multiple strategies and solutions" (Resnick & Rusk, 1996, p. 434). In order for students to gain a deeper understanding they need to create, construct (Papert, 1991), and reflect (Perkins, 1986; Kolb & Kolb, 2009).

The understanding of students' incentives to adopt learned skills when designing games around the content is still in its infancy; as such, there is a lack of empirical research addressing student learning in this manner. In addition, studies do not necessarily focus on whether what is learned in the classroom has a continued effect after the instruction is completed. Despite the preponderance of recent literature advocating the effectiveness of games for learning, there is limited evidence that designing games can achieve transference of skills from one situation to another. The fourth research question, therefore, examines undergraduate students' motivations to use information literacy practices they were exposed to throughout their class experiences.

This study focuses on individual undergraduate students in the social setting of the classroom and their incorporation, understanding, and use of information literacy concepts through learning by game design. These concepts include identifying what information is needed, understanding how that information is organized, identifying the best sources of information for a given need, locating the sources needed, evaluating those sources critically, sharing the gathered information, and internalizing this process for lifelong learning. To explore the research questions a descriptive case study methodology is employed. The specific methods and steps involved in analyzing the data in discussed in Chapter 3.

1.4 Operational Definitions

Throughout this dissertation and within the context of this study, the following definitions of the terms listed below will be applied:

Experiential Instruction: This is an active form of instruction that is learner centered, authentic and self-directed (Lindsey & Berger, 2009).

Traditional Instruction: This is a passive approach to instruction that is teacher-centered and associated with passive learning environments. It is characterized by direct instruction, which usually includes the presentation of material, thinking aloud by the instructor, guided practice, correction and feedback, and modeling by the instructor. The instructor plays the role of the expert imparting knowledge. (Kinney &Robertson, 2003; Kohn, 2008).

Games: Games are “form[s] of play with goals and structure" (Maroney, 2001, para. 2). This study focuses on all game types.

Game-based learning (GBL): GBL is the playing of games designed to bring about defined learning outcomes. It balances subject matter with gameplay so that players retain and apply the learned subject matter (Garris, Ahlers, & Driskell, 2002; Pivec, 2007).

Game design: Game design is an iterative process of conceptualization by which a created game is repeatedly proposed, prototyped, play-tested and reevaluated prior to the creation of a working product. The idea of “design” represents a broad class of experiences, but a key experience is that of learning by engaging in design-and-build challenges (Kolodner et al., 2003).

Instruction: Instruction is the range of activities that teachers employ to engage students in learning (Gagné, Wager, Golas, & Keller, 2005).

Instruction Librarian: A librarian who instructs formally on topics related to information literacy and research skills. Instruction librarians prepare for both credit-bearing courses and one-time class sessions.

Information literacy: This literacy forms the basis for lifelong learning. It is common to all disciplines. Its acquisition enables learners to master content and extend their investigations, become more self-directed, therefore assuming greater control over their own learning. An information literate individual is regarded as being able to determine the extent of information needed, access the needed information effectively and efficiently, evaluate information and its sources critically, incorporate selected information into one's knowledge base, use information effectively to accomplish a specific purpose and understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally (ACRL 2000).

Information literacy classes: These can be one-shot or semester long classes. In one-shot classes the librarian is invited as a guest speaker by faculty to introduce information literacy basics. Semester long classes are initiated by libraries, and taught by instruction librarians. The three major components addressed in information literacy classes are the acquisition of skills, assistance in the construction of knowledge, and the fostering of critical thinking in students (Kerr, 2010).

Peer testing: Peer testing is the process in which teams of students showcase their own game prototypes, play with others, and receiving comments and suggestions for improvement.

1.5 Significance

Libraries have been around for thousands of years, but their relevance in the digital age is often questioned because their economic and social impact is not well understood. A number of transformative activities are happening within library communities to help address this misunderstanding. Some of the more popular of these activities are game-based. Current and future generation of college students (labelled as "21st century learners" or the "Z Generation") are regarded as active learners; they choose to learn by doing instead of learning by listening (Anderson, 2004; Proserpio & Gioia, 2004). Therefore, many Z Generation students prefer to learn through constructivist-type activities, the use of technology, and teamwork. Students' strengths include multitasking, goal orientation, positive attitudes, and a shared style of learning (Geck, 2013). This generation of students, born in the late 1990s, is much like the Millennials in that they require a flexible and engaging learning environment (Kuranda, 2013). Gaming has been identified as a way to teach the Z Generation that provides this (DeVary, 2008; Lenhart, Jones, & Macgill, 2008; Kuranda, 2013).

However, the use of games in helping to advance knowledge and literacy has not been well explored by librarians. Current research has proposed that games designed around educational goals can serve as effective instructional tools. In the existing literature on this topic, there is an explicit connection between game design and the formally accepted theory and models of teaching and learning. Jim Gee's popular book *What Videogames Teach Us About Learning and Literacy* helped to catalyze the discussion about games (especially video games) and learning in the academic and public arena. Gee's 36 principles for learning through games (2003) explicitly discuss mapping the accepted learning and instructional design theories and models to commercial digital games. Compared to other types of instructional strategies, there are few studies that examine the range of effects of gaming environments on learning. Also there is a corresponding lack of theory and practice for their design and implementation (Van Eck, 2008). Noticeably absent from many of these discussions is the promising activity of game-making (Kafai, 2005; Hastie, 2010; Vos, van der Meijden, & Denessen, 2011). From a general perspective, this study will help to fill in some of the empirical data regarding the benefits of learning by game design. It will also explore the gap in the literature about learning by design as a pedagogical approach in the 21st century, linking this topic to the larger group of studies concerned with the learning potential of games. It will also provide evidence of how to employ active and engaging learning approaches in the library.

Furthermore, this study will make a significant contribution to the burgeoning discourse on alternative instructional approaches to teaching information literacy and, ultimately, other topics. Despite the considerable interest in game design and the purported theoretical potential for deep engagement in learning, the application, processes, and outcomes of learning in this way are still not well understood. As instructors strive for greater class participation and improved student learning, there is a greater mainstream acceptance of this approach. Learning by game design has become more prevalent among K-12 schools, especially within afterschool programs and computer lab activities. While its incorporation is still limited when it comes to the traditional classroom, it has been explored in a variety of domains. Game designing has been employed as a teaching technique within the fields of programming (Kelleher, 2006; Robertson, 2012), computer science (Kafai, Franke, Ching, & Shih, 1998), nutrition (Baytak, Land, & Smith, 2008), mathematics (Harel & Papert, 1991), and story-building (Kindborg & Sökjer, 2007; Carbonaro, Szafron, Cutumisu, & Schaeffer, 2010; Robertson, 2012; Denner, Werner, & Ortiz, 2012).

The findings of this research will provide a new understanding of learning by game design in information literacy instruction and game-based learning in libraries and other teaching environments. It provides an empirical basis to examine and evaluate different instructional strategies and a framework for instruction librarians and educators to test their values and beliefs about learning by game design. A meta-analysis conducted by Wu et al. (2012) reported that the majority of published studies on this topic were not based on learning theories and were mainly descriptive. This study is constructed around constructivist theories, and it will contribute to the growing body of literature surrounding the phenomenon of learning by designing games and the activity's ability to facilitate deeper levels of understanding.

1.6 Audience

This study will have two primary audiences: the academic researcher and the librarian practitioner. While the dissertation research is primarily oriented towards an academic audience, it seeks to address questions that are relevant to the practitioner-based community as well.

This study overlaps with the emergent efforts of education scientists to examine the impact of new technologies on learning and literacy today. As our personal communication technologies, Internet forums, and design and entertainment technologies become ubiquitous, our notions of literacy expand. The study of new literacies refers to a new way of looking at literacy as well as the study of new forms of literacy (Street, 1993; Barton & Rivet, 2004; Gee, 1996; Lankshear & Knobel, 2003). The varied forms of new literacies within this wide field include oral literacy, visual literacy, information literacy, science literacy, emotional literacy, and many others. This proposed study situates itself among the group of educators and academic researchers who are interested in examining diversified notions of literacy and the impact of new technologies on learning.

This study will also contribute to changes in library practice. Practitioner audiences are expected to benefit most immediately and directly from this research. Specifically, the study will produce findings that can support improving information literacy instruction by combining new features with traditional instruction. In particular, it can provide an opportunity to identify the best practices and the most effective use of learning by game design activities in information literacy instruction. Librarians have been challenged by the proliferation of digital media, Internet access, e-books, and online retailers transforming the manner in which information is delivered. As such, librarians play an increasingly vital role in helping people to develop the skills and the required literacies that they need in order to participate in today's society. This study can assist in helping these professionals by providing a clear overview of information literacy education with a well-grounded starting point.

1.7 Organization of Document

This section provides an overview of the remaining chapters of this dissertation and briefly summarizes the contents of the following sections. This document is organized into five chapters. Chapter 1 states the problem and discusses the purpose of the study, the theories that inform the research questions, the specific research questions, the significance of the study, and the audience of the study. Chapter 2 consists of a review of the relevant literature and the study's theoretical framework. Chapter 3 provides information on the research design, the data collection procedures, the validity and reliability of the data, the procedures for the analysis of the data, and the role and biases of the researcher. Chapter 4 presents the finding of the study. Lastly, Chapter 5 aggregate findings and provides discussions, outlines the conclusions drawn, implications, limitations and potentials for future research.

1.7.1 Literature Review

Chapter 2 will begin by describing the theoretical framework that is being used to explore the phenomenon of interest. From a theoretical perspective, learning by game design is grounded in constructivist theories of knowing. The elements of this theoretical framework will be described, these being social constructivism, the pedagogical foundation (constructionism and knowledge by design), experiential learning, motivation, and play and learning by game design within an information literacy frame. Recent studies that use game design will be discussed, with a focus on their methods, design environments, and findings. The history of learning by game design within the arena of information literacy will be reviewed. Concerns surrounding information literacy and the presently widespread teaching models will then be discussed. The review will end with an analysis of the incorporation and acceptance of games in libraries.

1.7.2 Methodology

Chapter 3 will discuss this study's research design, which is that of a descriptive case study. The theoretical framework of this design provides the focus for data collection and analysis. A brief report of the pilot study will be included in this section. The goals of the pilot study were to test the first methods that were proposed and to explore the logistics behind doing a study of this nature. The initial research design was revised based on the findings from the pilot. The rationale behind choosing a descriptive case study approach will be discussed in this section, followed by an explanation of the criteria that were used for case selection. This section will also explain the methods that will be used to collect and analyze data. The researcher will then articulate her personal and professional biases, since it is critical that these be recognized in order to avoid coloring the study's interpretations and results.

1.7.3 Findings (Within Case Analysis)

Chapter 4 describes the findings from the two cases. The researcher analyses the relationships evident in the cases and relates the findings to the research questions. Since this is a multiple case study, this chapter is structured so that each case is considered individually. Therefore, each case is presented separately providing an in depth understanding and description of the learning by game design phenomenon. This helps in illustrating the emergence of the each case's unique attributes, before attempting to locate general patterns and themes that exist across the two cases.

1.7.4 Discussion (Cross Case Analysis) and Conclusions

Chapter 5 presents the aggregated findings from the two cases. The ensuing discussions draw upon the theoretical framework and literature. The researcher then reviews how the forgoing sub research questions answers the main inquiry and the conclusions drawn. The limitation of the study is then discussed followed by the implications for libraries. This chapter ends by discussing future steps for further exploration.

CHAPTER II

LITERATURE REVIEW

2.0 Introduction

This chapter provides the background information that is necessary for understanding the context of this study. It is situated in the existing literature related to learning theories, game design, gaming in libraries, and the current state of information literacy. First, a review of the learning theories that informs the phenomenon, learning by game design. This is followed by an exploration of recent studies that have used game design in different learning environments with an emphasis on developing artifacts. The researcher then focuses on information literacy, its importance for 21st century learners, concerns about students' skills and commonly reported teaching models. This chapter concludes with a review on the acceptance of games in libraries, and among students and educators.

2.1 Theoretical Framework

The researcher draws on a number of constructivist theories to operationalize learning by game design in this study. There are multiple forms of constructivism evident within the existing literature and since this study is concerned with the construction of knowledge through social experiences, social constructivism serves as the foundational theory. The researcher reinforces this constructivist thinking by drawing on instructional theories that incorporates the guiding principles of the foundational theory. The nuances from constructivist pedagogies (such as constructionism, knowledge as design and experiential learning) and motivation contribute to the instructional paradigm for this study. The phenomenon of learning by game design is understood through these interrelated theoretical and pedagogical perspectives. The theoretical framework is discussed in the following sections. A systematic review of each theory and its interrelationship are first addressed. This is followed by a visualization of these interrelationships shown is Figure 2.1.

2.1.1 Constructivism: Social Constructivism Focus

Constructivism is an epistemology that describes how learners develop types of knowledge and understandings of that knowledge that are unique and meaningful. It is founded on the premise that individuals construct “mental models” in order to make sense of experiences. These constructions might initially bear little relationship to reality, but they become more complex and realistic over time.

John Dewey articulated the original constructivist theory. He supported the notion of “continual reconstruction” and focused on the process of learning rather than its end product. The idea of engaging students in learning experiences that interested them was central to his philosophy. Piaget, referred to as the “progenitor of constructivism” (von Glasersfeld, 1997, para. 3), and advanced Dewey’s notions of the construction of knowledge within the field of psychology.

There are many faces of constructivism. Doolittle and Camp’s (1999) view of constructivism resonates with this present study: they posited that constructivist philosophies exist on a continuum that involves cognitive, social, and radical constructionism, each philosophy varying on whether it considers knowledge and reality to be subjective or objective. On one end of this continuum, cognitive constructivism assumes that knowledge is objective and separate from the learner. On the other end of the continuum, radical constructivism assumes that all knowledge is subjective and a construct that is created by the individual learner. Social constructivism lies in the middle of this spectrum because it assumes that knowledge is subjective, constructed through a shared social system. Within social constructivism, learners construct meaning based on the socially defined nature of the knowledge that they are given.

Aside from Doolittle and Camp's continuum, there are two historical constructivist perspectives: psychological constructivism and social constructivism. Psychological or Piagetian constructivism involves the belief that "reality is not an absolute but a construction based on our past experiences and our current cognitive structures" (Bjorklund, 2000, p. 76). Piaget stated that, "life is a continuous creation of increasingly complex forms and a progressive balancing of these forms with the environment" (Piaget, 1952, p. 3). In other words, Piaget regarded cognition as an art in which individuals construct reality as a function of what they perceive in the external world and their cognitive structures (Bjorklund, 2000, p. 254). This allows individuals to create new and distinctive interpretations of knowledge based on their unique interactions with their environments (Bjorklund, 2000).

Piaget and Vygotsky differed in their ideas of cognitive development and their opinions of the settings under which the optimum conditions for learning exist (Nyikos & Hashimoto, 1997, p. 509). Building on social constructivist philosophy, Vygotsky believed that thought evolves from both an individual's experiences and maturation process (Manus, 1996). His views diverged from Piaget's in his argument that constructs have social and cultural origins and are learned through the collaborative process (Oxford, 1997). Implementing this view in the classroom means establishing communities of learners to promote peer learning and the co-construction of knowledge. This social learning process is "the distance between the actual developmental levels as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). Vygotsky believed that learning takes place within the Zone of Proximal Development (ZPD). In this zone, the learners, with assistance from instructors or peers, master concepts and ideas that they cannot understand on their own. To invoke an effective ZDP, the guidance that learners receive must have features such as:

- Intersubjectivity, which is the process whereby one or more participants who begin a task with different understandings arrive at a shared understanding (Newson & Newson, 1975),
- Scaffolding, which is when the support that is offered during instruction sessions is adjusted to fit the learner's current level of performance (Byrnes, 2000), and
- Guided participation, which is a broader concept than scaffolding. It refers to shared endeavors between more expert and less expert learners (Hausfather, 1996).
- Heterogonous grouping, affords improved social negotiation of understanding and meaning among members (Vygotsky, 1978)

The social constructivist instructor serves as a facilitator and guide within the process of each individual making meaning (Hausfather, 1996). Only when knowledge is internalized, transformed, and shared with others, do students participate fully in the construction of meaningful understandings. As students explore new topics, they are able to articulate new understandings and gain important skills. By working together with their instructors and peers, their learning becomes more self-directed.

Social constructivism invites librarians to think differently about teaching information literacy. It bids them to engage students in the learning process and to encourage students to take responsibility for what they are learning and how they are learning. Many of the definitions of information literacy focus on developing skills and attributes in relation to codified sources of information that are available in print or electronic form (Lloyd, 2007).

Studies have suggested that the definition of information literacy needs to be reimagined in order to position information literacy as "a catalyst for learning and at the same time inextricably enmeshed with learning" (Lloyd, 2007). In this recasting, information literacy constitutes a study of the connections that exist between people, artifacts, texts, and experiences; studying it enables individuals to develop both subjective and intersubjective positions (Albitz, 2007; Lloyd, 2007; Head, 2012). According to Kuhlthau (2004), engaging students in interesting information-literacy inquiries may be very helpful in preparing them to apply their knowledge to their lives. Social constructivism, with its emphasis on learning by design, is an excellent match for this study. The social constructivist approach goes beyond content and brings diverse disciplines, perspectives, ways of working, habits of mind, and communities into play.

According to Morgan, the Association of College & Research Librarians (ACRL) does not recommend any one approach to teaching information literacy; several researchers, however, have interpreted the language in the ACRL's Information Literacy Standards for Higher Education as embracing social constructivism. Woodard states that the language of the ACRL standards endorses social constructivist and discovery-based approaches to learning and teaching (2003, p. 185). Allen argues that the ACRL standard "construct a framework for learning how to learn" embraces the "essence of social constructivism and the ACRL's advocacy of the approach" (2007, p. 33).

Driscoll (2005) observes that the social aspects of social constructivism are important in allowing learners to achieve more complex levels of understanding (2005, p. 407). Cooperstein & Kocevar-Weidinger (2004) note that many elements of social constructivism lend to collaborative activities in the classroom. Given these perspectives, this study focuses on social constructivism because it represents the acquisition of knowledge through social interaction and is dependent upon the social environment. Given the belief that each individual has a unique interpretation of any imparted knowledge, social constructivism emphasizes the importance of how individuals share their personal knowledge perspectives with their peers as they learn and grow within a classroom environment.

2.1.2 Pedagogical Foundation

As discussed in the previous section, the social constructivist librarian creates a context in which students become engaged in interesting activities that encourage and facilitate learning. This librarian does not simply stand by and watch students explore and discover the subject content. Instead, the social constructivist librarian encourages the students to work in groups and to think about issues and questions and supports them with encouragement and advice as they tackle interesting challenges that are rooted in real-life situations.

The activities and formats of classrooms in which the pedagogical strategies are compatible with the social constructivist approach vary considerably. Four principles are typically applied in classes that employ a social constructivist approach, however.

1. Learning and development are seen as social, collaborative activities.
2. The Zone of Proximal Development serves as a guide for planning lessons.
3. Learning occurs in meaningful contexts that are not separated from knowledge that students develop in the "real world."
4. Out-of-school experiences are related to the students' school experiences.

The activity of learning by designing games is grounded in the constructionist and knowledge as design pedagogical approaches, which are applications of the social constructivist theory (Perkins, 1986; Papert, 1991). Constructionist pedagogy emphasizes that learners develop an understanding of content especially well when given opportunities to design and construct a personally relevant and shareable artifact (Papert, 1991). Social constructivism is related to constructionist pedagogy where learners are working together to construct artifacts. The important difference between these two is that constructionism focuses on the artifacts that are created through the social interactions of a group, whereas social constructivism focuses on the learning that takes place at the individual level because of the interactions of learners within a group (Pravat, 2003).

Self-regulation is also regarded as an important precursor to the construction of knowledge, because it leads to more complex levels of understanding, higher levels of retention, and a more active use of what has been learned (Perkins, 1986). This means that students are the managers of their own learning processes. The knowledge as design pedagogy encourages the active use of knowledge within this context through the creation of products that represent students' personal knowledge and levels of understanding (Perkins, 1986, p. 4). The greatest benefit of incidental knowledge lies in how it can cultivate thinking strategies that make the learner the designer of his or her own understanding.

2.1.2.1 Constructionism

The term "constructionism" was coined by researchers who developed the educational computer-programming language called *Logo* (Papert, 1991). *Logo* takes a constructionist approach to teaching computer science concepts to children (Papert, 1991). The proponents of constructionism argue that learners develop internal knowledge structures through the act of building things, interacting with their immediate physical and social worlds. In other words, constructionist-based activities potentially make visible the development of domain-specific concepts that educators perceive as evidence of deep understanding (Papert, 1991).

From Papert's perspective, the idea of projecting inner feelings and ideas is key to learning. The constructionist approach fosters the expression of ideas by allowing the learner to make them tangible and shareable; this, in turn, shapes and sharpens these ideas and helps them become expressible (Papert, 1991). The cycle of self-directed learning is an iterative process by which learners invent for themselves the tools and mediations that best support the exploration of the subject content that they want to explore.

Constructionism is viewed as the practical materialization of Piaget's constructivist theory. Like Perkins' knowledge as design pedagogy (which will be discussed in detail below), it states that the learner is the builder of knowledge rather than the receptor of knowledge supplied by the teacher. Papert describes his approach in two steps. The first step is an internal, active process in which learners construct knowledge from their experiences in the world. The second step is external, in which students learn by making artifacts that can be shared with others. Papert theory focuses more on the individual. Perkins' work with Salomon (2009) suggests that learning takes place at the individual level, but it is also embedded within the social context and aided by social mediation.

Over the past 40 years, constructionism has been extended to other subject domains, fostering design, creation, and expression involving new technologies (Resnick, 2012). Because of this greater usage, Papert's pedogogical approach can help us to understand how ideas are formed and transformed when expressed through different media, actualized in particular contexts, and understood by individual minds. Constructionism argues that individuals learn best when they are constructing an artifact that can be shared with others and considered within both individual and social contexts (Harel & Papert, 1991; Kafai & Resnick, 1996). This study embraces the design part of constructionism where the learner creates games that represent their understanding of the content learned.

2.1.2.2 Knowledge as Design

Perkins (1986) pedagogical approach, known as "knowledge as design," values both the active use of knowledge and its concrete manipulation. Within this paradigm, knowledge acquisition in any form can be understood as an act of design. Passive activities such as reading are most beneficial when the purpose and structure of the prose (i.e. its design) is reconstructed through reflection by the reader. Knowledge as design projects the active involvement of the student onto objects and events themselves, embedding abstract thinking into the manipulation of concrete materials. This provides a means of looking for potential learning activities in the characteristics of the materials, which leads to an internalization or transference of what Perkins calls "opportunities for design" (p. 98).

Perkins (1986) also suggests that design facilitates the constructive and creative use of knowledge by the learner as he/she adapts it to a purpose (p. 2). He combines epistemology and Piaget's cognitive psychology into a theory of constructivism based on the idea that the building of knowledge should take place internally, by one's own design, and externally, through being "scaffolded" (Vygotsky,1978). Within this theory, the learning process allows individuals to arrange the pieces of their knowledge into their own designs and constructions; it also guides and advises them by offering appropriate design-based learning environments and design-based intellectual tasks. These tasks offer a new level of insight whenever the learning highlights the constructed and constructive character of knowledge.

Just as constructivists claim that learners construct their own realities through interpreting their experiences in the world, knowledge as design emphasizes the idea that students achieve a higher level of understanding when their notions about concepts and the relationships between them are derived from their own experiences. Perkins (1986) sees knowledge as being transferred in two ways. Low-road transfer which where the learner perceives similarity in a new circumstance and applies the previously learned “frame” to the new situation. This is ofter occurs spontaneously. The high-road tranfer process, however does not occur automatically. It requires some form of instruction for the transfer to occur.

According to Perkins (1986), in academic settings, we often treat knowledge as data devoid of purpose and context rather than design laden with purpose. Because of this, Perkins believes that much of the academic knowledge that we hold shows symptoms of “truth mongering,” with knowledge being disconnected from the applications and justifications that make it meaningful (pp. 3-4). When a piece of data is connected to a purpose or goal, it becomes design-like (Perkins, 1986, p. 4). Instructors cannot map their interpretations onto learners, furthermore, because those learners might not share common experiences or ideas with the instructors. Understanding resides to some degree in the mind of every knower, and every knower interprets the external world according to his or her own experiences, beliefs, and knowledge. Perkins advises that instructors should not depend on “truth-mongering”, but instead help students to recognize and understand patterns among the pieces of the knowledge that they have already built.

From Perkins’s perspective, design is "structure adapted to a purpose" (Perkins, 1986, p. 2). Design can be seen in artifacts such as narratives, syllabi, games, and physical tools. The designer works with the artifact, modifying and manipulating objects to fit his or her desired purpose. The pedagogy of knowledge as design centers learning on the goal of "acting on" an idea, both intellectually and physically. Intellectually, the learner engages with the idea in an attempt to learn more. Learners do not actively listen and then mirror any one correct view of reality; instead, they participate in and interact with the surrounding environment in order to create their own points of view and transfer that learning (Perkins, 2004). Therefore, a learner does not just memorize information and retain it long enough to pass a quiz or test; instead, learners are given the opportunity to use their knowledge in applied settings. This can essentially be described as a dialog between ideas and the world, between theory and its application; knowledge as design is a perspective that explains the subjective relationship between a concept and its realization and between tools and goals.

2.1.2.3 Differences and Similarities Between Pedagogies

Although there are differences, there are also similarities between Perkins' and Papert's philosophies. In each ideology, knowledge and individual realities are constructed and constantly reconstructed through personal experiences. However, Perkins places more emphasis on reflection and transfer of knowledge, the internalizing of content, and visualizing relationships between new and prior knowledge. He also stresses the learner's self-direction and personal efficacy while seeing learners as a collective and underscoring the implications of social interactions. In classrooms, ascribing to Perkins' methods would mean offering students the opportunity to learn with and from others in order to make decisions and solve problems as teams. Both Perkins' and Papert's philosophies define knowledge as not merely a commodity to be transmitted, encoded, retained, and re-applied, but as a personal experience to be constructed.

Papert adheres to Piaget's idea of the stages of cognitive development, but he differs when considering the role of objects in a child's life. According to Ackermann (2001), Papert's "child" is very relational and likes to get in tune with others, with objects, and with situations. Papert also considers artificial intelligence theories and the mechanisms of the mind, these being useful in studying the 21st-century learner. According to Papert, knowledge, even that of adult experts, remains essentially grounded in contexts and shaped by uses; external supports and mediation remain essential to expanding the potential of the human mind at any level of a human's development. Some argue that this makes Papert's constructionism more situated and more pragmatic than Vygotsky's socioconstructivism (Harel, 1990).

This study draws on the philosophies articulated above to help in establishing a higher order of thinking in the classroom and improve transfer of knowledge to real life situations.

2.1.3 Experiential Learning

From an epistemological perspective, experiential learning aligns with constructivism, which posits that learners construct meaning from experiences (Doolittle & Camp, 1999). Experiental learning is used to explain how students learn during the act of designing games. In this philosophy, instructors engage with learners in direct experiences and focused reflection in order to increase knowledge, develop skills, and clarify ideas. There are several models related to experiential learning, but the basic premise is the same throughout: Individuals have experiences, reflect on them, and learn (Osterman & Kottkamp, 2004). Kolb's (1984) work provides an often-referenced model of experiential learning that can be found in many discussions of the theory and practice of adult education, informal education, and lifelong learning (Smith, 1999). This model's theoretical evolution is rooted in the works of constructivist scholars such as Dewey (1910; 1938), Piaget (1971), Lewin (1951), Vygotsky (1978), and Jarvis (1987), and continues to evolve. The theory of experiental learning stresses the importance that experience plays within the learning process (Kolb, 1984). Experience is a result of interactions between humans and their environments in terms of thinking, seeing, feeling, and doing (Dewey, 1938). It is described as a learning cycle or a spiral; when a learning experience is "enriched by reflection, given meaning by thinking, and transformed by action, the new experience created becomes richer, broader, and deeper" (Kolb & Kolb, 2009, p. 309).

The experiental learning model has "two dialectically related modes of grasping experience," Concrete Experience (CE) and Abstract Conceptualization (AC); it also has "two dialectally related modes of transforming experience," Reflective Observation (RO) and Active Experimentation (AE) (Kolb & Kolb, 2009, p. 298). A Concrete Experience is an experience or activity in which the learner is involved. Learning begins during a Concrete Expereince which later promotes abstract thinking. Reflective Observation, on the other hand, is a process involving observing and considering an experience from a variety of perspectives. During Abstract Conceptualization, the learner thinks about or analyzes what he or she has observed. In Active Experimentation, finally, the learner acts on or plans new experiences (Kolb & Kolb, 2009). This model suggests that learning requires abilities that are polar opposites, and it also provides a framework for understanding the way that teams learn from working together (Kayes, Kayes, & Kolb, 2005). In a team environment, some team members immerse themselves in concrete experiences, whereas others interact with new information through symbolic representation or reflection rather than using sensations as their guide. Some team members might observe how others involve themselves in the experience and reflect on what occurs. Another segment of the team members might choose to jump in and start doing things. The watchers favor reflective observation and the doers favor active experimentation.

Kolb's stages of the learning cycle are consistent with the stages facilited by learning via game design. It employs various tools like games, simulations, role plays, storytelling, and artifact creation. In this study, the constructionism and knowledge as design pedagogies contribute to the experiential learning environment. An identified problem with the experiental learning cycle is that it does not clearly demonstrate when learners move to different cycle stages (Egenfeldt- Nielsen, 2005). In other words there should be factors in place that can stimulate learners to move to the next stage. Additionally, Dewey (1938) emphasizes the importance of motivation, which is not necessarily addressed by Kolb's cycle. Therefore, motivation will be considered in order to understand how learners move through the different stages of the learning cycle. The following section describes the importance of behind learner's motivation in an instructional environment.

2.1.4 Motivation and Self-Determination

If effort is required for learning, then it follows that motivation is a requirement throughout the learning process. Motivation is co-requisite in the construction of knowledge and the process of conceptual change; therefore, planned instruction strategies are considered to be integral components of constructivist-informed instruction (Palmer, 2005). Learners with different types of prior knowledge can be motivated differently. For example, in this study, the background knowledge and gaming histories of the students might affect their motivations and consequently the effectiveness of the learning by game design approach.

There are a number of models of motivation, differing in their focuses and constructs. More common models such as the expectency/valence approach (Mathieu, Tannenbaum, & Salas, 1992) and Keller's (1983) Attention, Relevancy, Confidence, and Satisfaction (ARCS) model dominate the literature. In all of the models, however, behavior is seen as being either intrinsically or extrinsically motivated. Most models emphasize intrinsic motivation and address the reasons that individuals perform tasks that are derived from participation (Malone & Lepper, 2007). Other models examine extrinsic motivation, which lead individuals to engage with a task as a means to an end (Vallerand, Fortier, & Guay, 1997). Researchers often debate whether extrinsic rewards are less or more effective than intrinisic motives. However, both are regarded as important in determining the behavior of learners. Deci and Ryan (1985) state that a learner's self-determined behavior can stem from intrinsic motivation (the learner engages in an activity because it is interesting or enjoyable) or from extrinsic motivation, termed "identified regulation" (the learner engages in the activity because its outcome is regarded as valuable).

While theories regarding motivation are generally positioned from the perspective of the individual, Sivan (1986) argues that the idea of motivation is embedded in social constructivism. Within social constructivist theory, the construction of knowledge shifts from the learner as an individual to a socially conveyed process among peers and instructors (Loyens, Rikers, & Schmidt, 2008; Sivan, 1986). Therefore, motivation cannot be viewed solely as a psychological characteristic of individuals without reference to the social and cultural contexts within which actions take place. Minick (1985) also states that, "the individual as an object of research does not exist in isolation from actions and action systems" (p. 282). Similar to Ryan and Deci's self-determination theory, social constructivists see motivation as both extrinsic and intrinsic (Siraj-Blatchford & Siraj-Blatchford, 2002). Because learning is essentially regarded as a social phenomenon, learners are partially motivated by the rewards that are provided by their communities. Because knowledge is actively constructed by the learner, learning depends, to a significant extent, on the learner's internal drive to understand and promote the learning process. As a framework, social constructivism integrates the motivation of the individual student at his or her own level. Motivation is not considered a practice that is initiated separately from the act of learning (Sivan, 1986). Furthermore, the desire for individuals to establish, strengthen, and maintain relationships that lead to a sense of belonging within social groups is aligned with the social constructivist view of motivation (Greeno, Collins, & Resnick, 1996).

The fundamental premise of self-determination theory, is discussed in more detail below, considers interpersonal and social environmental contexts, maintaining that they can either cultivate or obstruct an individual's behavioral regulation. Individuals move along a continuum in either direction as their senses of autonomy, relatedness, and competency change in response to their environments.

The goal of any learning environment is to develop learners who are self-directed because the activity is interesting to them and because they think that achieving the outcome is important. According to Small (2000), games in the classroom foster interest, variety, and novelty, encouraging attention and increasing student confidence by establishing clear objectives and providing feedback. This study lends itself to a focus on the process of internalization or behavior-regulation and the social context that undesorces self-determination theory. By definition, self-determination theory (SDT) is a macro-theory of human motivation that focuses on volitional or self-determined behavior and the conditions that promote it; it also investigates the basic and universal psychological needs for autonomy, competence, and relatedness. When these needs are satisfied within a social context, people experience more vitality, self-motivation, and well-being (Spruijt-Metz, Nguyen-Michel, Goran, Chou & Huang, 2008). Self-determined behavior, furthermore, is effected through a continuum involving intrinsic motivation, extrinsic motivation, and amotivation (Deci & Ryan, 1985; 2002).

In this study, self-determination is operationalized using the Intrinsic Motivation Inventory (IMI). This valid, multidimensional instrument is used to assess participants' subjective experiences (Ryan, 1982). Specifically, it assesses participants' interest/enjoyment, effort, choices, and perceived competence along with the perceived value/usefulness of what they learn, the pressure/tension that they feel, and their perceived level of relatedness with teammates while performing a given activity. The interest/enjoyment subscale is considered to be the self-assessed measure of intrinsic motivation. The other subscales used in this study are discussed in Section 3.2.2.

Self-determined behavior is regarded as the core type of motivation that underlies play (Prensky, 2002). It is the type of motivation that is relevant to class or group participation. Autonomy, competence, and relatedness, traits of self-determined behavior, are all evident in play (Przybylski, Rigby, & Ryan, 2010). Autonomy refers to acting from “one’s interest and integrated values” (Deci & Ryan, 2002, p. 8). Relatedness refers to being connected to others and feeling a sense of belonging (Deci & Ryan, 2002). Competence is a feeling of confidence in one’s actions (Deci & Ryan, 2002, p. 7). Skinner and Belmont (1993) note that, although motivated learners are easy to recognize, they are hard to create. One of the goals of this study is to develop a class structure to foster learners who are self-determined because they find the activities interesting and believe that achieving the learning outcome is important. Intrinsic motivation is the energy source that is central to game play. With that in mind, the following section considers the nature of play.

2.1.5 Play

There are various definitions of play, and many of them depend on the context in which the term is addressed. There are also various kinds of play, including solitary passive play, solitary active play, and reticent play. Smilansky (1968) categorizes play as:

- functional (simple, repetitive muscle movements),
- constructive (the manipulation of objects to create artifacts),
- dramatic (the invention or substitution of imaginary situations),
- games with rules (the adherence to and acceptance of guidelines in play).

These four types of play are regarded as developing in a sequence, with functional play appearing ontogenetically in infancy and games with rules appearing as the behavior of older children. Rubin and Maioni note that preschoolers tend to engage more in functional and constructive play (free play) as opposed to dramatic play or games with rules. Caillois (1962) divides play into the two opposing forces of ludus and paidia. Paidia denotes childlike free play that is improvised, exuberant, tumultuous, and spontaneous, and that, at times, can be carried into unruly excess. Free play is also important to improvisers, who associate it with transgressing social and political boundaries. Ludus, on the other hand, is the contrasting impulse to play with ordered rules, commonly associated with gameplay. The constraints of ludus grant the players agency, allowing them to make choices within a defined frame.

For the purposes of this study, the researcher will hereafter bisect play into two categories: free play and gameplay.

2.1.5.1 Free Play

Free play is usually associated with the physical, mental, and social development of children. It is unstructured in nature, self-directed, and based on natural expression. Researchers agree that free play:

- Is voluntary, in that individuals can enter and leave at will,
- Is spontaneous and improvised, in that the nature of the play can be changed by any of the players,
- Involves pretend elements, in that play is different from everyday experiences,
- Is engaging and separated from the surrounding activities, and
- Is fun and pleasurable, enjoyed by all of the players (Brown, Sutterby, Therrell, & Thorton, 2000).

Mandryk and Inkpen (2001) note that "the characteristics that separate free play from games and the generic description of play have to do with the spontaneity and pretend elements of free play." Free play affects developments in language skills, symbolic thought, the ability to focus and control behavior, and problem solving (Brown, Sutterby, Therrell, & Thorton, 2000). Many researchers agree on the learning benefits of free play. Using various constructivist assumptions, diverse theorists have stated that the best way to foster learning and preparation for future life is through play (Piaget, 1962; Bruner, 1965; Vygotsky, 1978). Thomas & Brown (2011) succinctly sum up this relationship as, "where imaginations play, learning happens" (p. 118). According to social constructivism, free play is engaging, exploratory, spontaneous, and enjoyable; it helps learners to build upon their prior knowledge, and it is an outlet for self-expression and development people as wholes (Piaget, 1962; Bruner, 1965; Vygotsky, 1978; Bergen, 1987; Chick, 2010). Vygotsky believes that children are able to master their own behavior through free play. Dewey (1916/2011) argues that infiltrating a curriculum with play helps students to achieve positive intellectual growth; in addition, he advocates that activities that approximate daily experiences allow the acquisition of real, applicable knowledge. He claims that work filled with play will result in activities that are enjoyable and promote intrinsic motivation. Dewey's ideas of the importance of play can be summed up by the statement that, "Education has no more serious responsibility than making adequate provision for enjoyment of recreative leisure; not only for the sake of immediate health, but still more if possible for the sake of its lasting effect upon habits of mind" (Dewey, 1916/2011, p. 113).

Despite the advocacy of free play by theorists, it is often viewed as a childish activity, used only to occupy or distract kids. It is commonly removed from learning environments when learning pursuits are regarded as serious. The proliferation of sophisticated toys, the structured play of sports, and cognitively focused activities (i.e. filling out phonics worksheets or memorizing math flashcards) prevent students from practicing the skills that can be learned in unstructured imaginative free play (Spiegel, 2008; Resnick, 2013). The idea of maintaining free play in learning environments is embraced by the Lifelong Kindergarten group at the MIT Media Lab. According to Resnick (2013), the kindergarten free play approach to learning fosters the development of creative thinkers and underscores constructivist approach to education. The availability of technologies can extend learning through free play to all age groups (Resnick, 2009). The creation of a game is, in itself, a free play activity (Kafai, 2000). The act of using online game-building toolkits like *Scratch* or just regular materials to develop games is considered free playing, since it involves creating artifacts in collaboration with a team (Maloney et al., 2008). Kafai notes that afterschool classes where *Scratch* is used to develop games are, in actuality, teaching programming concepts; in Kafai's study, however, students only came to that realization after reflecting on their activities. Creating games and learning by game design can be thought of as free play activities.

2.1.5.2 Gameplay

According to Salen and Zimmerman (2004), "gameplay is the formalized interaction that occurs when players follow the rules of a game and experience its system though play." Egenfeldt-Nielson et al. (2008) see the dynamics of gameplay as emerging from the interplay between rules and game geography. Unlike free play, it involves interactive processes between the player and the game. This interaction between the various game components makes the experience rewarding, absorbing, and challenging for the player. The player's enjoyment of the gameplay does not necessarily stem from state-of-art technology or beautifully rendered art, but it does involve the artful reconsidering of everyday objects (Oxland, 2004). Ryan et al. (2006)

note that gameplay satisfies the need for competence, autonomy, and relatedness, and a player's sense of immersion is not controlled by the quality of graphics and sound. As within free play, furthermore, the cognitive processes invoked by gameplay are similar to those involved in learning, motivation, self-regulation, and abstract thinking (Lindley et al., 2008). Studies have shown that gameplay helps learners to apply, synthesize, and think critically about what they learn through active and social participation (Colby, & Colby, 2008; Fu, Su, & Yu, 2009; Koster, 2005). Game environments afford activities that promote experiential, situated, and active learning (Boyle, Connolly, & Hainey, 2012). Individuals prefer to learn through games because their optimal "flow" experiences can be experienced through gameplay (Prensky, 2002; Squire, 2003).

Discussions on the purpose of games in the classroom often focus on whether the instructional objectives can be met through endogenous (intrinsic) or exogenous (extrinsic) gameplay. Malone (1981) first addressed this issue by arguing that games should account for motivational heuristics such as challenge, fantasy, and curiosity when being designed. Later, Malone and Lepper (1987) expanded this heuristics theory for game design by adding other motivations such as control, cooperation, competition, and recognition. Habgood, Ainsworth, and Benford (2005) contend that learning through gameplay could be aided through what Kafai (2001) refers to as "intrinsic integration." Intrinsic integration has three distinct traits: flow, core mechanics, and representations. Flow is "a feeling of total concentration, distorted sense of time, and extension of self" that is experienced by anyone who is completely engaged with a task (Habgood, Ainsworth, & Benford, 2005, p. 492). This formulation echoes the mental circumstance which Csikszentmihalyi (1993) defines as "a state of consciousness that is sometimes experienced by individuals who are deeply involved in an enjoyable activity." Players who feel higher levels of flow and immersion within games apply in-depth problem-solving strategies (Liu, Cheng, & Huang, 2011). Additionally, flow is linked to the concept of intrinsic motivation (Chan & Ahern, 1999).

Core mechanics are the mechanism through which players make meaningful choices and arrive at a meaningful gameplay experience (Salen & Zimmerman, 2004). Habgood et al. (2005) argue that core mechanics are important for intrinsic integration because they help to create activities within the game that are relevant to the player. Core mechanics also help to create flow experiences and channel many motivating by-products, such as “challenge, control, cooperation, and competition” (Habgood et al., 2005, p. 493). Artifacts or representations that are created through learning by game design support the supposition that the structures and interactions within a game will be more beneficial for learning if they are representative of subject content (Ainsworth & Loizou, 2003; Miller, Lehman, & Koedinger, 1999; Papert & Talcott, 1997). By skillfully weaving free play interactions within the game with symbolic representations of the instructional content, players develop deeper conceptual understandings of said content (Martin & Schwartz, 2005; Kafai, 2012). Additionally, having their peers engage with their game artefacts fosters content learning through gameplay (Baytak, 2011; 2014).

This study takes into the consideration the affordance offered by both free play and game play to foster learning, creativity and expression in the classroom.

This study employs a social constructivist perspective because of its emphasis on knowledge as human construction. The theoretical framework of social constructivism is the lens through which this study’s format and results is viewed; the basic tenets of social constructivism inform and determine the boundaries of the literature consulted, the methods employed, and the analysis performed. The goal of this study is to observe how knowledge is socially constructed when students in a classroom design games that are representative of their understandings of a specific field of content.

The researcher developed the theoretical framework shown in Figure 2.1 to illustrate how these concepts interrelate within learning by game design. In this framework, learning by game

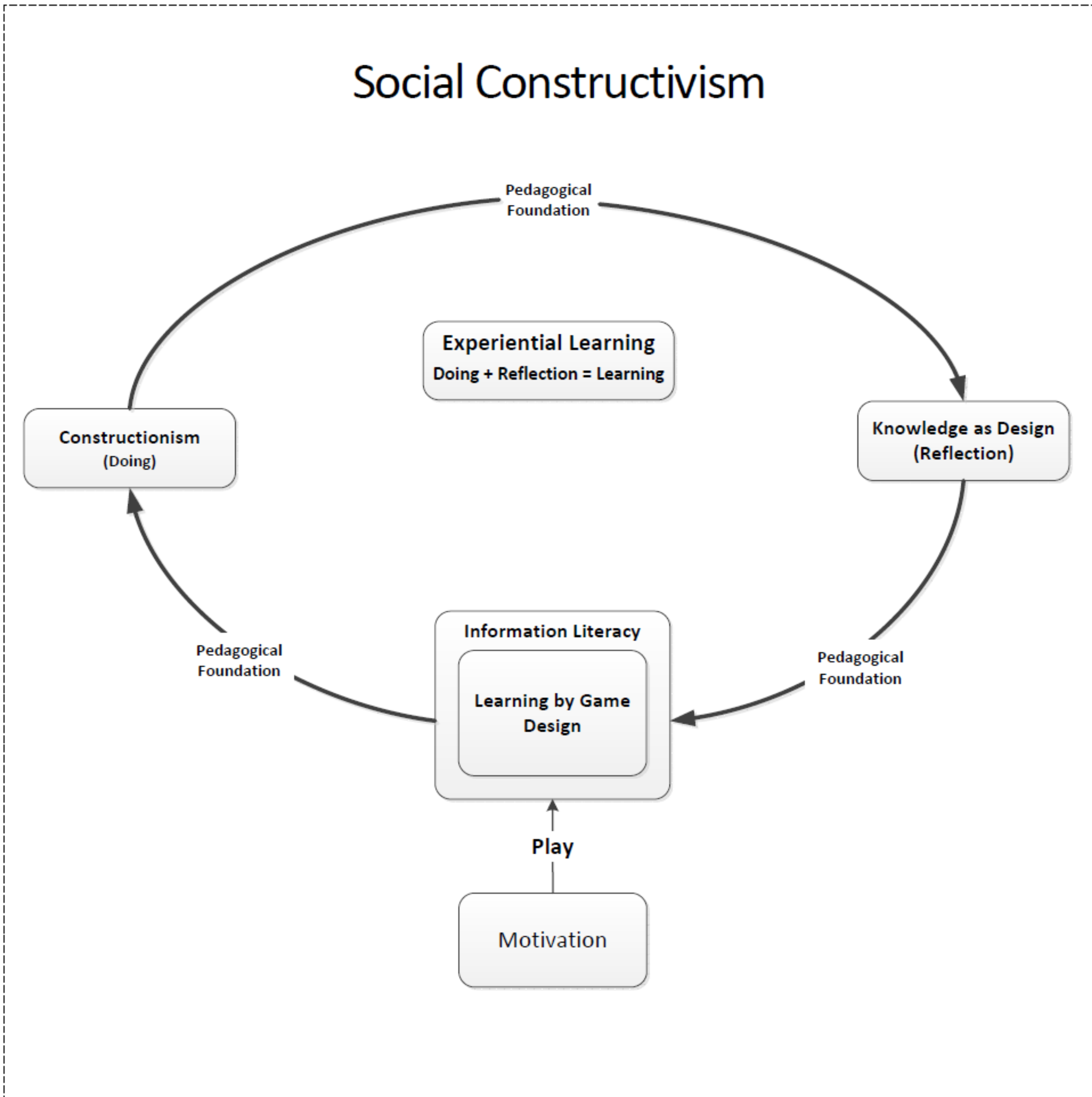

Figure 2. 1- Theoretical Framework Informing Study

design draws on the philosophies articulated in the supporting theories to help in establishing a higher order of thinking in the information literacy classroom and improve transfer of knowledge to real life situations. Social constructivism, the overarching theory of this study, is concerned with empowering students to learn through their classroom-guided experiences and reflect upon those experiences by sharing personal perspectives as they learn and grow in the classroom environment. While experiential learning provides the conditions for optimally engaging students in the information literacy learning experience the theory tends to focus more on individual development. Cognition with respect to class environment interactions tend to be lacking from this theoretical model. This is addressed in the theoretical framework (Fig 2.1) by embedding experiential learning within the boundaries of social constructivism. To qualify this learning process, constructionism and knowledge as design is connected with experiential learning in helping learners construct mental models through developing artifacts in order to understand the world around them and transfer their learned skills to multiple situations. When instructors design classes that engage students in learning experiences that are relevant; they have increased motivation to learn. As seen in the above sections many studies discuss the extent to which play is associated with children’s deep involvement, motivation, and pleasure. In this framework, motivation is supported by play and is seen as a co-requisite in the construction of knowledge. This theoretical framework guides the research, determining the class structure and variables that are measured.

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2.2 Game Design in Learning Environments

As the learning milieu is being changed by the influences of new media, instructors are slowly accepting of theorists' recommendations and exploring constructivist approaches to teaching; games are becoming an important part of afterschool activities, although they are still seen with less frequency within the classroom (Futurelab, 2009; Groff, Howells, & Cranmer, 2010). The recognized need to shift from behavioristic to learner-centered models of instruction, like teaching by game design, is slowly gaining momentum. Few studies have explored the interdisciplinary benefits of learners creating their own games, however. The opportunities for students to improve their understandings by designing their own representations of phenomena, discussing elements of said phenomena undaunted by complexity, and reflecting on their own thinking processes underpin the literature on the usefulness of having students design or construct games (Lemke, Coughlin, Garcia, Reifsneider, & Bass, 2009; Wu, Chiou, Kao, Hu, & Huang, 2012). As opposed to just consuming technology, students create their own learning environments through games (Kafai, 2005; Prensky, 2008; Heaven, 2013).

Learning by game design is usually taught using various online applications and tools. Given the increasing interest in games among 21^{st}-century learners, several freely available programs have been developed for users to design animations, simulations, and games. Researchers have used various game-programming toolkits in their studies in order to foster procedural thinking, problem solving, and logic. Lemke et al. (2009) recommend that more research be conducted within this domain. Their study illustrate, the activity of designing games fostered higher-level thinking, collaborative learning, and engagement; this was compared to other gaming environments that incorporated simulations and commercial PC and console games.

The learning by game design approach began in Papert's 1980s Logo environment at MIT, in which young children learned math by constructing artifacts involving fractions. This pioneering work led to the development of a number of programming languages such as *Smalltalk* and *Etoys* to teach computing and mathematics primarily in the K-12 environment. In the 1990s, much of the theoretical work related to learning by game design was done by Kafai, an early developer and researcher. She successfully promoted learner autonomy through game-designing activities (Kafai, 1995). Since Logo was not specifically designed for creating games, the 2000s and 2010s have seen the development of open-source game-creating toolkits like *Scratch*, *Alice*, *Stagecast Creator*, and *Gamemaker*. In the decades following Logo's creation, research studies on this topic started to become more diverse and were not just MIT-affliated projects; in other words, some of the studies had a focus that went beyond teaching computing. Within the last decade, studies have used various game-programming toolkits such as *StageCast Creator* (Habgood, Ainsworth, & Benford, 2005), *Gamemaker* (Overmars, 2004; Perciles, 2007; Baytak et al., 2008), *Alice* (Kelleher & Pausch, 2006), *Neverwinter Nights* (Robertson & Good, 2005; Robertson & Howells, 2008), *AgentSheet* (Ionnidou et al., 2003), and *Scratch* (Peppler & Kafai, 2007; Maloney et al., 2008; Baytak, 2009).

Despite the growing diversity of toolkits, *Scratch* continues to be the preferred tool among these investigations, promoted through the Computer Clubhouse global program. Recently in has also been incorporated into higher education classrooms. For example, *Scratch* has been used at Harvard University as an introduction to programming for undergraduates (Malan & Leitner, 2007; Malan, 2010). Students in Baytak and Land (2009) study used *Scratch* to develop games to help towards understanding environmental science. Their work emphasized the importance of sharing artifacts in the constructionist design process, emphasizing the opportunity to obtain feedback, redesign artifacts, and reconstruct knowledge. Owston, Wideman, Ronda & Brown (2009) used game design as a pedagogical activity to motivate and engage students in a Canadian social studies classes. Students created questions that would be incorporated into an electronic versions of board game. Robertson and Howells (2008) explored learning by game design using the commercial game *Neverwinter Nights*. Their exploratory study looked at the effects of role-playing game design by sixth grade students in Scotland. A consistent finding in these studies was the powerful learning environment that designing games created. The studies described above were some of the first to introduced learning by game design within classrooms and looked at improvements in students' motivation learning enthusiasm, determination to achieve, and the transferance of their learning to new situations. With the exception of studies coming out of MIT most of these game design explorations were done in non-U.S. countries.

This section discusses recent (2010–present) empirical studies that explore learning by game design. These studies were identified through a comprehensive search of multidisciplinary databases such as ScienceDirect, Proquest Central, and EBSCO. Only peer-reviewed journal articles that employed the elements of game design were included. The search strategies varied depending on the online database being used, though the search terms generally included wildcard variations of "game," "learning," and "design" as well as common database descriptors and subjects like "interactive learning environments," "learning strategies," "media in education," "game-based learning," "constructionism", "educational technology," and "constructivism." The studies that were used are listed in Table 2.1.

Table 2.1 Studies Exploring Learning by Game Design

Authors	Theory	Setting/Method	Tools Used/Topic	Variables
Luxton-Reilly & Denny (2010)	Social/Communal Constructivism/ Social Learning Theory	New Zealand/K-12 Classroom /Case Study	Peer Wise/Computer Science	Meta-level reflection, team collaboration, translating, and the conceptualization of ideas into artifacts
Alexander & Ho (2015)	Social Constructivism	US/ Summer Art Camp/ Case Study	Unity/Game Art Development	
Baytak & Land, 2010, 2011; Baytak, Land, & Smith (2011)	Constructionism	Turkey/K-12 Classroom/ Case Study	Gamemaker/ Nutrition	Engagement, enthusiasm, and translating ideas into artifacts
Kafai, Fields, & Burke (2010)	Constructionism	US/K-12 After School/ Ethnographic study	Scratch/ Programming	
Ke & Im (2014)	Not stated	US/K-12 Classroom/Case Study	Scratch/Math	
Khalili, Sheridan, Williams, Clark, & Stegman (2011)	Not stated	US/After School/Case Study	Gamemaker/ Immunology	
Li (2010)	Enactivism	Canada/K-12 Camp/Mixed Method (Survey and interviews)	Not specified/Science	Knowledge-building, engagement, and greater understanding of the subject.
Carbonaro, Szafron, Cutumisu, & Schaeffer (2010)	Constructivism	Canada/K-12 Classroom/Case Study	Neverwinter Nights/Computer Science	Storytelling, visual design, gender engagement with technology, and interest and fluency in computer science
Robertson (2012)	Constructivism	Scotland/K-12/ Classroom/ Case Study	Adventure Author/New Literacies	
Denner, Werner, & Ortiz (2012)	Constructivism	US/K-12/ Classroom/ Case Study	Stagecast Creator/ Computer Science	
Vos, Van Der Meijden, & Denessen (2011)	Constructivism	Netherlands/K-12/Quasi-Experimental	Memory	Motivativation, deep learning behavior, and improved problem solving
Li, Cheng, & Liu (2013)	Constructionism	Taiwan/UGClass/Case Study	Train B&P/Physics	
Hwang, Hung, & Chen (2014)	Not stated	Taiwan/K-12 Classroom/ Quasi-Experimental	Microsoft Kodu/Science	

Akcaoglu, (2014); Akcaoglu & Koehler (2014)	Constructionism/ Guided Discovery Learning	Turkey/K-12 After School/Quasi-Experimental	Microsoft Kodu/ Programming	
Ferrer-Mico, Prats-Fernàndez, & Redo-Sanchez, (2012)	Self-Directed Learning	Spain/K-12 After School/Case Study	Scratch/ Computer Science	Self-directed learning
Li (2012)	Enactivism	US/Grad Class/ Case Study	Scratch/Flash/ Adobe Captivate	Reconceptualization of pedagogical approaches
Chen, Rovegno, Cone, & Cone (2012)	Constructivism	US/K-12/Case Study	Not specified/ Physical Education	
Butler (2014)	Social Constructivism	Japan/K-12 Classroom/ Case Study	Storyboards/Foreign Language	User-valued game elements and team collaboration
Siko (2013); Siko & Barbour (2014)	Constructionism	US/K-12 Classroom/ Experiment	Powerpoint/ Chemistry	Improved learning

Within the 19 studies listed in Table 2.1, more than half of them (11) were conducted in non-U.S. countries (see Table 2.2). Unlike previous years, in which learning by game design was predominatly part of afterschool activites, most the studies (11) that were held within the past five years have been in K-12 classrooms. The majority of these studies were not affliated with MIT projects, which was a commonplace factor in previous years. Game design also made its debut in higher education classes in two studies. This suggests a possibility that more educators are recognizing the benefits of game-designing activities in the classroom. Similar to in past studies, game designing in this period was mainly used in STEM classes to help foster student interest in those topics. However, it is evident that the focus these studies is moving away from computing and mathematics to more science-based subjects.

Table 2.2 Learning Environments, Regions and Taught Topics Employing Game Design

Learning Environment/Region	Non US	US	Grand Total
Non- STEM	**3**	**2**	**5**
K12	3	1	4
UG	0	1	1
STEM	**8**	**6**	**14**
After school	3	3	6
K12	4	3	7
UG	1	0	1
Grand Total	**11**	**8**	**19**

Table 2.3 Learning Theories, Game Design Toolkits and Methods Used in Studies Exploring Game Design

Study/Toolkit	Built	Commercial	Community	N/A	Physical	Grand Total
Case Study	**1**	**6**	**6**	**2**	**1**	**16**
Constructionism	1	1	1		0	3
Constructivism	0	3	1	1	0	5
Enactivism	0	0	1	1	0	2
Not stated	0	1	1	0	0	2
Self-Directed Learning	0	0	1	0	0	1
Social Constructivism	0	1	1	0	1	3
Experiment	0	**1**	0	0	0	**1**
Constructionism	0	1	0	0	0	1
Quasi-Experimental	0	**2**	0	0	0	**2**
Constructionism*	0	1	0	0	0	1
Not stated	0	1	0	0	0	1
Grand Total	**1**	**9**	**6**	**2**	**1**	**19**

*Self determination theory

Most of the above researchers (16) employed a case-study approach to explore the game design phenomenon; the remainder (3) used experimental methods. Many of the studies were grounded in a constructivist view of knowledge, learning, and teaching. As seen in Table 2.3

constructionism (5) and constructivism (5) were the major theories used by the studies. Exploration of motivation was addressed in many studies, only one study emperically explored this aspect. Motivation was framed within constructivist theories. The social side of constructivism was addressed by only few (3) studies.

A variety of tools were utilized to teach a various of topics through game design. Most game toolkits were commercial (9), with *Microsoft Kodu* (2) being the most commonly used toolkit specific to PC and Xbox environments. Most of the commercial tools (6) were used within non-U.S. countries in K-12 classes (5). Studies in the U.S. showed a preference for community-based online gaming toolkits. The use of these community-based tools was less than in previous years, when they were the only option available to educators. *Scratch* (4) was still the predominent community-based game-building toolkit, the choice for 3 U.S.-based studies. This tool was mainly used in STEM environments, but, unlike previous studies, was now incorporated into classrooms one of them being a graduate class. Further details about these studies will follow.

These recent studies paid attention to the collaborative nature of game design and the benefits of giving students assessment responsibilities, incorporating the social side of constructivism (Luxton-Reilly and Denny, 2010 & Alexander & Ho's (2015). Baytak and Land (2010; 2011) and Khalili Sheridan, Williams, Clark, & Stegman (2011) studies stressed the need for collaboration in the design process and the importance of sharing the end product with other students to complete the external part of the constructionist process. According to the authors, students learn subject matter best if they are required to articulate their learning to others. These studies discusses how sharing provided opportunities not only for students to obtain feedback, but also to redesign artifacts and reconstruct knowledge in better ways.

Li’s (2010) study was unique in that it explored game design from a situated cognition perspective drawing on Bruner’s enactivism (built on constructivism). Enactivists believe that mind, body, and the world are inseparable and that learning is accomplished through doing. Li’s study highlighted personified approaches to the subject content, thereby fostering the learners’ problem-solving skills in more situated environment.

Gender plays an important role in the gaming environment and Carbonaro, Szafron, Cutumisu & Schaeffer (2010), Robertson (2012), and Denner, Werner & Ortiz. (2012) all focused on game design from the gender-differences perspective. These studies found no gender differences in the game-making skills among students, and in some case females were better in certain design skills than their male counterparts. These studies not only illustrated how game designing fostered students’ critical thinking skills, analytical problem-solving skills, and content interest, but underscore that games are not just a domain for boys and address the differential patterns of understanding and interpretation that are commonly employed by girls. Turkle (1988) identifies the different styles of computing between the two genders: the risk-taking style (mostly used by males) that is preoccupied with testing the limits of both machine and self through mastery and manipulation of the computer environment, versus the relational style (mostly used by females), which is "marked by an artistic, almost tactile style of identification with computational objects, a desire to `play with them' as though they were physical objects in a collage" (p. 50). These studies highlights gender design styles, putting to bed the concerns that girls could be disadvantaged by their lack of prior knowledge of games.

Most game design studies do not take into account the role of motivation. Vos, Van der Meijden & Denessen, (2011) study is one of the few that focused on improved student motivation in the game design classroom. Results showed improved motivation as well as deeper learning levels among the student participants who designed games rather than just playing them. According to Vos et al., (2011) the activity of designing games is a better match for a constructivist learning environment than just playing. Unlike game-design activities described by other studies, students were given specific criteria on how to design their games; therefore, they were not presented with a personified problem situation.

The work of Li, Cheng, & Liu (2013) is one of the two studies that took place in a higher-education environment. Researchers expressed concerns that fantasy-interfaces and elaborate narratives would distract students from learning. By contrast, their results showed these features help engage players and allow them to reach a deeper level of experiental learning offered through game design. Additionally, students who were less experienced in game design were assisted by their more experienced colleagues, encouraging student participation and teamwork.

The use of peer testing in fostering critical thinking were emphasized in the works of Hwang, Hung, and Chen (2013), Akcaoglu (2014) and Ferrer-Mico, Fernandez, and Sanchez (2012). Students who were involved in the designing activities showed improved problem-solving, decision-making, and troubleshooting skills. According to the authors, the creation of a curriculum that embraced constructionist approaches to instruction was crucial to the study's positive outcomes.

While most of the works listed in Table 2.1 looked at learning by game design from the student perspective. Chen, Rovegno, Cone & Cone (2012) and Li (2012) studies focused on instructors experiences in designing classes that incorporate game design activities. Chen et al. (2012) describe an educator approach to scaffolding game design elements through a progression of tasks and instructional techniques. The instructor used simple tasks to activate prior knowledge and then built in more complex tasks that gave students time to explore, edit, and refine their creations. Li (2012) provided educators with opportunities to construct their own games in order to enhance their understandings of instructional practice. Through the use of learning by game design, instructors were able to construct their own personal learning experiences, giving them first hand experiences of potential challenges students may face in a game design class. These two studies describe educators' first-hand experiences with learning by game design.

Butler's (2014) study focused on game elements from students' identified as useful learning components. Noted game elements were: clear rules and objectives, challenge, fantasy, self-controlled learning, feedback, and audio and visual effects. The learning elements most valued were repetition, imitation, and reviewing. The author noted that the students did not regard competition as an important component of learning. This study emphasized student analysis of created artifacts as a way to help students develop critical thinking skills and awarenesses of their own learning.

When it comes to incorporating game design in the classroom one of the concerns among instructors is the extra time needed to teach students the game design software. Siko and Barbour (2014) looked at designing games using ubiquitous classroom tools like PowerPoint. In their first study, learning by game design was used for review purposes at the end of the class. No prior introduction to games was given, and students were confused about the game-designing task. In the second study, learning by game design was integrated throughout the class and instructor's assistance was provided throughout the process. The authors attributed the scaffolding process as playing a critical role in the learning gains achieved.

These various studies illustrate how the experiential nature of online game-designing fosters the application of logic, visualization, and problem-solving once it is integrated effectively. All of these studies focus on the design of digital games. Many of the studies used game-designing toolkits. Further review indicates that, although the students who participated were asked to create games, no emphasis was placed on game elements. Much of the focus of these activities seems to have been on getting the students to understand the software that was being used. Only Luxton-Reilly & Denny (2010), investigated the social collaboration involved in designing games as a collective. In the other studies, the games were created by individuals and collaboration occurred during sharing and testing with peers. This collaborative activity provided players with constructive, clear, and concise feedback that improved their engagement and self-esteem. Student motivation was only measured in one study (Vos et al., 2011).

In many of these studies, the application of learning by game design was seen as a complex process in which teaching strategies and methods needed to be taken into account. Therefore, these studies show that learning experiences can be significantly impacted if game-designing activities are not successful integrated into the teaching environment. Siko (2014) and Chen, et al., (2012) focused on the need for increased attention to classroom structure when teaching via game design. If integrated effectively, learning by game design has the capability to create positive learning experiences, increasing the likelihood that students will be excited by the design and peer-testing processes. Most of the above authors indicated that, although learning by game design is used in teaching environments as an approach towards personal expression and knowledge reformulation (i.e. as a sounding board to test and evaluate knowledge representation), its incorporation can be challenging; further examination about the approach is still needed. As Kafai and Peppler (2012) note, it is important to examine how content learning and designing games interact with each other. While studies have concluded that game design, seem to be effective in increasing student interest in subject matter, the extent to which this translates into learning that is more effective is not always clear.

2.3 Collaborative Artifact Design

The most distinguishing feature of learning by game design is the creation of artifacts, therefore this section focuses on this activity. Designing shareable artifacts that reflect students' different styles of thinking and learning is the unique component of this instructional approach. According to Papert (1991), in order for students to gain a deeper understanding of something, they have to create it, construct it, and build it. He uses the term "objects-to-think-with" to describe those objects that embody meaningful and important concepts and enable learners to make contact with new ideas. Kafai (2005) notes that designing artifacts helps students to reformulate their understandings and express their personal ideas and feelings about the subjects being taught and the artifacts themselves. Papert (1980) sees game-making as a tool for allowing personal expression and knowledge reformulation, a tool that helps students to explore psychological and cultural aspects of their learning environments. Bruckman and Resnick (1995) also state that learning takes place effectively when students are engaged in constructing personally meaningful projects.

When designing these game artifacts, students use different strategies. For example, in Harel's (1991) study, students designed mathematics software. Kafai's (1998) study investigated the iterative process in which students changed their designs over time. Baytak et al.'s (2008; 2010; 2011) studies discuss the strategies of students to modify existing games instead of designing originals. Other common strategies which have been employed in various artifact-designing projects include the following:

1. Using templates: For some students, designing game artifacts might seem too complex. A common strategy to overcome this is to begin with templates and allow students to edit them. This helps students to become more comfortable, especially in the creation of digital games (Baytak et al., 2008; 2011)
2. Trial and error: When creating game rules and mechanics, students use different approaches. In cases where a game-designing toolkit is used, students might explore different codes and view the outcomes in their designs. This also helps them to discover the various features and functions of the toolkit (Kafai, 1998).
3. Learning from others: Collaboration is the social component of learning by game design, a component in which students share ideas, receive feedback, and gain assistance with their designs. This helps them to obtain new ideas and new strategies. For example, in Harel's (1991) and Kafai (1996) studies, students shared and helped each other with their designs.
4. Instructor assistance: The role of instructors in these settings are facilitators and experts. The instructors are available to students to answer questions rather than just to present facts and procedures. As noted by Stolovitch and Keeps (2011), instructors must use more of the "guide on the side" approach than the commonly used "sage on the stage" model.

According to Baytak (2009; 2014) and Hwang (2014), these strategies allow students not only to design relatable artifacts, but also to work as teams in planning the designs, debugging the designed artifacts, and sharing the artifacts with classmates before testing.

During the designing phase, students usually test their creations frequently to check for problems. Peppler and Kafai (2007) report three types of testing processes in the game-designing environment: debugging, peer testing, and audience testing. Within peer testing, students test their own games and collaborate with their peers, observing what went wrong in their designs and correcting these flaws (Robertson & Howells, 2008; Baytak & Land, 2011). The peer-testing process allows students to collaborate and share their ideas about content and design.

Kafai's (1996) study used audience testing, and argued that this process serves not only to test the educational appropriateness of the artifacts, but also to build a community of practice. The students in this study received two types of feedback from displaying their designed artifacts: the audience considered, first, the content information that the designer included in the artifact and, second, the play-ability of the game. Most constructionist studies are designed in such a way that someone in the community can judge, try, or evaluate artifacts and content. Harel (1991) and Kafai (2005) applied feedback strategies to encourage formative and summative evaluations of student designs. Since the classroom environment involved external sharing and provided the students with instant feedback, this process coincided with the feedback process within Papert's constructionism.

Researchers accept that the design process is complex and therefore creates challenges that students might encounter when combining and integrating the instructional content, the game context, the problem-solving process, and the time limitations (Kafai, 1996). The information and steps described above can help to assess student performance, abilities, capabilities, and progress over time.

2.4 The Importance of Information Literacy

The need to create information-literate students is not new, but its importance has intensified as the information world has grown. Back in 1989, the American Library Association (ALA) issued a report on the need for resources to be directed toward education in the area of information literacy. It is regarded as a survival skill in the Information Age and is required for the 21st-century workforce (Bruce & Candy, 2000; UNESCO, 2006; Lloyd, 2007; Crawford & Irving, 2009). Because it is recognized as being central to democracy, the essential elements of information literacy are embedded in national and international political agendas (ALA, 1989). Many countries have formally embraced information literacy in their national policies, defining its role beyond educational remittance by linking it with the development of a larger "information society" (Andretta, 2007). This is underscored by work done by the United Nations Educational Scientific and Cultural Organization (UNESCO) that aims to foster information literacy worldwide by assisting in the development of national information-literacy policies (UNESCO, 2008). Although information literacy has been promoted within the library profession, is not just a library issue; it has a far-reaching importance to the development of modern individuals.

Information literacy is a multifaceted concept that encompasses all other forms of literacy (Hepworth, 2000). Paul Zurkowski is credited with coining the term in his proposal to the U.S. National Commission on Libraries and Information Science in the early 1970s, which advocated that the U.S. Government should establish a national programme aimed at achieving widespread, work-related information literacy (Carbo, 1997). The multifaceted nature of information literacy, as described by Hepworth (2000), involves learning that addressess the use of information tools, the processes of information management and knowledge creation, the communication or exchange of information through collaboration, and the intellectual norms (theories and ethics) of subjects.

Gross and Latham (2007) identify the two nationally recognized information literacy standards that guide the work of librarians in the U.S. These standards belong to the American

Association for School Librarians (AASL) and, in higher education, the Association of College and Research Libraries (ACRL). They broadly define information literacy as the ability to evaluate, synthesize, and apply information that has been repeatedly linked to critical thinking and lifelong learning (Albitz, 2007; Alfino, Pajer, Pierce, & Jenks, 2008; Amudhavalli, 2010; Breivik, 2005; Ward, 2006; Kerr, 2010). In the broadest sense, information literacy involves everything from computer literacy to visual and media literacy (Eisenberg, Lowe, & Spitzer, 2004). It could be regarded as a unifying literacy and as an expansion of reading and writing (Eisenberg, 2010).

2.4.1 Students' Information Literacy Skills

Library resources are organized and codified to enable retrieval by the skilled searcher. In the world of the Internet, getting necessary information is accomplished through one search box that attempts to maximize the ability of the unskilled to find results. Many students need a "mental blueprint" in order to navigate both the physical and online components of today's academic libraries. The *Chronicle for Higher Education* article titled "Information Literacy Makes All the Wrong Assumptions" describes the typical information literacy skills of today's college students. It says that "the typical freshman assumes that she is already an expert user of the Internet, and her daily experiences lead her to believe that she can get what she wants online without having to undergo a training program" (Wilder, 2005, p. B13). College students associate the academic library with "books" and rarely, if ever, with the words "quality," "trust," or "authoritative" (De Rosa, Cantrell, Hawk, & Wilson, 2006, p. 3-24).

However, the reality is often different from the beliefs of the students. A two-year long ethnographic study conducted on five college campuses examined students' use of information literacy; it found that, when it came to finding and evaluating sources, students were "downright lousy" (Kolowich, 2011). Other studies support these findings and highlight the heavy reliance of students on simplistic Google searches, Wikipedia, and other paths of little effort (Griffiths & Brophy, 2005; Van Scoyoc & Cason, 2006; Hilligoss & Rieh, 2008, p. 1475; Head & Eisenberg, 2009). Students not only have difficulties with online searches, they lack domain knowledge (Markey, 2007) and do not understand what constitutes quality sources (Head, 2007). Constructivist tactics like learning by game design are appropriate in responding to this concern because they improve information literacy skills, creating critical thinkers and independent learners.

2.4.2 Impact of Information Literacy in Learning

Information literacy evolved from library and bibliographic instruction as a concept that facilitates more than the use of tools, instead enabling critical engagement with information and the construction of new knowledge (Bruce, 2000; Sundin, 2005). It is seen as "a way of engaging with, and learning about, subject matter" (Bruce & Candy 2000 p. 7) with the ultimate goal being contribution to lifelong learning and the critical thinking essential for effective engagement with information in academia and the workplace (Bruce, 2000; Sundin, 2005; UNESCO, 2006; Horton, 2008; Horton & Keiser, 2008).

Highly cited empirical studies by Limberg, 1999; Kuhlthau, 2004; Bruce, 2000 & Lupton, 2004 show that academic success, application of learning and continued lifelong learning depends on acquisition of information literacy competencies in accessing, evaluating, synthesizing, communicating and ethically using information. The impact of information literacy is not just limited to the academic environment but has been shown to act as a catalyst for learning in workplace and community settings (Lloyd, 2006). Lupton (2004) argues that as more instructors incorporate constructivist instructional approaches in the classroom, the need for information literacy will become more apparent as the learning processes involve creation, reflection and critical awareness.

Information literacy is more than just a text-based literacy, but is more of a social and physical experience with information. The different levels of learning outcomes of information literacy range from basic skills (the ability to recognize a need for information) to critical thinking skills (the ability to synthesize and build upon existing information, contributing to the creation of new knowledge). The higher order of learning outcomes are not always attained by librarians. As noted by Kuhlthau (2004), in many cases librarians do not always explore the information-gathering process as a means of development. Rather, "information is viewed as a thing or product to be given out, the right answer and the right source, rather than as an impetus for learning or changing constructs" (Kuhlthau, 2004, p. 3). Given the limited time that librarians often have for information literacy instruction, fostering higher learning outcomes can only be achieved by the collaborative efforts of the teaching faculty, librarians, and administrators and more constructivist learning approaches.

2.4.3 Information Literacy Teaching Models

There are a number of models to help librarians teach the concepts of information literacy. Using a model provides the instructor with a systematic approach to accomplishing specific learning objectives. Often, the models will incorporate multiple theories of learning and be based in research and practice. Most models break the learning process down into manageable stages. For example, students might need to define their information needs, formulate key questions, learn how to locate resources, evaluate and use information from many sources in a variety of formats, and display awareness of issues related to the ethical use of information (such as copyright and plagiarism). Common U.S.-developed models that have been examined emperically in the relevant literature are the Big Six model (Eisenberg & Berkowitz, 1990) and the Information Search Process (ISP) model (Kuhlthau, 1985).

The Big Six model is an informational problem-solving model that has been used for over twenty years; it was primarily developed for K-12 schools, but it has been adapted within higher education (Story-Huffman, 2014). It is a six-stage process model focused on solving problems involving task definition, information-seeking strategies, locating and accessing information, using information, synthesizing information, and evaluating information. One of the model's stated strengths is its flexibility and application to all subjects, ages, and grade levels. Eisenberg and Berkowitz (2011) stress that the activities listed in the model are meant to be integrated into the curriculum and not set apart as library instruction. Multiple handbooks and lesson plans have been developed for use with the Big Six model. Silva (2011) notes that the decontextualized one-size-fits-all activities within the Big Six model do not account for the epistemic differences of the disciplines, the rhetorical tasks and situations, or students' individual skill levels and prior knowledge; additionally, the Big Six model does not account for the affordances and limitations of differing technological environments (p. 20).

The other model, the Information Search Process (ISP) model, addresses information literacy learning as a process with seven steps: task initiation, topic selection, prefocus exploration, focus formulation, information collection, search closure, and writing. Like the Big Six, this model can be presented to students in the form of a worksheet to help them go through each step of the research process. In an investigation funded by the U.S. Department of Education, Kuhlthau et al. (1990) found that the model was applicable to school, public, and academic library environments. Callison and Preddy (2006) explain that the ISP has been tested more extensively than any other model. Carey (1998) notes, however, that even though librarians indicate a strong interest in a constructivist approach to information literacy education, they believe that models such as the ISP and the Big Six can be constraining frameworks because they insist that students move through specific steps in a specific order.

Despite the teaching models that are available, many librarians in higher education tend to plan their instruction using the Association of College and Research Libraries (ACRL) standards (Yang & Chou, 2014). Published in 2000, the Information Literacy Competency Standards for Higher Education (now under revision) is regarded as the benchmark for planning and assessing information literacy in higher learning institutions. The Standards are combined with performance indicators, assessment outcomes and outlines the skillset information-literate students should have at the conclusion of college. The standards address the core principles of identifying, accessing, evaluating, and using information fluently and ethically (ACRL 2000). These standards associates various levels of thinking skills with each learning outcomes mapped to Bloom's Taxonomy. The division between "lower-order" and "higher-order" thinking skills dates back to the Taxonomy of Educational Objectives (Bloom, 1956). In 2001, Anderson and Krathwohl revised this cornerstone of curriculum design. The taxonomy covers the cognitive, affective, and psychomotor domains. The lower-order skills are pre-requisites for the higher skills. Lower-order thinking skills are not belittled, but educators should not be content with their students gaining mastery only at lower levels. In implementing these standards, institutions need to recognize that different levels of thinking skills are associated with various learning outcomes—and therefore different instruments or methods to assess them.

As Lichtenstein (2000) laments, "Too often, librarians approach the design of information literacy programs without paying attention to the decades of successful work that has been accomplished by educational psychologists in understanding how people learn" (p.

25). While the teaching models as described above are valuable, not many librarians implement them (Booth, 2011). Many librarians provide instruction through single class periods, a format which does not lend itself to the use of teaching models. Some librarians do choose to develop hybrids of different models in order to meet their specific learning goals and teaching environments.

2.4.4. Approaches to Teaching Information Literacy

Higher-order learning, according to the revised Bloom's taxonomy (Anderson and Krathwohl 2001), consists of moving beyond remembering and understanding to applying, analyzing, evaluating, and creating. By having learners develop or design their own learning environments, learning by game design intrinsically lends itself to a supportive style of instruction that supports this level of learning. As was addressed in previous sections, the idea of design represents a broad class of experiences; one of its key characteristics, however, is that of learning by engaging in design-and-build challenges (Kolodner et al., 2003), culminating in the production of an “artifact” that represents underlying understanding (Kafai, 2005). The process of encouraging students to make their own games has the potential to create powerful learning environments because it encourages learners to develop an awareness of their own learning that is essential to the development of meta-cognitive skills (Robertson & Howells, 2008; Bates, Brown, Cranton, & Lewis, 2010).

2.5 Gaming Programs in Libraries

As libraries move toward developing new models for teaching information literacy, they increasingly become sites of situated social action and diverse conversations about the different ideas that shape their functions (Bruce, 2008). There is an ongoing discussion about the importance of encouraging community members to assist in making decisions, actively participate in library activities, and interpret and critically reflect on the services that libraries offer (Kapitzke & Bruce 2006; Bruce, 2008). Theorists see the main purpose of libraries as enabling users to learn, but also to teach one another within a community of learners. This means that librarians must understand user and community needs, developing more supportive and engaging learning scenarios and creating inclusive learning communities (Bruce, 2008). The most visible manifestations of spaces that foster technological support and collaborative work are the common areas of academic libraries. These appeared first in the late 1990s in the form of the Information/Learning Commons and large public computing facilities that supported online access to subscribed electronic resources and applications software. These facilities were typically maintained by partnerships between libraries and academic computing departments and were co-staffed by both (Halbert, 1999; Holmes-Wong, Afifi, Bahavar, & Liu, 1997). With this increase of social spaces, the introduction of gaming activities became possible in academic libraries.

According to Nicholson (2009), the most common goal behind the introduction of games within libraries is to interest the underserved and increase the libraries roles as community hubs. Mainstream spokespersons have urged librarians to add games to their collections, host tournaments, create in-library zones to accommodate free play, and use games to teach library users about information literacy (Hitch & Duncan, 2005; Storey, 2005). Circulating games and hosting tournaments have become acceptable practices in school, academic, and public libraries (Levine, 2006, 2008; Nieburger, 2007). As such, gaming is becoming more popular and accepted within these social spaces.

The relationship of libraries with games is not new; in fact, libraries have supported gaming for decades, hosting chess, Scrabble, and bridge clubs throughout the 1900s (Nicholson, 2008). Today, the majority of gaming focuses on video games, which were initially embraced within public library programs (Nicholson, 2008). Gradually, the adoption of video games extended to academic libraries (Harris & Rice, 2008) and school libraries (Moline, 2010). This initial deficiency within the academic domain can be attributed to the complicated decision-making process for library administrators and instructional personnel as they debated the role of gaming at their institutions (Robertson & Jones, 2009). In his study exploring ways for libraries effectively utilize gaming (both digital and non-digital) to support their institutional goals, Nicholson (2009) found that about 77% of public libraries supported gaming programs that could serve to bolster other library services when effectively planned and marketed.

2.5.1 Gaming in Information Literacy

With the acceptance of games in libraries and the increasing literature regarding the potential of gaming in different learning environments, exploration on teaching information literacy through game-based learning became a focus within academic libraries. It has predominantly been used for orienting students to library services and resources. Various non-electronic games like word puzzles and scavenger hunts have been used to teach about library technologies (McCain, 2008). Since there are no electronic commercial games that promote information literacy goals, however, some libraries have leaned toward the development of board games and electronic board games to deliver their lessons (Doshi, 2006).

The first mention of using digital games for information literacy instruction was in 1982, within *Citation*, a game designed to teach basic information literacy skills (Koelewyn & Corby, 1982). *Citation* presented an entire online digital library and its services through a 3D immersive graphic user interface (Cubaud, Thiria, & Topol, 1998). There were various approaches to utilizing and developing games for library instruction that incorporate information literacy concepts after that (The Cybrarian, 2007; McDevitt, 2011; Broussard, 2013). Many libraries began to develop games, a number of which were located online. One example of this is *Quarantined*, an action-adventure game developed by the Arizona State University Fletcher Library that is presented via a two-dimensional interface that augments formal library instruction (Gallegos & Allgood, 2007). Another game, *Within Range*, was developed at the Carnegie Mellon University Libraries. In this game, players sort resources on a virtual shelf using the Library of Congress's shelving system. This team also developed *I'll Get It*, a game in which the player acts as a library student assistant, locating resources to help library patrons (Beck et al., 2008). *Info Game*, developed at the Austin Community College, issues questions and scores answers to tests based on the content of a text-based tutorial (VanLeer, 2006). The University of North Carolina, Greensboro developed an *Info Lit* game board in which players click an electronic die to move their game tokens forward and score points for correct answers to the game's library-use questions (Rice, 2008). *Defense of Hidgeon* is another web-based board game, developed by the University of Michigan and meant to be played outside the classroom in small groups. In this game, players use various library resources to answer questions focused on the bubonic plague (Markey et al., 2009).

BiblioBouts was designed by the same research group at the University of Michigan and was constructed based on findings from their first game-designing effort. This digital game focuses on information-seeking activities and incorporates the *Zotero* citation management tool. The key goal of the design was to usher students through information-seeking activities (Markey, Leeder, & Rieh, 2012; 2014) Instructors choose broad topics for students to research and use the game interface to schedule the game's beginning and end dates . They set up bouts, caps, and quotas and invite students into the game. This game gave students repeated practice with information literacy tasks like selecting databases, narrowing topics, and assessing the relevance of information (Markey, Leeder, & Rieh, 2012). The overall success among these library-based game-development efforts was varied, but the work and findings were instrumental in fostering the conversation about the use of games in teaching information literacy.

2.7 Acquiring Acceptance by All Parties

Many educators avoid innovation for many reasons, in part because of a lack of understanding of nontraditional or radical approaches to teaching and learning, a reluctance to go beyond traditional instructional methods, a tendency to teach the way that they were taught when they were students, and the time investment without a known payoff that innovation entails (Bruffee, 1995; Leinwand, 1992; Long, 2004). Fleming and Mills (1992) suggest that educators' values and philosophies about the teaching/learning environment might impede the use of innovative teaching strategies if they do not align with innovative teaching methods. As Fleming notes "some teachers may be reinforcing their own preferences rather than catering for those with different needs" (Fleming, 1995, p. 7).

Some researchers argue that the need for game activities in education is somewhat exaggerated. Bennett, Maton, and Kervin (2008) refer to the 21^{st}-century learner debate as a form of academic moral panic. In the view of other researchers, arguments about the 21^{st}-century learner are still in need of critical inquiry in order to resolve the ‘‘clear mismatch between the confidence with which claims are made and the evidence for such claims" (Bennett et al., 2008, p. 782). Understanding students' perspectives could help educators to integrate instructional activities and gaming into the classroom, thereby improving and enhancing the learning process (Selim, 2003).

The usage of media to communicate with friends, to search for meaning, to create a personal place in society, and to relax and have fun is second nature to many of today's students (Bourgonjon, Rutten, Vanhooren, & Soetaert, 2010). However, it cannot be presumed that this is standard for all students, especially when it comes to games. Theoretically, games and learning are connected (Gee, 2003). Previous research, however, has shown that students do not necessarily acknowledge this. Like some instructors, they also hold the belief that play is irrelevant to learning (Fengfeng, 2008; Rieber, 1996). Students' resistance to new, innovative instruction processes that are offered in the classroom could be a threat to active participation (Squire, 2008). When it comes to activities involving games, some research has shown that experienced gamers benefit more from the use of games than their inexperienced peers (Egenfeldt-Nielsen, 2007; Sell et al., 2008; Silk et al., 2008; Virvou & Katsionis, 2008). Additionally, there are arguments about differences between the genders that influence ease of use, learning opportunities, and the overall usefulness of games as classroom tools (Bourgonjon et al., 2010).

Many of the researchers engaged in the 21st-century learner debate are partially right: Students who are more immersed in gaming do prefer a different kind of education. However, the claims about the different levels of immersion of the genders can be questioned. Findings by Bonanno and Kommers (2005) and Bourgonjon et al. (2010) show that the limited experience of many female students with gaming technologies may affect their acceptance of games as learning tools. However, the studies by Carbonaro et al. (2010), Robertson (2012), and Denner et al. (2012) all show female students being just as accepting of gaming activities as males. This suggests that the student population is more diverse than the literature often reports. However, large differences may lie within students' preferred mediums (Fox and Tang, 2014). Educators should be aware that students' initial acceptance of in-classroom gaming environment cannot be taken for granted.

Changes cannot be implemented without challenges, and there are impediments to the broader implementation of game-designing activities within information literacy instruction. First, the characteristics of contemporary schooling raise formidable challenges to the broader use of games in education (Rice, 2007). Many librarians are unfamiliar with game design as an instructional medium, and many lack adequate access to game-related resources. Short class periods limit long-term engagement of students with games. Commercial games do not align well with prospective curricula as defined by the national standards, and most games are not easily modified to meet this objective. Secondly, the empirical evidence of the benefits of games to teach information literacy is nascent. Actually, the body of research on the use of games for any type of education is in its infancy. Conceptualizing and testing how the use of games fosters learning that can be transferred outside of the game world is a necessary first step toward building a more robust body of research on what learners gain from playing and designing games.

In addition, the constructivist view of learning has its critics. Many researchers acknowledge that the creation of a classroom that encourages constructivist activities among students takes time and rethinking assessments. Yuen (2006) addresses the concerns of instructors about not all content being covered in a constructivist classroom. Another common complaint is that, although constructivist approaches allow for the creation of new meanings, these can be inaccurate (Kirschner, Sweller, & Clark, 2006). To help resolve these concerns the availability of facilitators is critical to guide students toward accurate meanings and knowledge within constructivist classrooms (Siko, 2014).

Although learning by game design can potentially promote better problem-solving skills, stimulate learners' interest, and motivate them to be engaged in learning, it does have drawbacks. Learning by game design is based on interactivity rather than displaying detailed descriptions of subject content (De Castell & Jenson, 2003). Because of this, learners might be distracted by the aesthetics of the game design and get off track in their learning. Again the sustained guidance that is necessary to foster learning experience needs to be considered when incorporating these instructional strategies into a curriculum. This study is takes these concens into consideration when integrating learning by game design activities into information literacy classes at the two sites. Approaches employed are discussed in Chapter 3.

2.8 Summary

This chapter outlined the situating theories of this study, including its foundational discourses and ideas. It presented a model (see Figure 2.1) for thinking about the intersections between game design, gaming, and learning. Experimentation with constructivist learning theories, motivation and play are defining characteristics of learning by game design. The experiental model of play and game design employs the same reflexive components. The activity of designing games fosters a reflection-in-action process and involves an iterative sequence of modifications. The activity of designing games within classrooms follows a cycle of testing, evaluating, modifying, and testing again. This sequence, acts very much like the process of play.

There is an apparent disconnect between the teaching-learning process of information literacy and the expectations of what information literacy instruction should achieve. As we can see from the relevent literature, desired outcomes in information literacy instruction are not always realized. Many students emerge from typical information literacy instruction sessions with a lingering inability to effectively access and use information or transfer learning from one situation to another. Information literacy instruction draws on an array of models that address effects, activities, and processes in this field.

To truly transition information literacy instruction from conceptual models to the classroom, further exploration and experimentation with experiential instructional approaches is needed. Instructional techniques should be made more salient, involving processes that incorporate multiple ways to measure reflection and learning achievements. The literature shows a discusssion and a growing level of acceptance of learning as a process of knowledge-construction with an emphasis on self-regulation. In a learning environment that manifests this, students construct their own understandings of the subject matter based on their prior knowledge and interests. Self-regulation allows students to manage their own learning processes. Both the construction of knowledge and self-regulation, furthermore, lead to deeper understandings, higher levels of retention, and a more active use of knowledge among students. The studies that were discussed in this chapter demonstrated that students who used constructivistic self-regulated learning strategies were more likely to obtain deep, conceptual understandings of complex topics than those whose learning was limited to declarative knowledge.

The next chapter will discuss the methodology used to obtain data measurements within this study.

CHAPTER III

METHODOLOGY

3.0 Introduction

This chapter discusses the research methodology used to examine learning by game design phenomenon, by first presenting the research design for addressing the research questions posed in Chapter 1. This is followed by justification of the method choice, case selection criteria, population to be investigated, specifics regarding data collection and analysis procedures. The planned methods used for this study are outlined. The chapter concludes with a discussion of strategies used to ensure research quality the role of the researcher and efforts taken to maintain the privacy and confidentiality of the participants.

3.1 Research Design

The goal of this study is better understand the phenomenon of learning by game design. The study takes place in a natural classroom environment at two higher education institutions taught by a librarian. Undergraduate students design games as a group activity around information literacy concepts. Data collection focuses primarily on gathering information to understand how the learning by game design approach affected undergraduate students from the perspective of intrinsic motivation, sharing of knowledge, representation of information literacy concept in games and the effect on students' skills. The study focuses on the external and internal processes that influence learning from the individual and collaborative perspectives to gain better insight on many nuances and complexities of the learning by game design phenomenon. Another important goal of the study is to support further research of the phenomenon on a practical level, and produce findings that can support improvement in instructional strategies used in information literacy classes and other learning environments.

Contrary to other approaches that integrate game activities into the classroom, learning by game design places learners into the roles of producers rather than just players. Therefore, students take control of their own learning through the challenge of the complex process of game design. The study grounds itself in understanding the construction of knowledge through game design from individual and team experiences. The goal is to understand how the integration of the learning by game design approach improves engagement, fosters student learning in information literacy classes, and the transfer and utilization of learned skills. Therefore, the research questions focuses on student's motivation, sharing through collaborative activities, incorporation of information literacy concepts in artifacts created and acquired skills. A multi-site descriptive case study design is used to explore these research questions. The use of multiple sites is meant to increase generalizability and provide an opportunity for descriptions and explanations that are more sophisticated (Miles & Huberman, 1994).

3.1.1 Rationale for a Case Study Approach

For this study, the case study methodology emerged as the appropriate approach. The phenomenon is examined in a natural setting and data is collected by multiple methods. The descriptive case study approach was chosen for a number of reasons. This was not the initial methodology intended for this study, and the decision to use this approach was influenced by the findings from the pilot study.

Before describing the specifics about the case study I will first discuss the findings from the pilot study. This is addressed in the following section.

3.1.1.1 Pilot Study

As mentioned, the origins of this study lies in a different research design. In preparation for this research study, a pilot study was conducted. Initially the intention was to use a quantitative approach to answer the research questions, aimed at exploring causality of the learning by game design intervention. At the time, few studies in the literature employed this approach. A quasi-experimental study was employed since it was not logistically feasible to conduct a randomized control study. A pre-test/post-test design was employed. A convenience sample of 200 undergraduate students enrolled in a six-week program at Syracuse University were the participants. The goal of the program was to provide pre-freshmen an opportunity to become familiar with the academic, social, and cultural life at the college level.

Part of the program activities included student's participation in library sessions, where they became familiar with resources and services offered by the five libraries located on Syracuse University campus. These sessions were done in a typical classroom setting, where students first passively learn about the library services. After the introductory session, students did a self-guided tour, where they were given the task of finding the location of objects and service points within the library. Students submitted the completed activity document to the instructing librarian and were then orally quizzed as a group about the activity they completed. Answer sheets with the correct responses were given to students at the end of the session.

For the purposes of the pilot study, the library sessions was modified. Prior to the library session, all instructors and students were taught the basics of game design using the game/multimedia design toolkit, *Scratch*. After the class tutorial, students designed game narratives, animated characters, added music scores and created backgrounds. Most importantly, they had an opportunity to add their creativity to this session and explore the various functionalities. They also played with completed games; selected from Scratch website, which is a sharing community where game designers upload their creations. This was done so students had a better sense of what designs were possible. All students were given a pre-test (see Appendix A) to establish a baseline measure for comparison with the post-test outcome measure. Posttests were given to the students two weeks after the activity. See Figure 3.0.

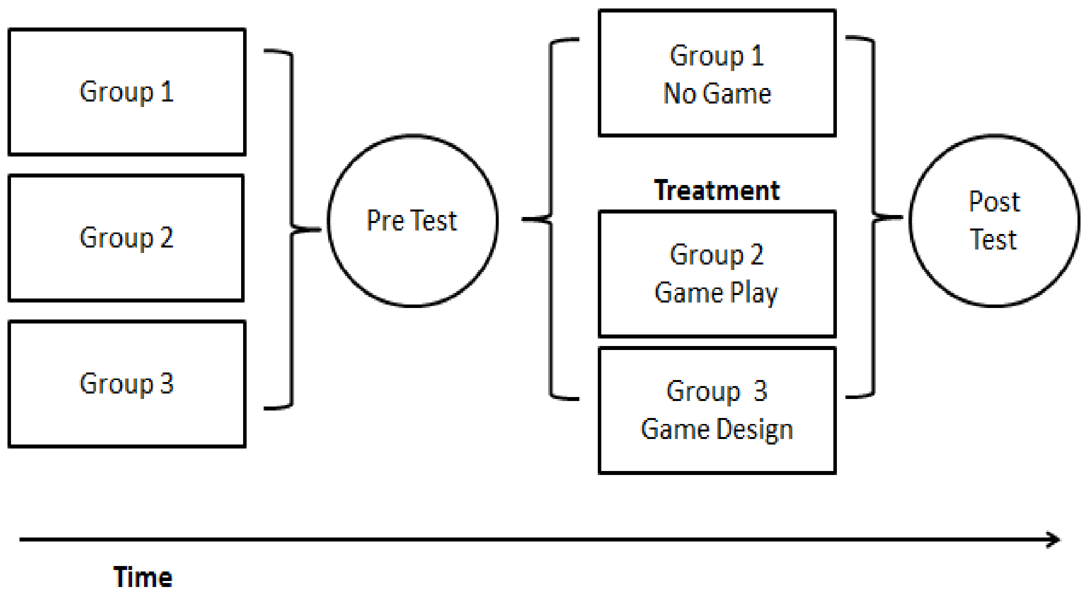

Figure 3.1- Quasi Experimental Design of Pilot Study

Four groups of students visited the library on different days during one of the scheduled sessions. All students did the introductory session and tour as done in previous sessions. The first group (Group 1) was the no treatment group. Students in group 1 had no game activity and were orally quizzed in the classroom. The second group (Group 2) was the treatment group that played a game created by librarians and the researcher, Group 2 played a simple hangman styled pre made game that incorporated tasks and questions from the self-guided tour. The third and fourth group of students were consolidated into the second treatment group, because they were fewer in number. Group 3 developed a plan for a game using either *Scratch* or paper plan of a game design to be created in using the toolkit. Students in this group designed a game to teach other students about using and finding library resources. All the class activities were recorded. This offered a firsthand examination of the participants engaged in library instruction and gaming activities. Interviews one month after the activity was also part of the research design. However, this did not materialize; the researcher communications to students to conduct a 20-minute interview were ignored.

Analysis of the data obtained from the pre and posttests showed that students in the two treatment groups' game play (Group 2) and game design (Group 3) achieved significantly higher posttest scores than students who participated in the no game activity (Group 1). There were however, no significant statistical differences between the two treatment groups' game play (Group 2) and game design (Group 3). Therefore, the learning retention of students in the treatment groups (Group 2 and 3) were higher than the no treatment group (Group 1). Analysis of the video recordings and observation notes showed that most of the students in the game development group (Group 3) were more engaged compared the other groups (Group 1 and 2) . Group 3 enthusiasm and motivation were noticeable from observations. There were few students in Group 3 who experience problems working with the design software and were not as engaged as their peers. This was primarily because these students chose to work alone or in pairs. Because students were allowed to choose their groups, they tended to work together with friends. Engagement among students was more pronounced in larger groups.

Many students in the traditional class environment (Group 1) acted similarly as noted by Head and Eisenberg (2009); texting, fidgeting, bored expressions and not engaged. This was noticed to a lesser degree in the game playgroup (Group 2). However, participation was not uniform among students in Group 2. The instructing librarian eventually resorted to calling upon individual students to answer questions. Time was the most debilitating factor that worked against the design group (Group 3). Many students became savvy quickly with Scratch, but because of the brief time allocated to the sessions they were unable to complete their design ideas. To overcome this time constraint, students were asked to present their draft ideas on paper. See Ramnarine-Rieks, (2013) for further details from this pilot study.

The pilot study showed that game development activity could be a feasible pedagogical activity for teaching information literacy providing time and effort was taken to integrate it into the class. The objective of the pilot study was to shed some light and to show that the use of games (whether playing or designing) can potentially improve learning retention and improve engagement.

The surprise finding was no significant statistical difference existed between game play (Group 2) and game design (Group 3). The researcher predicted that the game design treatment group (Group 3) would have higher scores in the posttests. A longer game design session may have helped in showing significant differences in learning between game play and game design. Better integration or scaffolding of game activities into the class or not limiting game design with Scratch may have also improved the learning outcomes. However, these were just unfounded speculation; a better understanding of the variables involved was needed.

The pilot study illustrated that many variables influenced the actions and conversations within the classroom. The pretest and posttest did not capture this well but footage from recorded observations did a better job at observing the students working together as groups and as individuals. As suggest by Ionnidou, Rader, Repenning, Lewis & Cherry (2003) the positivist perspective of multiple-choice and true-false type tests may not always be appropriate to judge the quality of learning that has occurred in dynamic environments. The quasi- experimental approach was therefore too limiting. As noted by Yin (2009) an experiment deliberately divorces a phenomenon from its context by only allowing the researcher to attend to a few variables. In the pilot, observations gave more insights into the student learning processes and interactions within the different learning environments. Therefore more structured qualitative data would have been useful in understanding the phenomenon.

The pilot study was useful in experiencing firsthand the planning of this intervention in a library instruction session. It allowed the researcher to realize the need for a better understanding of the many variables in play. Exploring the phenomenon proved to be more of complex than originally envisioned and a different approach was needed to capture the multi-faceted insights for a more complete picture. The quantitative approach used in the pilot informs the qualitative methods for the full study. The research design was developed to embrace approaches that are more descriptive. Descriptive studies are commonly done before an experiment to acquire a better understanding of specific variables to manipulate and include in an experiment. This does not mean that research methods are arrayed hierarchically. As noted by Yin (2009) experiments have been used for exploratory purposes. However, for this study approaches that elicited deeper understanding of the instructional environment, descriptive methods are best to achieve a fuller picture of relationships among variables.

3.1.1.2 Case Study

The case study methodology is regarded as a better approach especially when questions are more explanatory (Yin, 2009) and when a holistic, in-depth investigation is needed (Creswell, 2013). Yin defines a case study as “an empirical inquiry that investigates a contemporary phenomenon within its real-life context” (2003, p. 13) and suggest it as the best methodology to use for how or why questions; when there is no necessary control of behavioral events and when links need to be traces over time as opposed to frequencies or incidence. Case studies have been used in varied investigations, but more increasingly in instruction (Creswell, 2013). As Han and Bhattacharya (2001) pointed out learning in social constructivist environments can be different from learner to learner. Therefore, all of these elements need to be captured to get an overall sense of the phenomenon. A case study approach lends to this study, where the research requires the “close examination of people, topics, issues, or programs” (Creswell, 2009).

The descriptive form of case study method is used to develop a document that fully illuminates the intricacies of an experience. This methodology is often used to present answers to a series of questions based on theoretical constructs (Yin, 2003). It is generally considered most appropriate in the early stages of research on a topic or to provide novel perspective on an existing topic (Creswell, 2013). All these qualities afford a better understanding of student experiences in the learning by game design environment. Research on this phenomenon is still in the early stages and takes a different perspective on the intersection of the existing topics of the use of games in learning environments. This method is therefore appropriate for investigating this complex, contemporary phenomenon within its authentic context (Creswell, 2013).

One of the goals of all case study research is to develop an understanding of the bounded system in order to study the phenomenon in depth (Stake, 1995, Merriam, 2002). Boundaries help in scoping the study and outline the breadth and depth of the research. This descriptive case is bounded to groups of students at two sites that explores their learning experiences through game design activities in an information literacy class over a semester. The data sets are limited to the collection instruments listed in section 3.3.

Secondly, descriptive case studies answer questions based on theory. In order to fully explore and understand the learning by game design phenomenon and answer the research questions, data is collected from student's activities, intrinsic motivation inventory, game artifacts, student assessment forms and interviews. Classroom activities are observed, noted and recorded, instructors and students are interviewed, students are administered a motivation instrument to gauge its development in the classroom, self-reporting assessments are used to understand student's experiences. Data from these items are analyzed to address the study questions that address student motivation, sharing and collaboration among students, information literacy representation through the game artifacts and the effect of learning by game design on students' information literacy skills.

The case study inquiry is only successful when built on the collection and analysis of data from multiple sources (Yin, 2009). Therefore, the case study design allows for a multiplicity of methods. This leads to a triangulated research strategy. The need for triangulation arises from the need to confirm the validity of the processes. Denzin (1984) and Creswell (2009; 2013) identified different forms of triangulation. This study employs a methodological triangulation, where the use of different methods increases the confidence in the interpretation Yin (2009); Miles & Huberman, (1984); Merriam (1988). The data sources for this study come from a combination of methods used to document student's activities, thoughts and progress throughout the class. More details on the specific data collection instruments are discussed in the following sections.

One other important aspect of case study design is the unit of analysis (Yin, 2009, p. 29). Explicitly stating the unit of analysis is important within case studies because it can be very easy to wander from the intended study scope and unintentionally incorporate external data. For this study the primary unit of analysis is at the site level and the secondary unit of analysis is at the student level. Sites 1 and 2 are explored separately in Chapter 4 through an examination of student perspective of their own work and their involvement in a group. Chapter 5 compares and contrasts the 2 sites through a cross site analysis. Additionally, having a clearly defined unit of analysis is an important for a study's generalizability. With enough generalizability, this study's findings could allow researchers to consider the potential applicability of curricular modifications within other, non-information literacy settings.

3.2 Study Sites and Participants

Purposive sampling and criterion based sampling was used to select a site that best matched the researcher's objectives of this study. Creswell (2009; 2013) describes purposive sampling as the intentional selection of sites, participants, documents and visual materials that address the problem and research questions of a study. To identify suitable sites an online review of information literacy classes in Upstate New York college libraries was done. Instruction librarians from these libraries were contacted; six sites expressed interest but only two academic libraries qualified. Criteria needed to qualify for the study were; a required for-credit information literacy class, presence of accredited librarians and willingness to modify the existing syllabus to include learning by game design approaches. An earlier attempt to conduct the study was not fruitful since the information literacy course was cancelled due to low enrollment. Therefore, it was critical that the course be a required.

Two sites expressed interest in pursuing the study. Subtle differences between the sites is discussed the following sections. Prior to beginning the study, the researcher met with the instruction librarians to discuss her research interest and expose them to the literature on game design. Concrete plans for the study began after receiving the required permissions from library administration and Institutional Review Board from all institutions.

The following section discusses the specifics of the two study sites, the nature of their information literacy program, steps taken to integrate learning by game design into the class syllabus, the instructor librarians and student participants.

3.2.1 University and Library Site Information

Students from both sites were part of Life Sciences programs. Site 1 is a research university with a student body of approximately 1,650 undergraduate students and 600 graduate students. The schools offer 24 undergraduate and 30 graduate degree programs; bachelor's, master's and doctoral (Ph.D.) programs in the sciences. Site 2 is also a research university with an enrollment of approximately 2,800 undergraduate students and 800 students pursuing graduate work only at the master’s level. At Site 2 there are courses leading to Bachelor of Arts or Bachelor of Science degrees and graduate courses in masters in business administration, education, nursing and physician assistant studies.

Librarians at these sites took different approaches to teaching their information literacy classes. At both sites non-librarian faculty members supported information literacy classes. This was mainly because of the noticed improvements in student assignments, which was attributed to student’s use of library resources. Both librarians mentioned that they were known by students and identified as the library subject specialist. This meant students visited them regularly for assistance.

3.2.1.1 Site 1 Information Literacy Class

At Site 1, information literacy classes have been an undergraduate requirement for graduation since 1974. This site boasts being one of the first higher education libraries to have a for credit information literacy class. In an interview with the former library director, she mentioned that the program began as a 5-week pilot mini course in 1974. Documented evidence of improved student test scores, and expressed interest by faculty and students led to course approval by the curriculum committee. The classes are still conducted over a 5-week period, where students meet for fifteen one-hour sessions three times a week. This was a one-credit class. Content focused introducing students to the following

- Familiarity with the library physical and online space,
- Searching library databases,
- Understanding and avoiding plagiarism,
- Evaluating online information sources
- Understanding the information supply chain and differences between popular and scholarly resources and
- Identifying primary and secondary content.

See Appendix B for more details regarding class content. Three librarians presently do the face-to-face version of the class, once per academic year in the fall semester. This coincides with the influx of freshmen, the hope being that incoming students will take classes early to orient them to the library and the resources offered. The online version of the class is offered every semester. Only one librarian is responsible for teaching the online version. Students are assessed through class assignments. To help in fostering student's engagement the librarian incorporates assignments using various multimedia tools.

<u>3.2.1.2 Site 2 Information Literacy Class</u>

At Site 2, information literacy is taught as a one-credit class to Biology and Chemistry students. To be eligible for graduation and work on grant-funded research, students need to have successfully completed this course. According to the librarian, faculty initiated interest these classes. She worked with faculty to develop courses that teaches students how to use and integrate library resources into their assignments. Prior to enrolling in the information literacy class students complete four one-hour sessions over a two-year period. These sessions focus on introducing information literacy concepts such as searching and identifying appropriate databases, identifying various types of scientific literature, evaluating online resources and ethical use of information. Students are assessed through either pre and posttests or class assignments. Instruction sessions are integrated into the biology and chemistry class syllabus. Therefore, one class is made available to the librarian to deliver her content. According to the librarian, she attempts to make these classes as active as possible to offset typical lecture style of content delivery. See Table 3.1 for more details on the type of content addressed in these one-hour sessions in biology classes.

Table 3.1 Content Covered Before Enrolment in Information Literacy Class

Year/Semester	Class	Content Covered
1/ 1	Introductory Biology I	Introduce major library resources and bibliographic databases, understanding the difference between popular versus scholarly resources. Pre and post quiz – multiple choice questions on library databases, library website, constructing searches, identifying scholarly, peer-reviewed and popular content
1/2	Introductory Biology II	Focused searching on three faculty identified databases, understanding the difference between popular versus scholarly resources. Pre and post quiz – open ended questions on library databases, citation and referencing, constructing searches, identifying scholarly, peer-reviewed and popular content. Assignment - Poster presentation.
2/1	Cell and Molecular Biology (Majors)	Focused understanding the difference between popular versus scholarly resources and primary and secondary sources in Cell and Molecular Biology. Assignment – Develop lab reports identifying popular versus scholarly resources.

2/2	Environmental Science (Majors)	Evaluation of Environmental Science web sources Environmental Science Assignment (poster of Presentation)

The information literacy class was taught over a semester, where students meet weekly in one-hour sessions over thirteen weeks. Most students take this class in the junior or senior year. To be eligible for enrollment in this class, students must complete four one-hour sessions (exception only made to transfer students). Content (see Appendix B for more details) for this class focused on:

- Scholarship as Conversation. Identifying biases, authoritativeness and building on previous works
- Evaluating Scientific Information
- Advanced Searching
- Keeping Current in your field
- Privacy (student led)
- Open Source Access (student led)
- Scientific Misconduct (student led)

The latter three topics are assigned to students where they research and present on these topics as a group. Most topic choices were requested for inclusion by faculty; exception to this was privacy which was student requested. According the librarian:

> *"Scientific misconduct... I think it's really important for people when they're using information and also when they're producing information, to be really aware of what is scientific misconduct, what are some examples of it and how do you avoid it, and all the issues that surround scientific misconduct. So I think that topic is pretty crucial... Open*

access, I just think that anyone who is doing research right now needs to know about this. And I also teach them that because they're going to be faculty someday, some of them, and I want them to start thinking about it now ... Privacy... they were interested in things like Facebook and Gmail and they wanted to have discussions about everything surrounding privacy on those two things in particular…"

The Site 2 librarian was of the view that information literacy is more than just locating and evaluating information but saw it as enabling individuals to be more effective consumers and producers of information and be able to adapt accordingly to the changing information landscape. To help jump start the research process on the assigned topics students had access to a list of resources; made available through the course online space. The main idea behind this assignment was to have students teach their peers about privacy, open access and scientific misconduct. Students were assessed based on their presentation, references, resources used, and questions posed to the class.

3.2.2 Profile and Role of Instructor Librarians

Both librarians have an ALA accredited Master's Degree in Library Science and hold a second Master's Degree in Environmental Sciences. They have been students at the institution at which they currently work. Therefore, they have firsthand student experiences at the institution. Both have been teaching information classes for a number of years and continually modify classes in an attempt to make them more engaging. In addition, both librarians have presented on their teaching approaches from previous classes at local and countrywide conferences. When asked about teaching models used to help in developing their courses, both librarians indicated that the ACRL standards is used to guide their instruction. They operationalize these standards using teaching approaches adopted from peers, ideas discussed at conferences and faculty requirements. They were both aware of tested teaching models like Big6 and ISP but they do not actively follow its guidance in their course development.

3.2.2.1 Site 1 Librarian Profile

Site 1 librarian developed her information literacy course together with a committee. This committee meets before and after the delivery of information literacy classes. The benefit of this collaboration is to share ideas and discuss what approaches worked and which to avoid. Some recent ideas generated at these meetings were …

> *"A few semesters ago we threw out the idea of doing Wikipedia. Students become a Wikipedia editor, learn about Wikipedia, and then actually edit a Wikipedia entry… We have them create a bibliography and write a paragraph about their topic. We didn't feel like they were engaged. So by having something that felt like a hot button thing like Wikipedia ... It's trying to get more engagement. Another idea…We would put them into teams, and we would randomly assign them a database, and then they would have to learn everything about that database and toward the end of the class they would actually get up and do a presentation…"*

Every librarian had the option to adopt discussed ideas or develop her own. The only things that were standardized were the learning objectives, which were the ACRL standards. All syllabuses had to include these standards. When asked about what attracted her to the use of games, she mentioned that she knew about its potential benefits but felt that it would take too much time to integrate, since she had multiple commitments (subject specialist, archives, committees) as a librarian and their limited staff problem restricted her time. Therefore, she welcomed the opportunity to incorporate this approach in the classroom with the assistance of the researcher.

3.2.2.2 Site 2 Librarian Profile

Site 2 librarian was mainly responsible for developing her course materials. Some of topics covered were co-developed with faculty but the manner of delivery content was based on her preference. According to her

> *"I tend to really avoid lecture, which sometimes drives the BIO students crazy … I don't think it's always the best learning strategy. For any topic, I try to do a lot of active things where the students actually have a question or research topic ... So they would learn the material and then teach it to other people."*

Her main role was as an instruction and reference librarian. Unlike the Site1 librarian, she was not distracted by other commitments. She was also interested in the incorporation of games within her class. However, she was unsure about how to go about integrating them into the class structure.

3.2.2.3 Role as Instructor

In constructivist learning environments, learning is an active process, allowing students to construct their own knowledge, individually and socially. The instructor's job changes from being the source of knowledge to being an influencer and role model of class culture, connecting with students in a personal way that addresses their own learning needs, moderating discussions and activities that collectively leads students towards the learning goals of the class. Therefore, as instructor, the librarian takes on a learner-centered approach to teaching. Therefore employing various teaching methods that shifts the instructor role as a guide on the side. According to Li, (2010) there needs to be a balance between constructivist approaches and formal teaching when developing learner-centered classes. For this study, both approaches were incorporated. Siko, (2014) and Li, (2014) discusses the pedagogical and social role of the instructor in constructivist environments. From a pedagogical perspective, they stress the need for the instructor to create interactive, reflective and collaborative learning spaces to foster peer learning and a student centered-approach. Reflection helps in fostering lifelong learning because it helps learners to understand their own knowledge gaps and intellectual needs and develops new understandings (Perkins, 1986). Creating the opportunity for reflection allows learners to organize and generalize their experiences to create meaning. Through this process they project information that is already known, apply it to a higher level where it is reflected upon by being reorganized and reconstructed. Theoretically, collaboration helps in developing a supportive community fostering students to feel more comfortable in risks, and learning from errors (Vygotsky, 1978). Therefore, students take on an ownership their learning.

From a social perspective, the instructor needs to take into account the tone of the course. It should be a safe, supportive, informal and trusting environment. Therefore, the instructor should provide clear guidelines for assessment and rubrics where applicable and foster collaboration, provide support and intervene when discussions or projects are off topic. Within these perspectives, the instructor needs be flexible when unforeseen issues crop up in the classroom and be open to continuous class modifications as needed.

3.2.3 Class Planning

All classes were primarily held in a computer lab at both sites. Some classes at Site 1 were held in one of the library's conference room to facilitate game play. The researcher conducted the study at both sites simultaneously. Site 1 classes ran over five weeks with three 50-minute class meetings per week held in the morning. These classes were independent of other courses. Therefore, students were from different degree majors. There were 15 class meetings. Site 2 information literacy classes were more situated within the subject Biology. Students were all Biology students and had one shot information literacy class in previous Biology classes. At Site 2 classes had 50-minute meetings held once per week in the evenings. These classes ran for 13 weeks over a semester. Therefore, the information literacy class at site 1 was very fast paced, ending within a short period.

The researcher worked together with both librarians to integrate game activities. While the researcher does not have any formal training in education she has taught information literacy classes in the past as a librarian. Both parties understood the need for flexibility in scaffolding game design activities into the class schedule. Regular weekly one-hour meetings were done over a five-month period before the study. During these months, the discussions were on their current approaches to teaching information literacy and pedagogical approaches that embraced more constructivist approaches to learning. To help librarians better understand the learning by game design approach, the researcher shared her dissertation proposal and selected literature that featured the integration of game design activities and other experiential learning approaches into classroom instruction. This included literature that discussed learning as an active collaborative process, allowing students to be more engaged and reflective by creating artifacts constructed around the class content. Learning by game design experience was tied into the course learning objectives, rubrics and assessment tools. Former class activities were replaced to include game design. At Site 1, content was taught through traditional instruction. The idea was to cover most of the class content before student was asked to design games.

At Site 2 the class content was delivered through game based activities developed by the librarian and researcher. Content used to develop games was not taught in the classroom, so students were responsible for doing research to understand the content while working on the game design. Therefore, game design was not dependent on content as students needed to first work together as a group to first understand the content and then design their game. This difference between the two sites is a critical one to keep in mind throughout the study.

The information gleaned from working together with both librarians increased the researcher understanding of the broader classroom context and, deepened analysis of understanding students' literacy practices at each location. This understanding informed the development of the assessments and integration into the class structure.

The pedagogical approaches used in this study are from constructivist strategies articulated in constructionism, knowledge as design and experiential learning. These approaches are operationalized as follows:

1. Providing basic understanding of game design
2. Hands on experience with games
3. Scaffolding design activities into existing class structure
4. Instructor serves as a guide on the side
5. Development of a game artifact
6. Integrating collaborative opportunities among participants: discussions, play testing, game play
7. Creating opportunities for individual reflection
8. Fostering an learning environment to sustain motivation
9. Employing ongoing assessments and regular debriefing
10. Promoting a flexible learning environment

To facilitate the approaches listed above the following assessment tools were developed to better understand the game design processes and assess experiences and reflections by participants. These tools were developed on separate visits with both librarians. Through a series of agreements, they were standardized across both sites. These were as follows:

1. Student Demographics and Game Experience Questionnaire. Since this study focuses on the student, responses from this questionnaire were used to determine participant's prior game experiences and years in college. This item was distributed on Day 1 of the class

(see Appendix M). Data collected form this questionnaire was used at site 1 to assign students into groups. Attempts were made to group students with varied game experiences. At Site 2, students were randomly assigned into groups.

2. Game Exploration Questionnaire. Developing a game can be a daunting task. Use of models and representations can help support the design process (Perkins, 1993); Harel & Papert, (1991). Studies that explore designing games seem to report it as a simple activity. To help students' better identify and understand the interplay among game elements a class focused on just exploring games. The researcher and librarian selected games used in this class. See Section 3.3.4 for the specific games used in this exploratory activity. Questions helped in focusing participants thinking about game components (see Appendix J). We asked students to document their thoughts during the exploration and note ideas that resonated with them to aid in their own game design. Copies of these questionnaires with the instructor's notes were returned to students.
3. Individual Assessment. Knowledge by design and experiential learning emphasizes the importance of reflection across the progression of the learning process. These assessments (see Appendix J). were developed to guide student's documentation of their reflections. These questions were distributed at four points in the class. These were the concept, design sprint, after presentation of playable game draft and final phases of the game design process. See Figure 4.1.
4. Team Assessment. According to Vygotsky, (1978) one or more participants in teams begin tasks with different understandings but in the end arrive at shared understandings from endeavors between expert and less expert learners. To get a better sense of how teams worked together, students were asked to assess each member at three points in the

class (see Appendix J). These assessments were done after game design milestones (concept, playable game draft and final game).

5. Progress Report. Ongoing debriefing and feedback helps to reinforce and extend the learning process (Perkins, 1993; Papert, 1981). This questionnaire was submitted at the same time as the student presentation of the playable game draft (see Appendix J). Completion of this document was done as a team effort. The librarians viewed this tool as a mid-point assessment of the game design activity. Completed questionnaires were returned to teams with instructor's feedback that focused on connection making (Salomon and Perkins, 1989) between the learning objectives and suggested game modifications.
6. Peer Game Review. Papert (1980, 1991, 1993) places strong emphasis on the need for student created artifacts to be tested, displayed, discussed and examined. The idea being that the sharing of artifacts can result in refinements allowing the learner to gain deeper understanding from their peer perspectives. Papert regards the peer testing process as important and critical to the design process. Opportunities for sharing and testing were done at the presentation of the playable game draft and the final version. For the game draft, teams did a 5-minute presentation about their games after which their peers play tested their creation. For the final play test, no team presentation was done. Teams were only required to set up their games. Therefore, players tested based on their understanding of the rules and other game play documentation. Students reviewed games based on the criteria specified on this questionnaire (see Appendix J). Peer comments were given to teams to note as they further revised their game creations. Reviews

received from the final version of the game were used to document further game revisions in the final report.

7. Final Report Template. Gargarian (1996) addresses the concept" freedom in restrictions". He states that without restrictions the designer would become paralyzed because of all the options presented to them. While students had the freedom to design the game as they saw fit, a predetermined rubric was developed for them to follow. See Appendix C. This was done to ensure that students paid attention to designing games around their learning objectives and not get caught up in fine tuning aesthetics. The final report template was closely tied to this rubric (Appendix D) so that students knew beforehand what components of their design needed to be emphasized. For example, it was stressed that their game must possess significant information literacy content to meet their learning objective and attention to pretty graphics was nice to have but not necessary.

Both librarians together with the researcher assess student performance in the game design activity using items. Creswell (2009) suggest that data verification comes from close working relationships with the participants. The researcher adopted this by meeting with librarians before every class to review assessments, discuss and make any improvements to the class structure. Distributions of these assessments were spread over the class. See Table 3.2 for the distribution.

3.2.3 Students

All students were undergraduates that were 18 years and over. These participants aim to become professionals in the medical and environmental fields. At Site 1 twenty two students were enrolled in the information class. At Site 2 ten students were enrolled. Further details on demographics and experiences about student's participants are discussed in Chapter 4.

3.3 Data Collection

This study was conducted over a semester, 15 hours class contact time at Site 1 and 13 contact hours at Site 2. Data was collected during class sessions and interviews were done at the end of the course. Since all interviews were done individually, they were conducted separately from class time. As noted by Yin (2009) and Merriam (1988) the key strength of the case study approach involves the use of multiple data sources. Data were collected from two sites using various methods to produce a record that provided a comprehensive view of the phenomenon thereby allowing for triangulation of the findings. Data was collected using the following tools and methods: student's artifacts, submitted class assessment materials, recorded observation, participant observation, items from the Intrinsic Motivation Inventory (IMI) and interviews. Each data type collected will offer a lens into the research questions. The following sections describe the data collection instruments in more detail.

3.3.1 Observations

This method is usually regarded as one of the main data sources of the case study (Yin, 2009). Stake, (1995) noted that the researcher needs to become familiar with the entity by observing how it struggles against any constraints and copes with any arising problems. Learner's activities within the classroom is observed and recorded. In-class observations were recorded using field notes and video recording during class activities. Notes included dialog between students, observed interactions among team members, the nature of the instruction implemented in the class, iterative changes made to the instruction, observations made relating to student questions, their use of class time to design games, their expressed understanding of their information literacy skills. All classes were recorded and corroborated with field notes. Hatch recommends that the researcher "make a careful record of what people say and do” (p.73) within the setting. Therefore, attention was paid to verbal and non-verbal behaviors. Attempts were made to capture direct quotes whenever possible. The researcher paid attention to students interaction with games brought into the classroom and created by peers. Observations also focused on patterns of participation and interaction as well as the kinds of questions asked in the class sessions. For example, the researcher noted where students sat over the course of the class, whether individually or with group members. The researcher attempted to locate herself at various points in the classroom, sometimes with student groups or at different vantage point from the cameras. These observations were used as a source in building the interview questions.

3.2.1 Participant Observations

This method is generally considered the cornerstone of social science field research. Understanding the context of the use of a phenomenon generally requires "being there". Participant observation provides an opportunity to develop a deeper experiential understanding (Hatch, 2002 p. 72) of learners in context. Part of the role of the researcher will be to "gather data as an observer then as a participant" (Creswell, 2007, p.130) to describe the setting of the learning environment and reflect on the context of the activities the participants engage in during the time observed. Detailed notes were taken using the participant observation protocol. The template used taking notes is shown in Appendix E. According to Hatch (2002), "participants should know that the researcher is acting as a researcher" (p.74). As an observer, care is taken to reduce the level of intrusiveness by having the instructor introduce the researcher as an observer and assistant (Creswell, 2007). As for the role of participant, the researcher report the data from the "insider's perspective" (Hatch, 2002, p.74) which allow for richer understanding how participants engage. For example, the researcher presented on the game design activity and did a brief talk about the steps involved in creating a game in the class (slides from this presentation are contained in Appendix F). Also, she contributed towards classroom conversations; advised when needed on created game artifacts, participated in question and answers sessions during class sessions (even those unrelated to game design activity), announced reminders of deliverables and offered guidance and suggestion to students presentations. The notes from observation as a participant was also used to inform the development of the interview questions.

3.3.2 Intrinsic Motivation Inventory

The Intrinsic Motivational Inventory (IMI) is a self-reporting instrument and is used to assess the changes in intrinsic motivation among participants in the classroom. This instrument is used at the two points of the study: - At the beginning in the planning stage of the game design activity so as to establish a baseline measure, and at the end of the game design activity. In this document, these two measures are referenced as pre and post questionnaires. The IMI was developed by Ryan (1982) and his colleagues (Plant & Ryan, 1985) and many adaptations of the inventory, can be modified to fit various scenarios. The IMI is a 45-item scale, but to measure intrinsic motivation a 22 item version was developed from previous studies. The measure is regarded as valid instrument that determines the level of intrinsic motivation as an additive function of four sub scales; interest/enjoyment, perceived competence, perceived choice and pressure/tension. According to Deci & Ryan, (1985) the interest scale refers to intrinsic motivation. Perceived choice and perceived competence are positive predictors of both self-report and behavioral measures of intrinsic motivation. Pressure and tension is a negative predictor of intrinsic motivation. This measure is regarded as flexible because it can assess both four specific sub-dimensions of intrinsic motivation and the overall level of intrinsic motivation that an individual experiences from engaging in a task.

Vos et al., (2011) used similar subscales demonstrating the IMI is a reliable measurement that can be used to assess individuals' levels of intrinsic motivation in a game design scenario. Students were asked to rate to what extent they agreed with the statements based on the 1-7 Likert scale, where 1 is not at all true and 7 very true (1-7). Only the tense of the statements of the inventory was modified during the two administrations. For example, if an item at the beginning of the study says, "I find the task very interesting" the same item at the end will be modified to the past tense "I found the task very interesting". The order of the items were kept the same as featured in the 22 item inventory, even though past studies have shown that the order of item presentation is impact on reliability is negligible.

All negatively worded items in the IMI were reverse calculated as indicated in the instructions about scoring. This was done before the analysis. The aggregate scores of reliable items were calculated by summing all responses for each item and dividing by the relevant number of items per subscale. High scores for interest, perceived choice and perceived competence indicate a high intrinsic motivation (Reynolds, 2008). For the tension and pressure sub-scale of IMI, high scores indicated stressed students. This inventory aids in better understanding interest and attitudes of students maintained over the class. See Appendix G for the version of the inventory used in this study.

3.3.3 Semi Structured Interviews

The use of interviews elicit firsthand accounts of the people involved in the phenomenon. It emphasizes the social situatedness of the research data and allows participants (interviewers or interviewees) to discuss their interpretations of situations from their perspective. Interviews were done the week after the class was completed. The researcher entered the interview with preset question in mind but generated questions during the interview based on the interviewee's responses (Rubin & Rubin, 2005). Open-ended questions were constructed around observations made during class sessions over the semester and interviewees were probed on their experiences. Questions were crafted to capture student experiences and the essence of Perkins (1996) knowledge as design that helps the designer(s) reflect about the nature and theme of the design (p5) and its meaning to the individual. Questions elicit perspectives about information literacy from the individual student and experiences within their group settings.

To provide face validity, the interview instrument was co-constructed with the two site librarians. Because Site 1 classes were completed first, interview questions and probes were completed by the fifth week of the study. As instructors employing a new approach to teaching they were interested in understanding student's experiences with learning by game design and getting a sense of what content was learned using this approach. This acted as a peer review process and assisted towards eliminating confusing, redundant and unnecessary questions. The researcher also took into account student deliverables, such as class and team assessments, progress reports as well as observations when developing questions. This was done to ensure that the interview questions had the required depth and breadth to answer the research questions. See Appendix H for the listing of preset questions and probes used to guide the interviews.

Interviews were conducted at the end of the class. To elicit detailed responses, probes (Rubin & Rubin, 2005) were used to follow up questions. These probes included:

- detail oriented probes; to get participants to describe in detail the methods and actions they used during the learning by game design
- elaboration probes; to get participants to tell more about their experiences while engaged in the classroom and learning by game design and
- clarification probes; to insure that the information collected was clearly described

The interview protocol designed to interview students for this study is shown in Appendix I. At the beginning of all interviews, students were told that there is no right answer to the questions. They were assured that their response were confidential and will not affect their grades. These reminders were aim to help students feel comfortable and truthful with their responses. Incidences where students were unsure about questions the researcher rephrase question or provided examples for clarification.

Interviews were conducted in a conversational manner while ensuring all questions were address within a 30- 40 minute time frame. In the few situations, where the time exceeded 40 minutes, students were advised that they had the option to wrap the conversation or continue with the discussion. All interviews were recorded and transcribed; contingent upon the permission of the interviewees. As suggested by Miles and Huberman (1994) all irrelevant conversations were excluded from the transcriptions. For recording these sessions, the researcher used a smart pen, which is an inconspicuous device compared to a conventional recorder. In previous interviews conducted by the researcher the use of this device created less of a distraction and facilitated better note taking. Some interviews were conducted face to face and other were via phone. The choice depended on the interviewee preference. To ensure that the researcher accurately represented the participant's responses a member check system was established. Participants were sent their transcribed interview prior to the final analysis of the data. The intent was that any portion of the interview that inaccurately represented would be noted. All participants indicated that their responses were accurately represented, and no corrections to transcribed interviews were requested.

The semi structured interview questions explored themes that focus on acquiring a better understanding of the participant's experiences during game design activity, information literacy concepts they used in their design, rationale behind their game design and their use of learned information literacy concepts. The questions gave the participants an opportunity to reflect on the design activity, articulate their successes and challenges, aspects of the class they liked and disliked, information literacy content incorporated into the game, and their use of skills in other scenarios. Student responses were also used to complement the researcher's own interpretations from data acquired from other methods.

3.3.4 Game Artifact Design

In this study, student participants design an information literacy game using physical objects (e.g. poster boards, cards, dice) or an online application. This deliverable was assigned as the class final project. The designed game had to meet all the following requirements:

1. Easy to learn and intuitive
2. Clear rules of play
3. Possess learning objectives. The game design team should be able to say what the player will learn after playing.
4. Significant inclusion of information literacy content. This content had to be accurately represented.
5. Digital or physical face-to-face mode. For example tabletop board games, physical games, puzzles or games designed using online game toolkits or applications
6. Original or modification of other games.
7. Game play completed in 30 minutes

At Site 1students had the freedom to choose a topic that was addressed in the class. Students from Site 2 chose from four predetermined topics on a first come first serve basis. One class was devoted to exploring games to help create awareness around game design elements such as rules, mechanics, components, challenges offered and the end point. Students played examples of online library-created games as well as various board games; such as the familiar ones like *Clue*, *Candyland*, *Trivial Pursuit* and some non-mainstream games such as *Wits & Wagers, Forbidden Island*, *Settlers of Catan* and *Dixit*. Students were also be made aware of the array of open game development software applications *Scratch*, *Construct2* and *Twine*. Because these were a large number of resources for students to explore in just one class, these items were made available as references over the design phase. Online resources were included in the class website.

In any learning environment, many strategies are employed to make the learning process more meaningful. Constructionism and experiential learning sees design of artifacts as a cyclical process. In this study, the learner is an active builder of knowledge through five high level phases of game design. This is similar to the phases documented by (Harel, 1991; Reiber, Luke & Smith, 1998; Kolodner, et al.,2003; Kafai, 2005; Resnick, 2007; Hwang, Hung & Chen, 2014; Siko, 2014): planning (exploring and conceptualizing), designing, playtesting, peer reviewing, reflecting. Self-reported assessments were incorporated into these phases. Description of these assessments are described in section 3.2.3.

Explore and Conceptualize. This was the initial step for students in the game design process for students to plan their approaches. Students explore concepts and resources and create plans based on their previous knowledge. This phase emphasizes student directed research on information literacy concepts. Similar to the processes used by Kafai, (1996) and Kolodner et al. (2003), students were asked to keep notes and drafts of their process. In Kafai's study, students wrote their ideas and thoughts in class diaries in the planning process. However, this procedure fell through as the class progressed. Therefore, for this study students were given individual and team assessment forms with open questions to document their role and ideas as it developed in the different phases. These open questions were meant to help in guiding their thoughts as opposed to asking them to maintain a dairy. It also helped the instructor to note whether all team members were involved in the game design process.

Design. In this phase, students actively constructed their understanding of learned information literacy concepts into a game. Students not only translated information literacy concepts but also the game concepts. Students had the options to start their game design either from scratch or by modifying from a template. Self-reported team and individual assessment forms were completed in the two design sprints and final design phase. See Tables 3.2 and 3.3 for the points in the class where assessments were completed. Students were also asked to complete a game progress report after they developed their playable draft. This deliverable was submitted as a group, the objective being that student had time to reflect on their design and justify their approaches.

Play Testing, Peer Reviewing and Feedback. Play testing their own games and learning from errors is an important part of this process (Robertson & Howells, 2008). Within an informal class structure, students tested each other's games. By critiquing or reviewing their own games and other peer games, students often chose to redesign some parts of their games (Kafai, 1998; Kolodner, 2003; Baytak, et al., 2008). Testing and peer sharing are regarded as important components of constructionist-based designs. In other game design studies, researchers frequently used collaborative settings so that students can playtest and share ideas (Kafai, 2005; Kolodner et al, 2003; Shaw, 1996; Vos et al, 2011, Hwang et al., 2013). In these phases students completed peer review forms, which was shared with the respective team. To help in peer review process, guidance was provided. See Appendix J. Peer review was done at two occasions, during play testing of the playable draft and the final game.

Reflecting. Throughout the class students were asked to reflect by assessing themselves as well as from the team and individual perspective. At the end of the game development activity teams submitted a final report, which was structured to address specifics about the created game. For example learning objectives, game rules, game mechanics, and revisions made, proposed changes for the next version. See section 3.2.3 for further description.

The process flow of these steps or phases are shown in Figure 3.0. Activities involved in these phases were presented to students in the first class. The instructional librarian collected all assessments. Researcher and librarian collaborated in grading these assessments to determine student's participation in the classroom. Assessments were also used towards acquiring a better sense of student experiences providing additional guidance to those students encountering challenges.

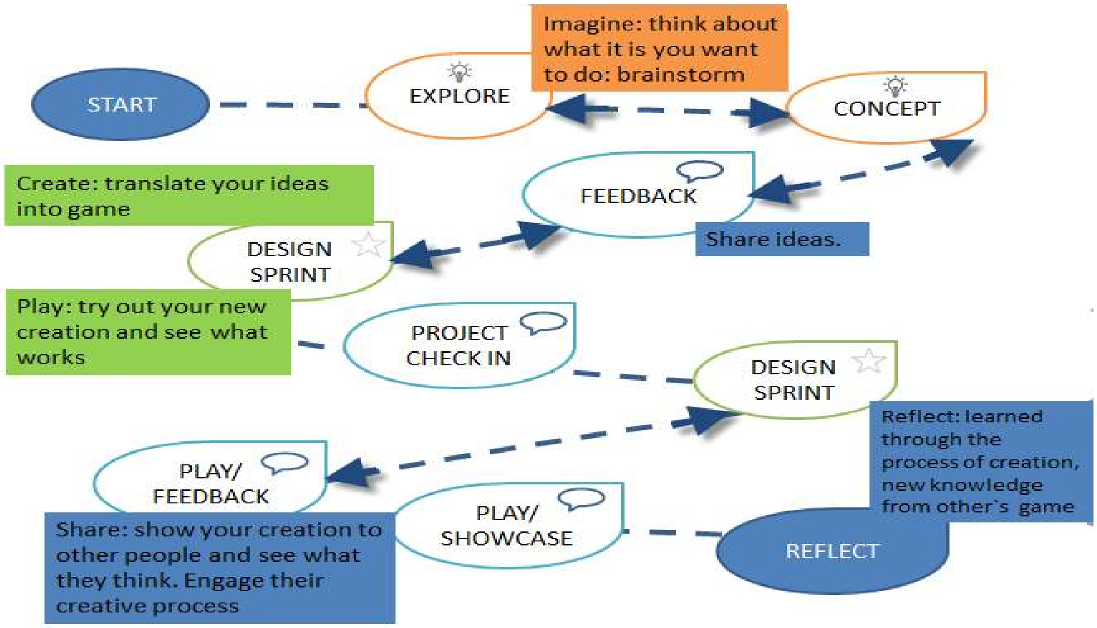

Figure 3.2- Phases of Game Artifact Design

3.3.5 Integrating Game Design into Information Literacy Classes

During game design activities participants met with their assigned teams. Class time was allocated for students to discuss ideas and develop their games. These class times are shown in relation to the entire class schedule in Tables 3.2 and 3.3. There were also classes dedicated to play testing games. At Site 1 students, final version of games were played during the last two class days. An all-class debriefing was done on the second day. At Site 2, three classes were dedicated to playing games created by the 3 teams with a class debriefing done at the last class. On these play days, groups set out the game components and rules and watch their peers interact with their game creations. Only when players were stuck, then they were game creators prompted to assist their peers.

Papert, (1991) stated that students' designed artifacts should treated as resources for the others in the class. Therefore, students played each other creations at the end of the class to learn the topic that was taught. All created artifacts and student notes were collected for analysis. In these phases, student's experiences from the pedagogical approaches of internal and external processes of constructionism, knowledge as design and experiential learning is explored. The exploration and conceptualizing phase focuses on the internal processes while the design and sharing/testing stages emphasized external processes. Tables 3.2 and 3.3 summarize the sequence of class activities, specific phases illustrated in Figure 3.2 and the instruments used to collect data from both sites.

Table 3.2 Summary of Activities and Data Collection - Information Literacy Class at Site 1

Class	Activity	Phases	Data Collection Instruments
1	Course Introduction and Game Design	Introduction	Game Experience Questionnaire Consent Forms
2	Library Tour – iPod Game	Explore/Concept	Observation Motivation Questionnaire
3	Game Exploration		Observation Group Exploration Report Individual Assessment Team Member Assessment
4	Catalog -Lecture/ Class Assignment		Library Catalog Assignment
5	Game Design	Design Sprint	Observation Individual Assessment Team Member Assessment
6	Databases, RefWorks, Plagiarism – Lecture	Explore/Concept	Observation
7	Databases, RefWorks, Plagiarism - Class Assignment Game Design		Observation Databases – RefWorks – Plagiarism – Assignment
8	Game Concept Presentation/ Game Design	Play/Feedback	Observation
9	Game Concept Presentation/ Game Design		Observation
10	Internet Searching, Wikipedia – Lecture	Explore/Concept	Observation
11	Presentation – Game Draft	Play/Feedback	Observation Progress Report
12	Game Design	Feedback/ Design Sprint	Observation Individual Assessment Team Member Assessment
13	Game Design		Observation
14	Game Play	Play/Showcase/Feedback/Reflect	Observation Individual Assessment Team Member Assessment
15	Game Play/Debriefing/End of Class		Observation

			Motivation Questionnaire Final Report
16	After Class	Reflect	Interviews

Table 3.3 Summary of Activities and Data Collection - Information Literacy Class at Site 2

Class	Activity	Phases	Collected Data
1	Course Introduction and Game Design	N/A	Game Experience Questionnaire Consent Forms
2	Class Assignment - Scholarship as Conversation		Class Assignment Observation
3	Game Exploration	Explore/Concept	Motivation Questionnaire Group Exploration Report Observation
4	Class Assignment - Evaluating Scientific Information	N/A	Team Assessment Individual Assessment
5	Game Concept Presentation	Feedback/Design	Observation
6*	Game Design	Design	Peer Evaluations
7	Class Assignment - Advanced Searching	N/A	Class Assignment Observation
8	Game Draft Presentation	Play /Feedback/Design	Observation Group Progress Report Team Assessment Individual Assessment Peer Reviews
9	Class Assignment - Keeping Current in Your Field	N/A	Class Assignment Observation
10	Play Group 2 Game	Play/Showcase/ Feedback	Observation Peer Reviews
11	Play Group 1 Game		Motivation Questionnaire Observation Team Assessment Individual Assessment Peer Reviews
12	Play Group 3 Game		Observation Peer Reviews
13	Debriefing/ End of Class	Reflect	Observation Final Report
14	After Class	Reflect	Interviews

*Data collection completed at Site 1

To answer the research questions, multiple sources of data was collected over the information literacy classes at both sites. Each data source is described in the above sections. To summarize this section the following Table 3.4 provides an overview of the multiple sources of data and the research question they will address. Table 3.1, shows the data sources that act as primary foundation for the 4 research questions addressed in this study.

Table 3.4 Data Sources for Research Questions

Research Questions	Primary Data Sources
RQ1: How can an instructor incorporate motivational theories into an information literacy class through learning by game design?	Observations (Recorded and Participant) Semi Structured Interviews Student's individual assessments
RQ2: How does the "learning by game design" approach within information literacy classes foster the sharing of knowledge among undergraduate students?	Observations (Recorded and Participant) Semi Structured Interviews Student's Team Assessment and Peer Game Review
RQ3: How do undergraduate students represent information literacy concepts in the game-based artifacts they design?	Student's game artifacts Observations (Recorded and Participant) Semi Structured Interviews Student's Individual Assessment, Progress Report, Peer Game Review. Final Report.
RQ4: What were undergraduate students' motivations to use information literacy practices they were exposed to throughout their class experiences?	Observations (Recorded and Participant) Semi Structured Interviews Student's individual assessments Intrinsic Motivation Inventory

3.4 Ensuring Validity, Reliability and Generalizability

The limitations of any methodological approach are often critiqued with respect to validation. This section discusses efforts taken to meet validity and reliability to ensure research quality. Case study employs multiple tactics for addressing validity and reliability at each stage of the research. According to Yin (2009) and Creswell (2013), aspects of research quality address construct validity, internal validity, external validity (generalizability) and reliability.

3.4.1 Validity

Validity refers to truth, correctness and the strength of the findings. Therefore, the onus is on the researcher to check, question and iteratively verify interpretations. A number of specific techniques are available to enhance the validity of results. Merriam (1998) identified strategies for ensuring sufficient validity in case study designs. These are triangulation, member checks, long-term observation, and peer examination, collaborative modes of research and researcher's biases.

By definition, triangulation involves "using multiple investigators, multiple sources of data, or multiple methods to confirm the emerging findings" (Merriam, 1998, p. 204). Triangulation between the evidence produced by different research methods is common in case study approach. Reason for using triangulation is to determine if results from one data set complements another data set. This study incorporates multiple sources of data and analysis procedures to ensure that conclusions represented the data sources.

In this study, member checks were conducted with librarians and students. This is when data analytic categories and interpretations are tested with members from whom the data originated (Creswell, 2009). In this study, participants were given the opportunity to review their interview transcriptions. The researcher's class observations were corroborated with those of the librarians during data collection. Evaluating games to determine the information literacy standard it covered was also determined by the researcher and librarian.

Engaging in long-term observation provided sufficient amount of time for the researcher to collect data. For this case study, the researcher visited the site weekly for 6 months prior to formal data collection. While this was done to primarily for planning purposes, it helped in better understanding the nature of the two sites which contributed to structuring of interview questions.

Data collection was done over a period of 15 contact hours at Site 1 and 13 contact hours at Site 2.

Peer examination occurs when colleagues have the opportunity to provide comments as the researcher develops findings based on the data. For this study, the researcher worked closely with the supervising dissertation advisor to ensure analysis and writing of results proceeded appropriately.

Collaborative modes of research provided opportunities for the study's participants to contribute to the research process. Extensive collaboration between the researcher and the librarian was an essential component of this case study. As noted, the researcher and librarians met weekly for 6 months prior to data collection to integrate the learning by game design experience in the classroom. Librarians also served as participants and therefore a source of data in the case study. Efforts were taken by the researcher to put aside her repertoires of knowledge, beliefs, values and experiences in order to accurately describe participants' experiences. For example, the researcher did not make any judgment about what was observed or heard from participants and remained open to data as it was revealed. Bracketing the biases forces the researcher to clarify "assumptions, worldview, and theoretical orientation" (Merriam, 1998, p. 205) so that readers understand a researcher's biases. Bracketing acknowledges that biases are inherent in all human endeavors and ensure that it is articulated. In Section 3.6 the researcher articulates her biases.

3.4.2 Reliability

Reliability refers to the replicability of the study. According to Merriam (1998) techniques for promoting reliability are investigator's position, triangulation and audit trail. The researcher should clearly describe her role and decision-making within the study. Section 3.6 provides specifics regarding the researcher's role.

Triangulation contributes to validity as described in the previous section but also plays a role in the reliability of the case study design. Various reasons have been documented for the use of combined methods triangulation. These include increasing concurrency and the ability to enhance the trustworthiness of an analysis by a fuller more-rounded account therefore reducing bias, and compensating for the weakness of one method through the strength of another, in the testing of the phenomenon.

A full and thorough account of how data is analyzed generates an audit trail, This process documents the connections from the evidence in multiple sources of data to the analysis process and the chain of reasoning leading to the interpretation. Merriam (1998) describe researcher's notes as a central component of the research process and especially helpful when moving from rudimentary analysis to a more intensive analysis. Typical documentation includes notes about data collection experiences, documentation of changes in design, the researcher's experience in the conduct of the study, and memos generated during data analysis. Additional notes are composed of the researcher's observations during a data collection encounter, and about the context of a data collection episode. Taking these aspects into consideration the researcher maintained notes based on the template shown in Appendix E throughout the data collection stage. To strengthen reliability, the findings and interpretations were shared and reviewed by librarians, fostering verification. The development of this documentation also ensures that others can understand the logic followed by the researcher in reaching the study conclusions.

3.4.3 Generalizability

Generalizability or external validity is an indication of the extent to which conclusions drawn from this study can be applied to other contexts or settings. Theoretically, generalizability applies reasoned judgments to evaluate the extent to which results apply more broadly. The purpose behind this case study is to understand the phenomenon in depth. Therefore, intent is that the study will provide a clearer picture and thus assist in the direction of future research. According to Merriam (1998) strategies for ensuring generalizability are rich thick descriptions, typicality and multisite designs. The outcome of a descriptive case study is a rich, thick description of events which provides an opportunity for readers to determine if findings can be applied in their contexts. Typicality highlights the representativeness of participants to a population. For this study's participants are well described, and the participant selection identified for qualities required for participation in this study. Multisite designs can use different "sites, cases, [or] situations" (p. 212) within the study. To represent diversity this case study uses purposeful sampling to identify two sites that represent variation within the sample population.

These combination of techniques draws on the strengths of different audiences to respond to different aspect of research quality throughout the research process.

3.5 Data Analysis

As noted by Creswell (2009) data generated by qualitative methods are voluminous. Therefore, a strategy was needed for the process of data analysis. According to Merriam (1998), this involves the following steps: organizing data, categorizing data into manageable parts, synthesizing, finding connections and determining importance. To help document the analysis process the researcher uses the suggested steps.

3.5.1 Organization and Immersion in the Data

The researcher ensured that evidence was sorted by data sources, for example interviews and observational data. According to Eisenhardt, 1989 when a pattern from one data source was corroborated by the evidence from another, the finding is regarded as being stronger. Stake, (1995) advocates the use of data analysis through "categorical aggregation, direct interpretation, patterns and naturalistic generalizations" (p. 163). Data gathered from the many sources discussed in the above section primarily hinged on categorical aggregation. Quotations from student assessments and assignments, information gather from observation (notes, recorded and participant observation), transcripts from semi-structured interviews and notes from game evaluation were used to provide a thick description of the study (Merriam, 2002).

This process began as interim analysis during the data collection process. Interim analysis is described as the frequent analysis conducted during the data collection phase that aids the researcher in making decision about any adjustments to data collecting instruments (Miles & Huberman, 1983). The researcher viewed the video recordings after each class to corroborate observation notes. This also helped in identifying any possible class modifications that may be necessary. Suggestions were communicated to the instructors and discussed before the next class session. This form of instructional iterations underscore the constructive approach. Interim analysis of recordings was also useful for developing and fine tuning interview questions.

3.5.2 Preparing, Synthesizing Coding and Categorizing of Data

To prepare the data for further analysis recorded data from observations and interviews was transcribed. During the transcription process, as Miles and Hubermann (1994) suggested, irrelevant conversations were excluded. Video-recordings were transcribed based Erickson's (2006) Type I approaches which focuses on whole-to-part and interaction process. In the first step, the researcher reviewed the entire video without playback. During this step, main themes were noted. In the second step, the researcher watched the recording again but this time pause and replay where appropriate. Time stamps of these possible episodes of interest were noted to easier retrieval. For the third step, the researcher focused on these episodes of interest. These specific parts were coded and considered in reference to other data sources.

For this study, the researcher relies on theoretical propositions presented in the literature, and analyzes the evidence based on those propositions Yin's (2013). These perspectives are independent, yet intertwined because together they provide a deeper understanding of the phenomenon. This deductive approach is based on these earlier theories and moves from the general to the specific situations. This overarching approach is applied to data analysis in order to understand the phenomenon learning by game design within the context of the research questions.

Coding is a process of reducing the data to variables or categories of interest. It is defined as "the formal representation of analytic thinking," coding the data "is the process of generating categories and themes" (Marshall & Rossman, 2006, p. 160). This process was ongoing and recursive. The researcher took a deductive approach to coding the data. Transcribed data from observation and interview recordings and assessments were coded using *Dedoose*. The following steps describe the iterative coding process for data collected.

1. Open coding by reading text to develop initial understandings; identify meaningful segments from data
2. Rereading text to develop additional meaning; inclusion of additional notes if necessary
3. Assigning themes based on notes
4. Axial Coding. Grouping themes into categories

5. Reflecting on categories to determine match with research questions
6. Organizing data based on categorical codes
7. Discussing with second coder for inter rater reliability. Formative reliability check.
8. Recoding as needed based on discussions with second coder. Summative reliability check

According to Merriam (1998), to generate categories the researcher needs to use the constant comparative method. This method requires the researcher to compare data constantly to find connections between each data segment from which to generate categories. In this study, the constant comparative method of analysis will be used to develop categories. More specifically, observation and interview transcripts, assessments, assignments, game artifacts and field notes from each case were compared to mine for themes. The data from various sources were organized based on the categorical codes. If needed the data was recoded based on agreement between the two coders.

<u>3.5.2.1 Inter-Rater Reliability</u>

To reduce the incidences of bias in the coding process and seconder coder was employed. Assessing inter-rater reliability is where data is independently coded and compared for agreements. This is a recognized process especially in quantitative research. Some qualitative researchers argue that assessing inter-rater reliability is important for ensuring rigor; others regard it as unimportant. To improve reliability the researcher decided to have another coder involved in the process. During the study, the researcher attended a number of conferences and discussed experiences with game design with attending librarians. Few indicated interest in helping with the coding process and saw it as good practice for work they hope to publish. They were contacted to assist in the coding process. The researcher eventually consulted with one instruction librarian who was suitable based on her expressed interest and use of games and other active learning approaches within her information literacy classes. She was also familiar with the literature on constructivist learning approaches in libraries. The process was explained and initially half of the anonymized data were given for coding. She was asked to assign codes to the transcribed recordings and assessments. Through several meetings codes assigned by the researcher and the librarian were discussed until there was a level of agreement. Where there was significant disagreement on code topics, both coders compared and discussed differences in interpretation until agreement was reached; topic codes were either modified or kept, and when necessary, category descriptions were also amended. At the completion of the process, the percent of agreement between the two coders was calculated. This was 97% or 0.97. A general rule of thumb for percent agreement according to Neuendorf: “Coefficients of .90 or greater are nearly always acceptable, .80 or greater is acceptable in most situations, and .70 may be appropriate in some exploratory studies for some indices” (Neuendorf 2002, p. 145). For a detailed description of the codes used in this study see Appendix K.

3.5.2.2 Analysis of IMI

The questionnaire items were analyzed based on face validity; the researcher's knowledge of these constructs. Initially the internal consistency reliability of the items for the IMI questionnaires was assessed using Cronbach’s (Cronbach, 1951) coefficient alpha. However, because of the small number participants, reliable statistical data analysis reporting on quantitative results of these measures was not possible. Therefore only descriptive data (means) from the questionnaires is reported..

3.5.3 Cross Case Analysis: Finding Connections and Determining Importance

This is a multi-site study; includes two research sites. Merriam (1998) identified two stages of analysis when multiple cases are presented. First, the within-case analysis occurs to generate “a comprehensive case in and of itself” (Merriam, 1998, p. 194). This is followed by cross-case analysis which allows the researcher to “enhance generalizability” (Miles & Huberman, 1994, p. 173) and “to deepen understanding and explanation” (p. 173). This approach generates understanding beyond the uniqueness of an individual case and may lead to a more universal understanding of the phenomenon of interest. Miles & Huberman advocates for an “interactive synthesis” (p. 176) when conducting a cross-case analysis. This approach combines data analysis procedures that separately focus on analyzing variables evident across cases (variable –oriented strategies) or on analyzing the individual qualities of each case (case –oriented strategies).

In this study, interactive synthesis relies on the presentation of separate cases. Next, themes evident across cases are described (variable-oriented strategy). Within-case analysis is a detailed description of each study. Through each within-case analysis, patterns of each study should emerge which will move the analytical process to the cross-case analysis. Once within-case analysis was completed, the researcher began a cross-case analysis in an effort to build abstractions across the cases (Merriam, 1998). Cross-case analysis, “a thematic analysis across the cases” (Creswell, 1998, p. 63), was employed by selecting categories and then searching for within-group similarities together with intergroup differences (Eisenhardt, 1989). Chapter 4 is focused on the within-case analysis, and chapter 5 focuses on the cross-case analysis and other conclusions.

3.5.5. Assumptions

For the purpose of this study, the following assumptions are made. The researcher assumes that all class submitted materials such as individual and team assessments, IMI, progress reports, peer critique and final report were true reflection of student’s experiences.

Assumptions are made that participants answer all interview questions honestly and to the best of their ability. Since most interviews were conducted less than a week after the class the researcher assumes that interview participants would be able to recall their class experiences with clarity.

3.6 Researcher Biases and Role

Explicit discussion of the researcher's philosophical position or personal qualities allows others to understand the ways in which the researcher individual characteristic, context and knowledge affect experiences and findings. The researcher has worked as an academic librarian in two countries and has been actively involved in teaching information literacy classes in previous positions. She sees the librarian's role as being multi-faceted and evolving to focus on teaching various literacies. She sees librarians as the central connector to preparing students for the next generation for jobs that do not yet exist. She believes that students need to master skills, like creativity, critical thinking, problem solving, and varied literacy skills in order to be successful in the 21st century. She also believes that learning is best achieved through constructivist approaches. The researcher thinks that librarians need to be open to exploring different instructional strategies. Games have become more accepting in academic library environments, which make it opportune time to introduce game design. The researcher believes that game design can greatly improve learning and engagement in information literacy classes. She is part of the Scratch community and interacts with a number of educators who also hold this belief.

Stake (1995) notes the importance of defining the researcher's role in the research process and establishing an acceptable role with the participants of the study so that they will feel at ease. Creswell (2009) notes the role of the researcher is to gather information, and collect data via the stated methods. For the purpose of this study, the researcher is presented as doctoral student, studying the effects of the learning by game design in the classroom. As a participant observer, she is involved in the class activities together with the instructor. Building a rapport (Creswell, 2009) and helping the participants "learn how to be studied" is vital to the success (Hatch, 2002, p. 51). In addition, Creswell (2009; 2013) note the importance of conveying the purpose of the study and apprising participants of the researcher's motivation. The incorporation of learning by game design activities, student deliverables and other course planning was done together with the instruction librarians.

Merriam (2002) notes that the human element associated with qualitative data can often encompasses biases and subjectivities and should be controlled and withheld from the study. Triangulation can reduce the effect of researcher bias. Throughout data collection and analysis the researcher will maintain an awareness of her personal biases and implement strategies to ensure that the study's findings is not do not invalidated.

3.7 Rights of Participants

Before this study was conducted, approval was sought from Institutional Review Board (IRB) responsible for reviewing research applications from Syracuse University and the participating institutions. These procedures were implemented to protect the rights of participants regarding confidentiality and freedom from risk. Once permission has been received to conduct the study all participants was be given consent letters to complete.

The researcher was responsible for assuring voluntary participation from librarians and students by obtaining signed informed consent. At the beginning of the study students and librarians were given consent documents to review and sign (see Appendix L). All students enrolled in the information literacy classes were invited to participate. The researcher reviewed the form with the participants to insure they understood the terms and answered any questions that arose. The researcher explained to students that they would not receive any monetary or material rewards for their participation. They were assured that all their responses to the interview questions would be anonymized and their refusal to participate will not negatively impact their course grade. To safeguard anonymity and privacy of participants, the researcher stored all the data in locked drawers and password-protected folders.

Only students providing informed consent was included in the study.

3.7 Summary

This is a descriptive case study for which the theoretical framework provides a focus for the data collection and analyses. Purposive sampling was employed in select cases for in-depth study. Two cases were selected. Various methods are used to collect several types of data from both sites to answer the research questions posed. Combined with the specific research questions and the inquiry focus, the selected techniques provide a cohesive but flexible plan for data collection and analysis, while providing opportunity for triangulation of data sources and analysis of findings. As data were collected, interim analysis was done. This was followed by more intensive analysis which involved iterative coding of quotations from student assessments and assignments, information gather from observation, transcripts from semi-structured interviews and notes from game evaluation. Within-case analysis was done for each case followed by cross-case analysis. Variables evident across cases were analyzed. The quality of the study was strengthened by several validity and reliability elements integrated in the research design. This included data triangulation, creation of an audit trail, multiple stages of participant review.

CHAPTER IV

FINDINGS (WITHIN CASE ANALYSIS)

4.0 Introduction

In this chapter the findings collected from each site using the various forms of data collection is discussed. These are submitted student's assessments, final game design report, graded assignments from non-game design activities, observations and video recordings, IMI questionnaires, game artifacts and interviews. Social constructivist theory guides the specific inquiries of this multi-site descriptive study. In order to create a constructivist-learning environment, design and play activities were incorporated into a traditional lecture-based class.

Four research questions are addressed in this study. To create an environment where students are more accepting of learning by game design approach, the instructor draws upon motivation theories. The scaffolding of these approaches help towards creating in class environment where students are also more self-determined and accountable for their learning. The first question explores the impact of the motivational aspects used in the information literacy classes by the instructional instructor. Given the belief that each individual has unique interpretations of knowledge, social constructivism points to the fact that students will, if given the opportunity, share their personal knowledge perspectives with their fellow classmates as they learn within a given environment. Learning by game design affords collaboration among students. Therefore, the second question looks at how students share knowledge within the classroom. In this study, game play is addressed from the constructionist perspective. Instead of playing someone's creation student design their own game that is representative of their understanding of the concepts addressed in the classroom. More specifically, the design process assists in concretizing ideas into the created games. The third question looks at how students represented concepts they learn in the games they design. The primary purpose of information literacy instruction is to enable students to apply these skills to new situations. Therefore having the understanding and ability to extract a specific learned information literacy skill from its original context and apply it to a novel situation is the desirable learning outcome. The final inquiry explores this transfer, by investigating student motivations to use the skills learned in the information literacy classes in other learning environments and in their daily lives.

This chapter presents each case individually (within case analysis). This approach help in facilitating an in-depth understanding and description of the phenomenon under study at both sites. Therefore, each site is treated as a standalone entity. Findings from Site 1 is presented first followed those from Site 2. Demographics and prior experiences of the participants are first presented. The following sub sections are organized by the study research questions.

4.1 Site 1

In the following subsections, the researcher discusses the findings from Site 1.

4.1.1 Site 1 Participants and Prior Experiences

To gain some insights about student demographics and prior experiences a brief questionnaire was distributed on the first day of class to students at both sites. See Appendix M for the specific questions that were asked. Questions about student's game design and game play experiences were reiterated during the interviews. Students were also asked about their prior experiences in information literacy in the classroom and again in the interviews. Responses from the interviews was corroborate with those received from the game experience questionnaire and class discussions.

Most students enrolled in the information literacy class took the initiative to take the class early in their college life. Of the 22 students enrolled in the one-credit information literacy class at Site 1, most were freshmen. See Table 4.1, which shows student gender and college level. There were 14 (63%) freshman followed by 6 (28%) sophomores, the next majority. The information literacy class was a required course needed for graduation. That meant that all students at this college had to have completed this class by the end of their senior year. Therefore, most students were in the beginning stages of college and chose to complete the information literacy class early in their study. In the interviews, many freshmen remarked that they were glad they had not postponed taking the class. They mentioned that a number of their professors highly recommended the class be completed by the end of the first year, and were glad they followed through on the recommendation. Junior and senior students remarked on their shortsightedness for not pursuing the information literacy class earlier.

There were an equal number of males and females. Some educators have expressed the concern that games are more attractive to males and therefore might alienate females if incorporated into the classroom (Kelleher, 2008). Five (45%) of female did expressed concerns about designing a game.

Table 4.1 Gender and College Level of Students at Site 1

Site / Gender	Freshman		Junior		Sophomore		Senior		Total
	Male	Female	Male	Female	Male	Female	Male	Female	
Site 1	36%	27%	0%	5%	14%	14%	0%	5%	100%
Total	63%		5%		28%		5%		(n=22)

Further probing about their concerns revealed that they were under the impression that they will be developing video games. These female students did not think developing video games would have been impossible but were concerned about the amount of time it would have taken from their schedule. Other than these expressed concerns, females were supportive of the game design activity. Even though a few female students expressed that they were not gamers, they thought it would be a good class activity. For example after the lecture covering game design specifics and its phases, the following conversation ensued.

Researcher: "Are there any questions?"

Constance: "This is not video games?"

Researcher: "Not necessarily, you have the option to create any type of game. We have given you a number of resources that is available in Blackboard and we brought them to class."

Bo: "We will be working together as a team?"

Instructor: "Yes, we will tell you your group members on Wednesday."

Bo: "Why design a game?"

Instructor: "We were thinking that it will, you think deeper about the content. Remember all your games must have learning objectives. We are experimenting with this approach to see how it works. If it does, we may be including in other classes. Would you prefer just lectures and presentations?"

Class: (Unanimously) "No!"

Bo: I am not sure I understand the relationships but I am open to the idea.

Maggie: "I think it is a cool idea. A bit unclear how we will go through the steps but I think it's cool".

Penny: "I am not a gamer, but I really think this will be fun especially if we work as groups"

Researcher: "We will use this diagram as a reference in classes so you have a reminder of the big picture".

As noted in the conversation above female students were supportive of the the game design idea. The male student here was a bit skeptical, questioning whether they will learn anything from this approach. However, in later conversations he mentioned that he was open to the idea but was unclear about how it would have played out in the classroom since he regarded games as just useful for recreation.

Most students were freshmen and there was a equal gender representation. Many students were game players, regardless of gender and were suupportive of game design. Students associated the games as meaning video games. Interesestingly enough about 20 (90%) students mentioned in the interview that they were under the impression that they were being asked to build video games when the game design activity was presented as an option.

4.1.1.2 Site 1 Student Participant Prior Game Experiences

Both male and female students described themselves as avid game players. The common stereotype many have of game players is that they are male; and females are not necessarily interested in games. See Table 4.1 for details regarding specific students' game experiences. Male students regarded themselves as expert game players. There were 14 (64%) students, who self-reported themselves as games experts. Among these game experts, 3 (14%) of those were females. Six (27%) students (females) labelled themselves as intermediate game players. In conversations during the first day of class about the types of games played most frequently, many students mention that they mostly played video games

Researcher: *"Can you tell me about the types of games you play?"*

Bo: *"I play video games mainly, board games with my little sister, but I like video games".*

Luke: *"Yeah mainly video games". (Class murmur in agreement)*

Researcher: *"So is it safe to say many of you play video games?"*

Class: *"Yeah!!"* - Most students nodding affirmatively.

Researcher: *"What about other types- board games, party games, skill games…?"*

Bo: *"What do you mean by skill games?"*

Researcher: *"Skill games, something as simple as paper tossing in the trash can or playing jacks or darts. Just some examples to give you an idea".*

Penny: "*I am not really a game player. I play games with my son so it is more of a fun thing. I don't play video games."*

After reviewing, the results from the game experience questionnaire 13 (60%) students identified themselves as video game players. Mostly male students were video game players (exception Patricia). Many female students (7 or 32%) reported playing other game types such as party, board and skill. Penny and Ariana initially mentioned they were not game players but on further discussions relabeled themselves as game novices and mentioned having played many board games. These findings are similar to those found in some studies, which indicate that females are not players of video games.

Table 4.2 Prior Game Experiences of Site 1 Student Participants

Pseudonym	Game Skill	Types	How Long (yrs.)	Play Frequency
Bo	Expert	Video	2 to 5	Once/week
Patricia	Expert	All	5 to 10	Once/week
Jerome	Expert	Party/Video	5 to 10	Once/week
Mike	Expert	Party/Board/Video	Over 10	2 to 3/month
Matt*	Expert	Party/Board/Video	Over 10	Daily
Ernie	Expert	Party/Board/Video	2 to 5	Once/week

Jason	Expert	Video/Skill	Over 10	Once/week
Luke	Expert	Party/Board/Video	Over 10	Daily
Edmund*	Expert	All	Over 10	Once/week
Maggie	Expert	Party/Board/Skill	2 to 5	Once/month
Eli	Expert	Party/Board/Video	Over 10	Once/week
Laura	Expert	All	Over 10	2 to 3/month
Wayne	Expert	Board/Video	5 to 10	Once/week
Mark	Expert	All	Over 10	Once/week
Lilly	Intermediate	Board	Over 10	Once/week
Nellie*	Intermediate	Party/Board	Over 10	2 to 3/month
Abby	Intermediate	Party/Board	5 to 10	2 to 3/month
Rhianna	Intermediate	Party/Board	Over 10	2 to 3/month
Constance	Intermediate	Party	2 to 5	2 to 3/month
Margaret	Intermediate	Party/Board	Over 10	2 to 3/month
Penny	Novice	N/A	N/A	2 to 3/month
Ariana	Novice	N/A	N/A	N/A

* not interviewed

Many students played games frequently (Table 4.2). College students are described as avid game players and most students reported this trait. Students integrated games into their leisure time alongside other forms of entertainment. Luke who played games daily said that he was not a TV person. He preferred games instead. Regarding the frequency at which game were played among Site 1 students, only 2 (9%) male students played games daily. Most male students tend to play games once per week (11 or 50%). Female students played games less frequently than their male peers. Most females (7 or 32%) played games 2 to 3 times per month.

Playing games was a commonplace activity in the lives of students. Many reported playing games for a number of years. Most students (12 or 54%) at Site 1 have been playing games for over ten years. These were mostly male students.

When students were asked if they had any prior opportunities to design games, no one had previous experience. This was asked again in the interviews, only Jason mentioned that the closest he came to game design was developing mnemonics for studying.

Overall, these findings show that games were very much a part of the student culture among the Site 1 participants, regardless of gender. Most of the students had prior experience with a variety games. They played games regularly and had done so for a number of years. The male students had been gamers for longer, on average, than the female students. Many students mentioned playing games at social events or for fun and entertainment. No student had designed a game previously. Eleven students (50%) indicated that the game design activity should be relatively easy to complete because of their prior gameplay experience.

4.1.1.3 Site 1 Student Participant Prior Information Literacy Experiences

Most students had taken information literacy classes at previous learning institutions. This was a surprise discovery for the instructor. Students were asked about their prior experience in information literacy, and 18 (81%) mentioned having taken classes at prior institutions they attended. In the interviews, some mentioned that the course content was a repetition of material covered in previous classes. Luke, Rhianna, Margaret and Constance were transfer students mentioned that they took information literacy classes at college level. According to Constance

> *"Yes, I feel like we've learned the same and almost insightful, even in middle school. I feel like this is something that everyone should know... Like a basic knowledge thing. Again, it's always good to remind people about that. In every new school you go, you think you could get away with things. I feel like it's good to reiterate stuff to teach people like, what they should do and what they shouldn't do. I did forget some things"*

Mike indicated that while some of the content was repetitious some areas were new to him.

> *"Like the parts about using credible websites, recognizing that was same old stuff, but the rest of it was quite new to me....Some of the new things were searching the library catalog. I didn't really know how to navigate the library's catalog very well."*

Fourteen (64%) students mentioned covering information literacy in high school in depth. For example, in interviews Jerome stated that…

> *"It wasn't new information. It was just applied differently. I knew how to use the databases and search tools in my high school, but it is just relearning. … My senior year, we were doing senior inquiry projects where we had to research a topic of our choice and we had to use a lot of sources for that was a big part of it."*

Patricia also mentioned that …

> *"Yeah, I did some of this stuff before. I took college courses in high school, so I learned through UMB college course. It is all different for each library and each campus, so it is definitely good to have an introductory class I guess for how to use the library and how to use the library's website. I now use the library's website a lot. It is really good to have that."*

The students who had taken similar information literacy classes before mentioned being familiar with such skills as citing resources in MLA format, taking steps to avoid plagiarism, and evaluating web sources. They also talked about their awareness of needing to cite their sources and the strategies for determining website appropriateness when completing assignments. A number of them also mentioned avoiding using Wikipedia as a reference because of being penalized for that by instructors in previous classes. The instructor mentioned that not many students in previous years had expressed prior knowledge about the information literacy topics. She admitted that, in hindsight, it would have been valuable to test the students' skill levels during the first class session.

4.1.2 How can an instructor incorporate motivational theories into an information literacy class through "learning by game design"? – Site 1

This question examines efforts made by the instructor to integrate learning by game design into existing classes to foster student motivation. Self-determination theory states that individuals have certain psychological needs that must be met in order to be intrinsically motivated. Those needs are autonomy, perceived competence, and relatedness (Deci & Ryan, 2000). The following section considers meeting these needs when integrating the learning by game design approach into the information literacy class.

Autonomy

The instructor supported students' autonomy by providing choices and encouraged them to be responsible for setting their own actions into motion. When people have some choice in a task, they buy into doing it to a greater extent than when it is forced upon them (Ryan & Deci, 2000). Students were offered a number of choices related to the game design project. First, the instructor did not want the students to feel forced into designing a game, which could potentially lead to decreased levels of creativity and interest in the subject matter of the class. Therefore, students were given a choice of either developing a game or creating a presentation. Although offering this choice meant a potential reduction in the number of study participants, it helped to enhance the students' sense of autonomy. The instructor also indicated to students that she was open to entertaining other project suggestions

Additionally, the students had the option to create games that focused on any of the class's information literacy topics. They also had the ability to choose what type of game to design. While the reseacher would have liked the students to develop non-trivia type games, the instructor felt that the removal of this option was much too limiting. In one of the design class conversations, a student questioned the researcher's suggestion.

Jason: "*You said to try and avoid trivia type games"*

Researcher: "Yes, trivia types games are like tests or a quiz, so the player may feel like they are taking a test. You want to be thinking about how to incorporate your topic that you want the player to learn so you want to incorporate the content into the game, not just have them answer questions. Think about the Life game you are exploring. What are you learning from the game?"

Jason; Yes!! I can see information literacy being like Life. It depends on the choices you make.

Luke: "We are not allowed to develop questions."

Researcher: "No, I am just saying that to try and look beyond that?"

Instructor: "Yes. The type of game you design is flexible, so if you want to develop questions you can do that as well."

In this conversation, the instructor reiterated the fact that the students could develop any type of game that they considered suitable for teaching information literacy. This did not mean that there were no limitations placed on the project. The researcher and the instructor collaborated to develop a rubric (see Appendix C) and agreed that games would be developed based on the specifics stated in this document. Specifically, the games had to possess information literacy learning goals, incorporate at least one information literacy topic, include clear and easily understood rules, and not exceed 30 minutes of gameplay. There were many occasions, furthermore, in which the instructor acted on students' suggestions. For example, when she attempted to have students work outside of their game-designing groups, some of them were not agreeable. As Jerome mentioned,

> *"If we stay in groups the whole time and work on all the packets that we do and the different things on the computers, if we do that in groups, that would be better for our games because we would work with each other and learn each other ways of doing things."*

Changes that were made because of suggestions like this illustrated to the students that their opinions mattered and helped in developing their autonomy.

Perceived Competence

The instructor took measures to ensure that the students consistently perceived themselves as competent. When they were told on the first day of class that they had the choice to design a game for the final project, a few wore apprehensive expressions. Class conversations about the instructor's expectations helped to reduce this anxiety, especially among those students who did not regard themselves as game players. Game-designing activities were alternated with play sessions and traditional lectures. Approximately 5.5 (36%) of the class sessions addressed information literacy content. The instructor covered information literacy content in the first set of class meetings in order to balance the students' cognitive loads. She significantly reduced her lecture time in favor of having students' complete assignments in the classroom. This gave the researcher and the instructor the opportunity to assist students as they experienced problems. When time did not permit an assignment to be completed at the class end, it would be submitted at the next class. In case the students had concerns or did not understand the class content, the instructor reiterated her contact and availability information at the end of every class session.

Attempts were made to include game-based activities in the assignments. For example, students performed self-guided tours, and one of the assignments incorporated the library game *Goblin Threat Plagiarism Game* to test the students' understanding of citations. To make the searching tasks more applicable, the students were asked to do these assignments around their interests or the topics of assignments from other classes. Students focused on game-designing activities in the latter part of the course.

Because none of the students had experience in designing games, the researcher and instructor wanted to give them an adequate amount of time to conceptualize, develop, and complete their ideas. The other 9.5 class sessions (63%) were developed around the game design activity. Even though most of the students indicated that they felt competent, already knowledgeable in information literacy, and experienced in gameplay, the instructor and researcher wanted to be able to bolster their perceived competence if they got stuck. Anticipating that students do not always completely understand how to do a project before they begin we ensured that enough time and support was available.

All of the students indicated experiencing some measure of confusion about the game design activity, but this did not deter them from choosing it as the option for their final project. Class conversations about the instructor's expectations helped to reduce anxiety, especially for those students who did not regard themselves as game players. We anticipated that designing games was not as simple as many students thought. In summary, the approaches described above helped in maintaining students' perceived competence.

Relatedness

The instructor bolstered relatedness via the following efforts. Both the instructor and the researcher maintained a non-dominating presence in the classroom. Administrative classroom aspects such as recording attendance were deemphasized by, for example, having students collect name tents at the beginning of each class. By the fifth class, this activity was discontinued because the instructor and researcher were familiar with the students and was able to identify absentees. This activity also helped the instructor and researcher address students by their names which and illustrate to them our interest.

Additionally, the instructor and researcher helped boost relatedness by referencing personal experiences, while assisting students. The instructor also referred to her experiences in her lectures.

Since most of the students were freshmen, collaborative activities helped to foster a more social environment. To create a relaxed atmosphere, candy and other snacks were made available in the classroom during play and playtesting activities. Many students remarked that these efforts helped to make the class sessions fun. For example, the students responded positively to a simple 30-minute play activity that oriented them to the physical layout and services offered by the library. This was a self-guided tour in which groups of students were assigned to identify different spaces in the library, take photos with iPods, and then present their findings to the class. Eighteen (81%) students mentioned that this was an effective way to learn about the library. Eli, who was a sophomore said,

> *"I have been here for some time and this was the most I that I have found out about the library. I've utilized mainly the Academic Success Center. I lived in there. I've taken out two books, I think because most of my information that I get is going to be online, for me, personally, so far. Other than that, any kind of class, I've taken in there. I haven't really explored the downstairs although this year I've been doing a lot more research. I've been*

using the Writing Center quite a bit. I guess doing that game really shows you what opportunities, and all that you have available in the library."

Mark's comment was typical of the responses made by many freshmen.

"It definitely made it better to figure out and actually the use of the different areas of the library, to know where they were because I didn't know where any of the rooms were beforehand. It was definitely helpful making you more familiar rather than just giving us a map or something like that"

Most importantly in promoting relatedness, the instructor was flexible, fostered student collaborations and allowed them to experiment and discover their own solutions. She also implemented suitable student suggestions. In interviews, all students mentioned being comfortable interacting with the instructor. On many occasions, both the instructor and the researcher sat together with students as they developed their games or completed their in-class assignments. All of the students saw the instructor, as a resource for help in future research and class assignments.

<u>4.1.2.1 Participant Suggested Class Modifications and Application to Other Classes at Site 1</u>

Students liked the class structure and the integration of game design activities. In the interviews, students were asked about suggestions for class modifications, they would have liked to see and if they thought learning by game design approach was suitable for other classes. Most (14 or 64%) students liked how the classes were structured, the combination of lectures, game design activities in the classroom and play testing. Two (9%) persons mentioned the need for more lectures. Laura suggested a longer class about game design while Ernie felt more classes were needed to cover information literacy content. He noted *"I liked it. I thought it was pretty well rationed out. Maybe a couple more lectures about more specifics and stuff like that. Maybe* *jump in more specific higher in depth things. Maybe 1 or 2 more lectures. Other than that, it was pretty good… I liked the stuff about Google and privacy. More stuff like that."*

Ernie was referring to a brief talk by the instructor about how Google uses a people data and about managing privacy online.

On the other hand, three students (14%) thought that there were too many lectures. According to Constance,

> *"I thought it was nice. I feel like we didn't need so many lectures. A lot of them were getting repetitive, but I did enjoy a few. A few of them really did explain a lot to me about how the school's library runs and how the systems run and things like that. I did feel they were starting to get a little bit repetitive after a while. ... Probably, maybe a little bit of less on repetitiveness, of like lectures. More active type stuff. Maybe a longer tour activity. I feel like every school make sure that you know what plagiarism is and how to avoid it. That was just a repeat again."*

Margaret and Bo thought that too much time had been spent on database searching. Those students who saw the need for fewer lectures expressed familiarity with information literacy content from previous classes at other institutions. However, from class observation, it was obvious that students still needed assistance in class assignments. For example, Margaret required assistance refining her database searches during the class assignments.

When asked which mode of instruction they preferred (game design, game play, or lectures) all of the students mentioned that they liked the combination of these three approaches. Some elaborated, saying that they liked designing games, but had only been able to do so because the lectures gave them a better understanding of the content. Jerome mentioned that he liked the game design approach because he had learned the most from this process. According to him,

> *"Well, I mean it's hard to say because everyone has a different way of learning. The game design is nice because it's interactive but I learn the most here. I don't know how much, and actually think the people who designed the games learned the most from that area than the people who actually played those. I mean the lecture and assignment part wasn't always interesting but it was helpful."*

All of the participants noted that they needed to play test their game multiple times to ensure that there were no sticking points and their game did not break. They noted the number of additional play testing needed after changes were made. Multiple design iterations were done to implement suggested modifications and ensure rules and questions were clear. They also talked about having to be more analytical and evaluative in order to fine-tune questions to eliminate the ones that were too confusing or long-winded. This meant that they went through the content repeatedly during these editing cycles drawing on a higher order of cognition in the Bloom's Taxonomy. Because this process was time-consuming and needed buy in by all group members, they often met outside of class to playtest their games and develop and edit questions.

All of the students liked that they were given the opportunity to play the games created by their peers. Ten students (53%) mentioned that more time was needed for playing these peer games. According to Patricia, each game should have been play tested during a single class session. Groups had 20 minutes to play each final game; 10 students (53%) felt that the time allocated was too short, even though they had previously played with other groups' creations during the draft playtesting stage. Students also mentioned being nervous and anxious when other teams played their games. Jason's comment echoes concerns that were expressed by some of the other participants, *"It was kind of weird, like would they like it, you know, what they would think of it. They seemed to like it for the most part. So that's pretty cool to see all that work and someone actually enjoyed it."*

Eighteen (81%) students saw learning by game design as suitable for other classes. Wayne was on the fence regarding it applicability. According to him:

> *"It depends on your style of learning. I do fairly well with straightforward information and using it. Some people would do better; I guess actually most people would do better in the game format and being interactive with that and being able to enjoy it. But, you know it's difficult to make games that are enjoyable and informative at the same time. ...I was surprised in the beginning we were doing that in this class. I'm trying to really think of other classes ... You mean in college?... I'm not sure how much it could help teach biology, but maybe it could make it easier. It just depends on the subject material and the audience… I mean, I don't know how well game design would work as a focal to other classes, maybe on a smaller scale, but doing mixed teaching is I think that's really a good way to go in other classes."*

When the students were asked if they had a particular class in mind that would benefit from the learning by game design approach, 17 students (72%), all of them freshman, mentioned that they thought it would work well in their introductory biology classes. Bo had a broader idea of this approach's applicability, saying that he saw it working well in any introductory class. Maggie, the only senior in the class, saw it as being a useful approach in the planting design class she was taking that semester. Others were not sure about the approach's applicability to a specific class. All of the students, however, mentioned their conviction that future information literacy classes should adopt the learning by game design approach.

Most of the students at Site 1 thought that the class was well-crafted with respect to the time allocated for lectures, game design activities, and gameplay. Many of them mentioned that they liked the mixture of these three activities, though they did emphasize the need for more time allocated to playing the final games. As outlined above, however, many students saw the learning by game design approach as being applicable to teaching other subject matter.

4.1.3 How does the "learning by game design" approach within information literacy classes foster the sharing of knowledge among undergraduate students? – Site 1

This research question explores the social learning process in students. The co-construction of knowledge requires students to develop skills not only in working together but in coming to mutual understandings of their topic. The data used to address this question were collected from observations, semi-structured interviews, individual and team assessments, and peer reviews of games. The class was developed in so that students received guidance not only from the instructor but also from their peers. Opportunities for sharing of knowledge occurred within groups and with other class members during presentations and during playtesting of games. The following subsections discuss the findings on these two kinds of sharing among undergraduate students.

4.1.3.1 Sharing Among Group Members – Site 1

Placing students in heterogeneous groups helped fostered opportunities for more able students to assist less able peers in learning. Students were grouped on the basis of their responses on the game experience questionnaire. There were five groups with 5 members each. Group 2 lost two members and Group 4 lost one after the second class. The instructor noted that there was normally an attrition of 5–7 students every semester and that a loss of only three students was comparatively small. The remaining members of these groups did not feel disadvantaged by their smaller group size.

Members Interdependence

The more knowledgeable students willingly shared their expertise and took on teaching roles as needed. This was especially noticeable in Group 3. Penny, who did not feel familiar with either games or information literacy, worked closely with her team members. She noted, *"First time I liked working with a team, they were very nice to explain everything for me. I am happy to be working together with them.*"

It was observed, on a number occasions where Jason and Ernie worked with Penny to help her understand searching in databases and edit game content created for the project. Once, she sought their help on an assignment for another class. They helped her find resources for an essay she was developing. She had initially sought help from the instructor, but she soon became more dependent on her team members for assistance. When Jason and Ernie were asked about their willingness to provide assistance, they said they saw it as a learning opportunity. Jason noted in the interviews, *"Going through searching with her was really useful. I learned a lot even though I was showing her stuff. It was like practicing. It really help in doing the questions…so it was not really taking up extra time away from making the game."*

Other students who helped their peers expressed similar sentiments: they described the opportunity to learn and to practice through teaching.

Students were focused on completing a common goal and did not recognize differences in seniority. Some of the freshmen arrived in the class with more knowledge about information literacy than some senior students. Willingness to seek assistance from a more junior peer did not turn out to be a problem among team members. In interviews they mentioned not taking their peers' years of enrollment into consideration. When asked whether they knew that they were working with more senior peers, most of the students (16 or 84%) said that it was not something they thought about. Their concern was to take steps to ensure that everyone contributed equally and that they ended up with a game that everyone would like playing.

Working Cooperatively

Despite not having met previously, students were very open to sharing their ideas and expertise and worked cooperatively with their team members. In the interviews, students were asked about their group experiences. All students reported interacting well with their teammates. Comments like "*I loved my group*" and "*I wish my group were part of my other classes*" were common. One team noted even though there were some problems they liked working as a team. Overall student liked that they worked well together and their members took their responsibilities seriously. They also expressed their surprise regarding how well they worked together, especially since they had not met previously. Lilly's (Group 1) commented on her peers' respectfulness in her individual assessment, *"My team seems easy to get along with. They have been respectful to everyone who gives their opinion about the game ideas."*

Class time was mainly used to develop the information literacy content for their games. They expressed having very hectic schedules and since class time was not enough for playing testing or doing their game board they opted to focus on developing the content in the classroom. Most teams, developed trivia type board games, which meant they needed to develop information literacy questions. Overall, groups regarded class time better used to develop and edit their questions, as small sub-groups or individually. According to Lilly

> *"We did most of the work on the board and testing after class. The computers was there so it seem better use of time in developing the questions besides the teacher was there*

and we could see if everybody agreed. We would meet in the library afterwards or weekends."

Only Group 4 groups spent significant class time play testing and addressing game board artwork. On many occasions, half-completed game boards were brought in by the team members responsible for that task. This was done so that other group members could review any updates. This pattern was observed in all classes after the first design sprint. To reduce student distraction in content-specific classes the instructor gave students 5 minutes at the beginning of each class to address game design matters. In design classes student either paired up or worked individually on the computers. Time was spent searching online databases or the catalog, looking at the research guides and exploring the library website. Even those who worked individually usually consulted another team member before the class ended.

Groups resorted to using *Google Docs* to share the information literacy content used in their game. When focusing on editing or deciding which question to use they spent class time reviewing this list. Only Group 4 whose game was limited in content did not use this online tool.

Students worked as teams throughout the class. After the first team activity (game exploration), most students remained in the same teams for the rest of the course. Because the computer lab where classes were held was not designed for collaborative activities, most groups of students would spend time together huddled around a single monitor. As the class progressed, however, individuals began working alone and then reviewing their work with group members.

Distributed Leadership

Students were dependent on each other and cultivated healthy working relationships. Most of the groups did not designate any specific leader. Only Maggie, in Group 4, labelled herself as a team leader; others regarded themselves and having primary responsibilities. Maggie elaborated on this label by saying that she assigned tasks to her other team members and was responsible for the game idea.

Students' responsibilities changed as the game developed. In their individual assessments, different students listed different tasks for each milestone. Many of them reported that once their main task was completed, they assisted in other activities. Abby indicated a similar team approach, involvement in multiple tasks in the game design process

> *"Once we had all agreed on the board that I drew, Nellie added the other drawings; I started doing the research to develop my questions. We sort of worked back and forth and just did things as they needed to be done"*

Groups did not dive into creating games right away; they took time to plan their approach and assign responsibilities to members. One of the most noticeable aspects in all the groups was the division of labor. All the teams mentioned that one of their first tasks had been getting to know each other, which gave them the opportunity to decide on individual responsibilities in the game design activities. The students said that this had helped them in the planning process. Jerome talked about their approach to the first design activity:

> *"After the game exploration we had some ideas. We were thinking Monopoly, Mike was set on that idea and we agree it was simple. But I knew it was going to be a lot of work so we had to divide it up. My sister designed a biology board game on the cheetah. It was the food cycle for a cheetah. She had to design an entire board game by herself… it was very thorough and in-depth, I remember how much work she had to do. We wanted to be sure everyone had something to do."*

Initially the groups divided their tasks based on each member's interests and strengths. Team members articulated their own skills and strengths and indicated the kinds of responsibilities they thought best suited them. For example, in the game exploration class, Bo described himself as very organized, and self-assigned this responsibility. He then proposed setting up a *Google Docs* site where the group members could share their work. When asked to describe his role in the individual assessment, he said that he did a little bit of everything, but saw himself as a project manager. Other groups were observed to have team members similarly taking the initiative to manage the game design activity. These were mostly male students, and they assisted their teams in reaching consensus when decisions needed to be made. Among the strengths they frequently listed were proficiency in artwork, game ideas, and writing. One task that was assigned to all group members was the contribution of information literacy content. This responsibility was divided up among all group members.

Level of Participation

As the design activity came to focus more on the information literacy content, some students became less involved in the process. Students used a four-point scale to rate their colleagues on the following characteristics: involvement, constructive use of class time, collaboration beyond the class structure, and contribution of original ideas (see Appendix J). These assessments were distributed at four points in the study (see Table 3.2).

In general, the students rated their peers lower after the exploration and concept phase. Table 4.5 shows the reduced frequency of the high ratings (4) individuals received from their team members. In the concept and design phases, where the students focused on the specifics of the game (mechanics, rules, and board design) the participation scores were high and included many 4s. When the students were developing the information literacy content for the draft, the number of 4s diminished, but they increased again as the students began developing the final versions of their games. The annotations to the individual assessments reflected this lull, where few mentioned they had not completed their question cards for the playable game draft or did not follow up on suggestions made by peers.

Table 4.3 Relative Frequency of High Level Participation Scores over Game Design Phases

Criteria/Phases	Concept	Design	Draft	Final
Very Involved in Design Process	100%	90%	86%	81%
Used Class Meetings Constructively	100%	81%	77%	81%
Collaborated beyond the Class	95%	81%	72%	86%
Contributed many Original Ideas	90%	77%	77%	81%

Students found that it wasn't as easy to develop information literacy questions as they had originally thought. Those who described themselves as "well informed" on information literacy also described initial hiccups in constructing their questions. Some of them (19 or 22%) found the process tasking because it required going in detail through the class material and, at times, re-doing the assignments. As Rhianna noted, *"It was a sneaky way to get us to go through databases. I had to redo the advanced searching part to form my questions."*

Ariana remarked *"Developing questions and integrating it is hard, because there is a lot of stuff online, and the answer is not the correct answer. It's close to the answer, but it's not the right answer. Making multiple choices are hard."*

Most (18 or 82%) group members bounced back from this reduced participation when they realized that the final deliverable was fast approaching. They attributed this rebounding to one-on-one assistance by some of their more knowledgeable team members.

Group 4 did not fare well after the demonstration of their playable draft. Maggie (Group 4) was highly motivated and wanted to achieve a high quality product, though two other members (Edmund and Eli) were content with expending minimal effort. This mismatch of expectations caused some frustration among their team members. In addition, Maggie mentioned that even though she was a senior, her information literacy skills were limited. She had given

Edmund the lead in incorporating web-source evaluation into their game because he had mentioned being knowledgeable in evaluating online information. Maggie did not give negative reports about her team members until the final review, in which she noted of Edmund, in the open comments section, "*Negative attitude, sometimes didn't volunteer, no original thinking much, waited to be told what to do*"

Laura commented on Edmund disinterest after their delivery of the playable draft. *"He spent last class on Google not doing too much to help, when presenting he didn't know much about what the product was"*

Knowing that this team was experiencing some problems the instructor tried working with them more closely. After play testing Group 4's game, other teams suggested inclusion of more content. During the design session, the researcher observed Eli viewing research guides to locate information on assess web resources. Edmund was content in spending the class time looking at iPhone reviews. Edmund's engagement did not improve as the class progressed. He was not available for the final interview, but he said in all his individual assessments that his team worked well together and that his own task was developing cards. In the final assessment, he said that he had come up with the game's title and had helped with the final report.

Most teams worked and interacted well together. Individuals helped peers, especially those who were weak in information literacy. Team members took on multiple responsibilities as needed, and assigned all team members the responsibility of contributing content to the game. Many students underestimated the difficulty of repurposing information literacy content for their games. It was this challenge that led to the reduced participation among some group members when they were developing the playable drafts of their games. Most of the teams reported improvement in participation once the playtesting of the final version of their game was due.

4.1.3.2 Sharing Among Class Members – Site 1

Constructivism highlights the importance of extending peer sharing beyond teams to include other students in the class. According to Papert sharing with other groups help students reflect on their own learning on the design artifact (in this study the designed game). This section discusses the sharing experiences among students outside their groups.

4.1.3.2.1 Structured Peer Sharing

Peer sharing activities got the students thinking more critically about their own games, and they felt that these activities brought up ideas they would not have thought of on their own. Thus, they responded positively to peer reviews and adopted many of the suggestions made by their colleagues.

Structured peer review opportunities were integrated in the class. Students were reminded that these activities was not about just addressing flaws but for providing constructive suggestions. Feedback offered by students varied depending on the game development phases. Through their peers, teams received suggestions about their game design, content inconsistencies, clarity of game rules and question construction. The feedback was documented and shared using the peer review assessment (see Appendix J). Students took some time to warm up to the idea of offering feedback in a structured class. After the first design sprint, they shared their game design ideas through a 10-minute presentation. Initially only the instructor fielded questions to presenting group, with the rest of the class being silent.

Group 1, who were the first discussed the idea of developing a trivia game, catalyzed students' interactions. Other teams were also interested in developing trivia games but noted the researcher suggestion that they explore more imaginative approaches. The other teams were having difficulty streamlining their game ideas, and when Group 1 ignored the researcher's suggestion and adopted this approach, other teams had wanted to learn more about their idea. Group 1's trivia-type game propagated its adoption by other groups.

Resulting discussions from peer sharing extended design ideas beyond the group. For example, during the concept presentation, Group 1 introduced their game as a modification of *Monopoly* but the class thought the idea as too boring. Mike who wanted to incorporate *Trivial Pursuit* but had been ignored by his team used the presentation as an opportunity to pitch the idea again. The class liked the suggestion, which led to team adoption. Others found the activity as useful toward s generating more concrete ideas about their game. According to Mark, *"The things that I liked about it were it helped in coming up with the concept of the game. Like when we got to see what others were doing we figure out how we wanted to create our game. That was most interesting to me because I didn't know how the game was going to pan out or what we were going to use to make our game come together. That was interesting to me."* Other students echoed this sentiment, and most of them indicated that they had made significant refinements to their games after the peer testing. The apprehensiveness that the students showed in the first peer sharing session did not reappear in the other sessions (playtesting of draft and final game).

Ownership

Having to share their games with other teams gave students a sense of ownership. Many of them described the efforts they had taken to create a game that was attractive, engaging, and accurate. Students also mentioned being nervous about having others play their games. Common worries were that the game was too simple, too difficult, had incorrect answers, rules wouldn't understood, or just that their peers wouldn't like it. For example, Ethan expressed his concerns about the question structure several times:

"Some of the questions on the note cards were wordy and could get difficult because they were long too. You actually had a hard time figuring out what the question was asking. Maybe make those questions a little shorter; just get rid of them at all. Because we had so many questions of them, I think there were 5 real long questions that we could probably just get rid of."

Jason concerns were more generic

> *"It was kind of weird, like would they like it, you know, what would they think of it. They seemed to like it for the most part. So that's pretty cool to see all that work and someone actually enjoyed it."*

Teams noted that during playtesting, they had to ensure that everyone in the group understood the game. This meant that multiple sessions of playtesting and editing were needed.

Peer sharing tested students indirectly. Some of the students (17 or 89%) mentioned that they had to be sure that everyone understood the information literacy content. That meant reviewing the questions to ensure that the answers were correct. Most of them (18 or 94%) said that when they used multiple sources to confirm their answers. According to Bo, *"We had to be ready to defend our answers"*

This action of defending was observed during final game play, where at times other teams would question the answers provided in the game. If there were disagreements, discussions like the following ensued:

> *Maggie : Conference papers are not primary (from Group 4)*
>
> *Lilly: Yes, they are*
>
> *Jerome: Yes, they are original research work (Group 1) … (looking at the instructor for confirmation)*
>
> *Instructor: Yes!(nodding)*

Maggie: Okay!

The instructor or the researcher was always on hand to confirm the answers in discussions like the one above. Even though the students recognized some of their peers as more experienced, they regarded the instructor as the authority. That did not mean that they took all of the suggestions the instructor offered. When the question involved game modifications, the students adopted the approaches they regarded as most viable. For example, the game modifications suggested to Group 4 were not adopted. However, on matters of content accuracy, the instructor's suggestions were always heeded. The researcher and instructor reviewed the accuracy of all playable game draft questions. Only some additional questions used in the final design didn't go through the instructor's review process, and there were a few instances of incorrect answers to these. The players quickly noticed these inaccuracies and rebutted them. Insufficient proofreading and long-winded questions were among of the most common matters for edits suggested by peers during the final game play.

Articulating Understanding

Having students articulate the learning objectives verbally and visually, helped students understanding of information literacy content. In addition to explaining how their game was played, students discussed the specific content it covered and the ways in which it could help players learn. The game Group 4 created was not well received, but suggestions for improvements were offered rather than simply criticism. Group 3 was especially helpful; one of the topics covered in their game was evaluation of information. Members of this team dominated the list of suggestions given to Group 4 advising on ways they could incorporate evaluation steps into their game. The members of Group 4 took these suggestions to heart and expanded their narrow perspective on information evaluation beyond web resources in their final report.

At times, the instructor facilitated these conversations by posing questions directly to quieter students so that discussions were uniform.

4.1.3.2.2 Unstructured Peer Sharing

Peer sharing extended the community of involvement in the classroom. After the first peer sharing activity students quickly realized they were not just limited to obtaining advice from their group members. After that, there were occasions where groups would invite members from another team to offer suggestions on either their game board or game idea. This type of sharing did not extend outside the classroom. Groups with strong game presentations earned respect from other teams. Group 1 and 2 demonstrated well developed playable drafts. Their members were recognized as “experts” and were consulted by other teams for assistance. These “experts” expressed a sense of pride in being asked for advice.

The instructor also encouraged unstructured peer sharing. When assistance was sought from the instructor, she responded to the team versus an individual student. In addition, the instructor acted as a facilitator and “ceded the floor” to the students by referring questions to other teams. Only when students were unable to provide a solution did she take the opportunity of this teaching moment to respond to the class. This approach was not limited to game design activities but was done for the in- class assignment.

Through peer sharing students had opportunities to provide constructive feedback from other teams that help in their own understandings. The activity provided opportunities for articulating ideas, views and question each other not just on specifics about the game but about information literacy content. Peer sharing gave students the opportunity to interact with the content from different perspectives. Students exhibited ownership in the game taking additional efforts to improve their game aesthetics, confirm accuracy of their answers, multiple instances of editing questions and play testing their game.

4.1.4 How do undergraduate students represent information literacy concepts in the game-based artifacts they design? – Site 1

This question is directed at the different ways in which students incorporate information literacy content into their games. Data used to answer this question was from observation, individual assessments and interviews.

Design sessions were dynamic and discussions among group members prompted students to search for new information especially as they made decisions on what content to include in their game. Students were given the freedom to be imaginative in their game design, with some limits described in the rubric (see Appendix C). For example, learning objectives were an essential requirement for all created games. Having students finalize their learning objectives early in the design process guided the content that would be incorporated into the game. Only Group 2 and 3 modified their learning objectives as they decided to expand on the topics covered after the concept presentation. Initially, both groups chose to address search strategies but after further team discussions included additional topics to avoid content duplication. At times, the instructor also considered student's recommendations. Group 1 was interested in exploring privacy and was given permission by the instructor to include in their game. Game board, rules and game mechanics were modified over the class to meet desired goals.

Giving students the freedom on their topic choices resulted in them exploring the content more broadly. Teams modified or adopted game mechanics from mainstream games and overlay various aspects of information literacy. Groups 1 and 2 combined game mechanics of popular games like *Clue*, *Monopoly* and *Trivial Pursuit*.

Table 4.4 provides a list of the games created, including titles, briefings, ACRL Standards addressed and stated learning objectives. See Appendix N for illustrations and further game play description of the artifacts developed at Site 1.

Most groups (3 or 60%) developed trivia type games, which allowed them to incorporate multiple information literacy topics into their games. A sampling of the questions developed by these groups and the information literacy skill they tested are shown in Table 4.5. As seen students' trivia questions addressed the lower levels of Bloom Taxonomy which focus on remembering, understanding and applying facts, concepts and processes. Groups 4 and 5 did not rely as heavily on trivia, they focused more on the recall of authoritative websites criteria and reference style structure. Their games focused on single topics: the evaluation of web resources (Group 4) and the structuring of different styles of citations (Group 5), Group 4 decided upon their topic because it fitted well with the game mechanics of *Candyland*. During game exploration, they limited themselves to reviewing just one game. On the other hand, Group 5 was more concerned with the importance behind their topic. According to Ariana (Group 5) understanding citation styles was important in other classes and it was a shortcoming addressed by other group members.

> *"I came up with the idea for matching and using citations because I know I'm not good at citing. We all were. I figured I might as well learn something that I can use later on and I thought of the theory of climate change because in my other classes we were talking about the climate change. We were all interested in the topic and we could research the topic at the same time. Then, we all thought to find our different things. I had books for all the styles. We had to look up the sources and cite them and everything like that. We found out all these rules and moved them out and did a lot of the research for it."*

Most groups preferred (4 or 80%) to develop physical board games. Initially, Group 5 developed a card game changing to an online version after the other groups play tested their physical draft. They found multiple cards too cumbersome, and addressed this by developing a digital version with similar mechanics. They used the online game tool *Sporcle* was to develop their games where players matched items to APA, MLA and Chicago citations.

Table 4.4 Description of Games Developed at Site 1

Group No./ Game Title	Game Description	Stated Learning Objectives
1. Trivial Searchopoly	Using a dice, players move around the board by correctly answering trivia questions. Questions are split into six categories; constructing searches in databases, finding library resources using the catalog and library services, tips for searching Google, protecting ones' privacy and constructing citations. ACRL Standards addressed in game play: 1, 2, 5	Understand how to: 1. Develop advanced and basic searches to use databases more effectively 2. Find books and services in the library 3. Avoid citation errors 4. Use Google and Google Scholar more effectively and safely
2. Library Rush	Game developed using mechanics of *Clue* and *Trivial Pursuit*. Game used to create awareness about good research practices (for example finding reputable resources using databases) versus bad research practices (for example not using citations). ACRL Standards addressed in game play : 1, 2	1. Obtaining good research skills 2. Understanding how to access library resources and services 3. Understanding how to search databases
3. Connect Trivia	Trivia questions overlaid on the game *Connect Four*. Trivia question focused on online searching and identifying primary and secondary resources. ACRL Standards addressed in game play: 1, 2, 3,	1. Understand how to develop good databases searching using advanced and basic searches 2. Use appropriate search engines for research – Google Scholar 3. Understand types of information
4. Internet Land	A modified version of Candyland used to identify reliable web sources. ACRL Standards addressed in game play: 3,	1. Identifying reliable web sources
5. Climate Change Citation Match	An online matching game, where individual players matched 15 hints to citation styles (APA, MLA and Chicago). Resources cited were are specific to climate change resources. ACRL Standards addressed in game play: 5	The player will be able to: 1. Tell the difference between MLA, APA and Chicago style citations 2. Write citations in each style 3. Cite different types of materials 4. Memorize citations formats 5. Avoid plagiarism

Table 4.5 Sampling of Questions Developed by Groups 1, 2 and 3 at Site 1

Question Category	Examples of Questions	Information Literacy Skills Tested by Players
	Group 1: Trivial Searchopoly – 50 Questions	
Citations	1. What are the parts of a book citation? 2. What is the importance behind citing sources?	Recall of the specifics on writing citations. Understand the importance behind avoiding plagiarism
Databases	1. What are three reliable databases for biology? 2. How do you narrow your basic search? Which options help?	Recall and recognize subject specific online databases Explain application of search strategies
About Site 1 Library	1. Your textbook has combusted spontaneously and you need to complete your assignment. Where can you find another textbook and how long will you be able to use it? 2. Site 1 Library is the only library on campus? 3. There are 3 computer clusters in Site 1 library. (True or False)	Recall and recognize the different routes to locating resources within library services
Searching Google	1. If you want to exclude a word from your search include __? 2. Where do you go on Google to find journal articles?	Explain application of search strategies in commonly used search tools.
	Group 2: Library Rush – 60 Questions	
About Site 1 Library	1. How long can you borrow a book? 2. When is a book overdue? 3. Where is the quiet study room? What is the room number? 4. What is the Power Tower? Where is it located?	Recall and recognize the different routes to locating and using resources within library services.
About Journals	1. What type of source is a journal article? Primary or secondary? 2. What does it mean when a journal is peer reviewed	Understand how information is created and critically think about the sources.
Searching Online	1. Give an example of a Boolean connector? What does it do? 2. What are three limiters to narrow your search?	Explain application of search strategies
Writing help	1. Name three citations you can use in your research paper? 2. What are the components of the MLA reference style?	Recall of the specifics on writing citations.
	Group 3: Connect Trivia - 50 Questions	
Evaluating Resources	1. Which of the following is NOT a way to tell if an article is biased? 2. What is a primary source? 3. You should always choose the reference from a .com site (True or False)	Remember the general criteria for evaluating information

	4. Blogs are unbiased sources of information (True or False)	
Citing Sources	1. You must cite your source used in a research paper when...? 2. YouTube videos does not need to be cited (True or False)	Understand the importance behind avoiding plagiarism
Writing	1. What should be included in an introduction of a research paper? 2. What is included in the body of a research paper?	Understanding how to communicate information effectively
Searching Online	1. What feature allows you to search various forms of a keyword? 2. What type of searching allows you to use controlled vocabulary?	Explain application of search strategies

Students needed to possess a deeper understanding of the content to incorporate it effectively into their games. For example, they needed to be analytical by, making judgements on the responses to question they constructed. This required the employment of higher order thinking skills. Class content was actively used in designing the games. Most students (17 or 89%) revisited their class assignments and explored the online class resources in detail to develop content for their game. The instructor mentioned that students in previous classes tend not use the class resources made available in the online class space, so the game creation activity inspired students to explore content more deeply than students usually did in this course.

Some took the initiative to explore class topics further. For example, Group 1 chose to explore maintaining privacy on Google. The idea was triggered by a class video that highlighted Google activities with user data. Table 4.6 summarizes the reported tasks students undertook in order to develop content for their game. Most students (21 or 95%) reported having to use online databases extensively to develop their content. Many times this also meant reviewing the class assignment, which provided them further guidance through the process. These tasks were done either individually or with group members. All students mentioned exploring the *Google Scholar* as a way of developing content for their games; many of them (21 or 95%) were previously unfamiliar with the site and saw it as an additional resource for accessing peer-reviewed resources. They like the customization features and noted the "Cited by" feature was especially useful since not all online databases had that information.

Table 4.6 Tasks Undertaken by Students to Develop Games Tasks Undertaken by Students to Develop Games

Reported Tasks	Percentage of Students
Using Google Scholar	100%
Fine tuning search strategies using various online databases	95%
Revise class assignments	90%
Identify appropriate databases	90%
Reviewing the library website	77%
Evaluating websites	72%
Exploring online catalog	68%
Evaluating online resources	68%
Exploring other library games	68%
Exploring citing styles	54%

Students' games incorporated a number of ACRL Standards, which were used as the learning goals for Site 1 class. Table 4.7 describes the five standards and performance indicators. The instructor and researcher reviewed the student-created games and the tasks undertaken to meet the standards. Because Group 1's *Trivial Searchopoly* covered a range of topics, four standards applied to it. The games from the other teams met more modest standards.

The majority of students developed trivia board games which afforded them to cover multiple information literacy topics. To do this they needed to engage more deeply with the class content. Designed games met a number of ACRL Standards that were used to guide the learning objectives of the class.

Table 4.7 Performance Indicators Undertaken by Students in Developing Games

ACRL Standards	Performance Indicators	Groups
Standard One: The information literate student determines the extent of the information needed.	Student can interpret research topic and decide what sources would be most appropriate.	Groups 1, 2, and 3
Standard Two: The information literate student accesses needed information effectively & efficiently.	Students able to use advanced search strategies like Boolean operators, truncation, and keyword generation as they search for relevant sources. Make suggestions to improve effectiveness and efficiency.	Groups 1, 2, and 3
Standard Three: The information literate student evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system.	Students evaluate sources critically based on currency, relevance, accuracy, authority, and purpose. Based on these criteria, they select appropriate sources.	Groups 3 and 4
Standard Four: The information literate student, individually or as a member of a group, uses information effectively to accomplish a specific purpose.	Students work in groups and applies new and prior information to the planning and creation of the game. They revise the game based on feedback and are able to communicate the learning objectives, rules and other aspects of the game	All groups
Standard Five: The information literate student understands many of the economic, legal, and social issues surrounding the use of information and accesses and uses information ethically and legally.	Student understands many of the ethical, legal and socio-economic issues surrounding information.	Groups 1 and 5

4.1.5 What were undergraduate students' motivations to use information literacy practices they were exposed to throughout their class experiences? – Site 1

This question addresses student motivations, observed changes and articulations made by students regarding their use of information literacy skills during and after taking the class. Data obtained from completed IMI, class observations, individual assessments and interviews were used to inform this question.

4.1.5.1 Intrinsic Motivation Measure at Site 1

The efforts taken by the instructor to foster intrinsic motivation was fruitful. Table 4.7 shows the means of the self-reported responses from the IMI inventory.

As seen by the mean scores in Table 4.7 students were intrinsically motivated and this increased as the class progressed. The interest and enjoyment subscale is a measure of intrinsic motivation and the mean score increased by the end of the class. Even though students saw the game design activity as challenging, they considered themselves competent. They also saw themselves as having options. Perceived competence and perceived choice scores were maintained over the class with a slight increase noted at the class end. Despite the realization that designing games was more difficult than anticipated, the tension scores remained low throughout the class.

Table 4.8 Means from IMI Subscales at the Beginning and End of Classes at Site 1

Site 1	Interest/Enjoyment		Perceived Competence		Perceived Choice		Pressure/Tension	
	Begin	End	Begin	End	Begin	End	Begin	End
Male	4.9	5.6	5.0	5.9	5.4	5.8	3.0	2.8
Female	5.0	5.7	5.2	5.4	5.5	5.9	3.3	2.9
All Students	5.0	5.7	5.0	5.7	5.4	5.9	3.2	2.9

Class observations underscore these results from the IMI inventory. Classes were dynamic and students were always engaged in the classroom. The instructor was supportive of all class assignments. At one class there was a student observer and the instructor proudly explained the games being created by the students? Witnessing episodes like this can help students to take pride in their own efforts. In responses from interview all students mentioned that they enjoyed the class despite their initial concerns about whether they would be able to successfully design a playable information literacy game. Some students felt that they could have done a better job, but, overall, the students thought that the project was an enjoyable way to learn.

4.1.5.2 Students Application and Transference of Learned Skills at Site 1

As students implemented their game ideas and created content they were able to improve the skills addressed in the class. Table 4.8 illustrates information literacy skills, which students identified as being improved when they were interviewed. All students reported improvements in their database searching skills, knowing the services offered at the library, searching the library catalog, awareness of scholarly search engines that were available and making attempts to avoid plagiarism in their assignments.

In class, the students were observed to grow more comfortable searching databases. They depended less on the instructor and other group members. Penny, who was very apprehensive about her search skills at the beginning, later said that she was able to use databases better because of the practice she gained while developing game content.

Students also expressed having a better understanding of services offered by their library. Junior students mentioned learning about a number of services that could have saved them time in previous years. Students who indicated having previous information literacy skills found the class useful in identifying their weakness. As noted by Wayne

> *"I guess I haven't had that much experience. I've been learning little bit over the years in high school and continuing now and what sources to use credibly and I consider myself very comfortable with databases before, but now I am more comfortable. I'm getting better at recognizing good and bad sources. I definitely do use databases when I need something that is credible and don't trust stuff on the Internet."*

Table 4.9 Improved Information Literacy Skills Reported by Student

Information Literacy Skill	Reported Improved Skills/Awareness (%)
Use a variety of library sources (online databases and catalog) to find peer reviewed materials for assignments	100%
Use scholarly search engines	100%
Use citations in assignments. Awareness of plagiarism	100%
Identify which online databases to use in their research	100%
Awareness of library services	100%
Break down research topic into keywords	77%
Use of advanced searching	77%
Better able to evaluate information. Not accept statements at face value	95%

Note: 19 students were interviewed

Overall, students felt that the game design process gave them the opportunity to practice and hone their learned skills. As Bo noted, he had to understand processes in order to ask questions about the topic in the game. Other students expressed similar statements having to be knowledgeable about content before designing their game. Students also felt that having to playtest on multiple occasions was instrumental in providing them with necessary practice (for example searching databases, exploring the library website, and practicing reference styles) that was not achievable through a single class assignment. For example, some students noted that having to search different databases on multiple occasions during the game design process was instrumental in helping them better understand the logic behind how various databases work. Therefore, they were able integrate these searching skills to multiple databases with different interfaces.

Students found their information literacy skills being very useful in other classes. They mentioned being better able to find resources for their classes since they had a better idea of where to look. Jerome was very specific in the skills he used.

> *"Yes. It's a lot easier now. I've already had to use it for online biology class a couple times just to find articles and stuff. My English class I had to look up a couple essays. It is a lot easier. .. For biology lab we had to find two primary resource articles on primary*

forest verses secondary forest that were relatively new. We had to adjust the search settings to 2013-2014. It had to be peer reviewed too so we had to click that box. Trying to think. We had to cite those two articles that we used. We had to figure out which kind of citation we had to use, which was APA and typed those, which we learned how to do in class. My game had some citations in it too. The other group's game group, the Sporcle one, I don't remember which class had the citation game online but that one helped. I became more familiar with the different kind of citation styles"

Freshman students talked about being relieved that citations were covered in the class since it was a skill they needed to have in their English classes and the instructors were very specific about the different styles. Those who included citations as a topic in their games felt that the game design process offered significant opportunities for practice. Group 5 game focused on constructing different styles of citations noted this learning advantage. According to some of their members, they felt they learned more about the reference and citation styles by designing the game. Mark and Constance were specific about the learning advantages offered by designing the game. They felt they learned more by designing their game than just having to a game that was created by another group.

Over half of the students at Site 1 (12 or 63%) said that they used their skills in everyday situations. Students were asked if they applied their information literacy skills beyond their academic work. All responses address being skeptical of information available on free websites. Students talked about finding themselves looking up the author credentials, domain names (whether .org, .com, .edu or .gov) and dates especially when accessing information online for classes or just everyday information. Constance reiterated a statement made by the instructor in one of the classes, *"Everything on the Internet should be taken with a grain of salt"*. Ariana noted "*Yeah, I look to see where the information is coming from for everything even basic stuff like celebrity gossip. It is just what I do*". Other students (4 or 21%) talked being more aware of bias and trying to recognize it when it exists, especially in news stories. When asked to elaborate, they mentioned noticing the absence of evidence and the reporting of individual views.

Students reported improvement in a number of their information literacy skills. They were able to use these skills in other classes and found the experience beneficial. Only few students related to these skills in non-academic situations.

4.2 Site 2

The findings from Site 2 will now be discussed in the following sections. The organization of these findings is similar to those reported for Site 1.

4.2.1 Site 2 Participants and Prior Experiences

The information literacy class was a requirement towards graduation and for most students this was their last opportunity for taking the class. Ten students were enrolled in the one-credit information literacy class. Most (8 or 80%) students at site 2 were seniors and the other 2 (20%) were juniors. See Table 4.10 for demographics of students. There was an equal distribution of male and female students.

Table 4.10 Gender and College Level of Students at Site 2

Site / Gender	Freshman		Junior		Sophomore		Senior		Total
	Male	Female	Male	Female	Male	Female	Male	Female	
Site 2	0%	0%	20%	0%	0%	0%	30%	50%	100% (n=10)
	0%		20%		0%		80%		

To be eligible to enroll in this class, students needed to complete four pre requisites in freshman and sophomore classes Therefore eligibility was achieved in their junior year. Only 2 (20%) juniors chose to take the class early.

Both male and female students liked the idea of designing a game about information literacy. When the option of designing a game was offered in the first class session, students considered it a good idea. Later, responses from interviews that were done at the class end revealed that Diana and Edgar preferred the option of doing a presentation. They mentioned agreeing to the idea of designing a game because most students were open to the idea and they thought it would have been a good thing to try since it was a group effort. These two students mentioned they adapted to their peers' preferences but in hindsight wished they had chosen a more conventional approach for a final project.

4.2.1.2 Site 2 Student Participant Prior Game Experiences

Both male and female students regarded themselves as game players (See Table 4.11). Students had experiences with all types of games. In class conversation about the types of games played, students mentioned playing a variety of games, not just one category. Five (50%) students played all game types; most (4 or 40%) being male students. Three (30%) female students reported not being players of video games, preferring board, tabletop and skill games. Allison indicated that she did not play any games in the questionnaire. On further probing about her game playing experiences in the interview, she stated :*"I do play some games with friends, but not frequently, they mostly play video games and I'm really bad with computers as it is, so I always have a little more difficulty than I'd say other people."*

Both male and female students were experienced game players. See Table 4.11. Most saw themselves as experts (3 or 30%) or intermediate (6 or 60%) game players. Game playing was a prominent part of student's life. Most played games daily (3 or 30%) or weekly (3 or 30%) regarding it as their only form of relaxation.

Students were asked prior design experiences, or been involved in any game designing activity. All students mentioned having no previous experiences in designing games.

Table 4.11 Prior Game Experiences of Site 2 Student Participants

Pseudonym	Game Skill	Types	How Long (yrs.)	Play Frequency
Bruno	Expert	All	Over 10 years	Once a week
Clint	Expert	All	5 to 10 years	2-3/month
Noah	Expert	Video	Over 10 years	Daily
Bobby	Intermediate	All	Over 10 years	Daily
Diana	Intermediate	Party/Tabletop/Skill	Over 10 years	2-3/month
Edgar	Intermediate	All	Over 10 years	Daily
Hannah	Intermediate	All	Over 10 years	2-3/month
Jessica	Intermediate	Party/Tabletop/Skill	5 to 10 years	Once a week
Vanessa	Intermediate	Party/Tabletop/Video	Over 10 years	Once a week
Allison	Novice	N/A	N/A	N/A

4.2.1.3 Site 2 Student Participant Prior Information Literacy Experiences

Most (9 or 90%) students had prior one-shot information literacy classes with the instructor. Edgar was the exception, since he was transfer student. The instructor had an in-class test on the first day to get a sense of retained skills from those prior meetings. (See Appendix O for test tasks). In interviews, students mentioned taking the test in previous classes and were familiar with the tasks. The test required students to demonstrate their ability to think about information sources by submitting examples of different types of resources: primary, secondary and tertiary sources. This preliminary test was meant as a self-test for students to gauge their retained information literacy skills from previous classes. Even though Edgar mentioned that he had done research previously he was unable to complete this assignment in the first attempt. He was unfamiliar with such tasks as refining search tactics and information types. Additional after class meetings with the instructor helped in resolving his concerns and he completed this test successfully in his second attempt. Students demonstrated understandings of core information literacy skills that were honed through their involvement in research projects and other assignments.

4.2.2 How can an instructor incorporate motivational theories into an information literacy class through "learning by game design"? – Site 2

This research question addresses the considerations taken by the instructor to maintain student intrinsic motivation over the duration of the information literacy class. In planning integration of learning by game design aim to meet the following psychological needs: autonomy, perceived competence, and relatedness (Ryan & Deci, 2000). Data used to answer this question were from class observations, student individual assessments, IMI Inventory and interviews.

Autonomy

Students' autonomy was enhanced by giving them options in creating their own class experiences. They had the choice of either designing a game for their final project or developing a presentation as was done in previous classes. The instructor introduced the game design option as an exploratory teaching approach and thought it as being a suitable alternative as the class was held later in the day. Students like the idea,

Instructor: What do you think of this idea?

Vanessa: "It's a great idea, especially at 6 o'clock at night. At least I won't have another presentation or poster. I am of bit tired of that. It's all we do in Bio"

Instructor: "Well, it will definitely not be a boring class. I don't plan on it being one"

Noah: "Yeah, I think that, instead of some of the more tedious projects, where you are just on your own, trying to find articles and things like that, I think that using some type of game design to maybe improve finding articles, or making a research report, or your own article, as we had to do in some of the lower biology classes, I think it would be a lot more interesting for us, having to design a game, while still including all those same aspects of learning… I think that people would appreciate the kind of breaking out of just doing the same thing in every class, over and over."

Similar comments like those expressed by Noah and Venessa were articulated by other students in the class. In the interview responses 8 (80%) students said they were intrigued by the idea when it was proposed. They thought it had the potential of being more engaging especially for a late evening class. By the show of hands all students were agreeable to doing the game design activity, and it was implemented. Students were randomly assigned into 3 groups with 3 to 4 members. Only Group 2 had 4 members. Teams were given four topics to choose from to develop their game content. These were scientific misconduct, open access, online privacy and Wikipedia and each group had to choose a different topic. Groups decided among themselves whether to be address a specific aspect or cover the entire topic in the game.

The instructor emphasized that their games will be used to teach the class about the topic, which was done through the game play. Therefore, the instructor did not cover the content in the classroom. Since these topics were new to students, a list of resources was made available in the online class space to help teams get started. The instructor mentioned here expectation of looking beyond those resources. This approach of providing just enough information to build on a foundation for developing their creations was used in her previous classses. Other than the specifics listed in the rubric (See Appendix C), students had the freedom to develop any type of game. Topics were delegated on a first come basis. By the end of the first class students were placed into their groups and had their topic.

Perceived Competence

The instructor incorporated the game based teaching together with game design activities to maintain a comfortable challenge level and perceived competence. Four (30%) classes covered information literacy content that focused on: scholarship as a conversation, evaluating scientific information, advanced searching in Science databases and keeping current with research. Most content was delivered using a game based approach. Advance searching was done as a classroom assignment with assistance provided by the researcher and instructor.

In the first class the instructor talk about her approach to students letting them know that lectures was minimal and they would be drawing on information literacy content addressed in previous classes. The instructor used interactive information literacy-based activities to keep the class engaged and promoted intereaction.

Seven (53%) of the classes were developed around game design activities. Because the topics students were using to design their games were not taught in the classroom the instructor wanted to give ample time to address any potential misrepresentations during the game design process. In the interviews all students mentioned that they were initally confused about how the game design activity will play out, but they were open to the idea. As Jessica mentioned, *"I think I was unsure how that was going to happen. How I was going to learn, what kind of game. I was a little confused but as the semester went on I understood more. It's obviously like an active style for a library style literacy class."*

Students saw themselves as competent since they were all game players. Allison was a bit concerned about not being creative enough since she did not see herself as a game player. Bruno did not see game design as being difficult and he confidently mentioned to his group that he already had some ideas in mind. Not everyone was comfortable as Bruno, therefore a class was dedicated to just exploring games. This activity was introduced early to help students develop their ideas. Students liked the idea of class content being interpersed with game design activities. As noted by Hannah from the interviews

> *"I liked how one week we'd have a lecture then we did the game thing together as groups and time was back and forth. I like how that it was divided up so every week we weren't just working on our game designs. I thought it worked really well that it was such a small class, we're in 3 groups. We ended up all having different ideas and did different things. That was cool. I think our time in the class was used very wisely.*"

When students were asked about their previous knowledge about the topics they used to develop their games, most (8 or 80%) (exception Diana and Venessa) mentioned they were not familiar with the topic they chose. Their choices were influenced by the team's interest.

Overall the instructor incorporated active learning strategies to maintain students perceived competence. Since the idea of playing games developed in the class were meant to teach players about the topic, an entire class was assign to each group for other teams to play the final version of their games. Active strategies like those described above was used to maintain student confidence and make the class activities challenging and engaging.

Relatedness

Students related well with each other and the instructor. Most students had met each other in previous classes or had worked on research projects together. For example, Noah, Diana and

Bobby worked together as student assistants in a research lab with a professor. The instructor modified her lecture sessions as game based classes. Throught collaborative activities like these students were given ample opportunities to develop relationships. In addition, through working together they could draw on each other expertise in the classroom.

Most students (with the exception of Edgar) had met the instructor in their one-shot information literacy classes. From observations,it was apparent that the instructor and students related well with each other in previous class meetings. Even though Edgar had not met the instructor before, he mentioned in the interview that he found her easy to interact with and appreciated her flexiblity.

Both the instructor and the researcher worked together with students during all class activities. Maintaining relatedness was fostered through having students feel socially connected with each other and the instructor and researcher.

4.2.2.1 Participant Suggested Class Modifications and Application to Other Classes at Site 2

Students expressed confusion regarding the topics used to create their games. They mentioned having the at least an introduction to topics covered in classes would have help in providing some guidance. All students saw topics as wide reaching and thought they spent a lot of time figuring out concepts to include in the game. Noah explains,

> *"I think the most difficult part was just trying to figure it out, because I think we had the most difficult topic, just where it comes to game design. Because while Open Access is a pretty well a known saying, it's not as intricate as maybe some of the other ones, so the hardest part was just trying to figure out how we could design a game where people could actually understand the topic, and apply the topic, throughout their daily lives, where maybe people don't really understand the concept of Open Access, where they just*

try to find an article, and okay, it's not there, that's fine, I'll just move on to the next one… The hardest part was just trying to get everyone else working, to get the point across that Open Access was an actual real issue, and that it was something that needs to be addressed by the scientific community, because it is kind of stifling how students and other researchers obtain information, and how they build upon that information, and interact with each other. I think the most difficult part was definitely just trying to design a game around the topic while meeting all that criteria."

Not everyone understood the social aspects and it relation to information as realized by Noah.

All students suggested that at least one class should have addressed topics. They were unfamiliar with them and had a hard time relating it to information literacy. Allison mentioned, *"I never even heard of open access or what was the other one? …scientific misconduct. I am not sure how it fits with the class."*

Edgar said he did not think that the topics were suitable for the class and it was not what he expected when he thought about information literacy. He thought project topics were introduced because of the game design activity and did not realize it was standard in previous classes. Vanessa mentioned about floundering in the beginning, but when the instructor supported framing privacy from the perspective of Facebook the topic became clearer. Other groups chose to keep their topic broad so that the player could understand all aspect, this led to it being a challenging especially when it came to developing their content. Students indicated that they did have to interact with a lot of materials in order to come up with ideas. This meant that they spent of lot of time researching their topic. Jessica explained in the interview the challenges of narrowing their topic

For us, we had a difficult topic so it was hard for us to associate a fun game. I mean our game was challenging. We also wanted to make sure we could demonstrate what open access is and was not sure what to leave out. We did not want to just say that open access is important. Then you said to include the social part, that meant more work. So that was difficult, it was difficult to try that, put all those aspects into it.

Despite the challenges encountered with understanding their game topic, students liked the class structure and found the game based activites engaging. All students liked the combination : game based instruction, game design and game play. When ask about which approaches they like best, students thought using just one approach would not work well in a classroom. They mentioned the combination of activities was proportioned out nicely. Edgar noted that even though he did not like the idea of game design he felt that it was well integrated given that it was the approach that was decided by the class. Diana and Bobby felt the approach worked because they had covered information literacy in previous clasess and most of them already knew each other.

Students thought that enough class time was given towards designing the game. Eight (80%) said they liked that they were able to worked together with the instructor and peers during their game design activity. Three (30%) felt that too much time was spent on designing a game. When asked to elaborate on what part of game design took up the most time. They mentioned developing the content, because of the reaserch they needed to do and understanding the topic. In class discussions with Diana she mentioned about the amount of time involved in coming up with the questions even though the group had developed their game idea in the first meeting. She explained further in the interviews.

"I thought it would have been a pretty straight-forward process. It was easy to learn the concepts to design a game. It made me realize how much goes into a game... We went with our first idea. I thought it would be easier than it was at first. But then, as I was making questions and stuff I realized that it's more difficult than I thought. When you were actually creating the questions, that process of creating questions there was a lot of stuff to cover. That takes a lot of time."

Students did not underestimated the time involved in designing a game. They noted that the topic they chose was new to them, so becoming familiar will require time. All mentioned scheduling outside meetings at the first class. Members from most teams (Groups 2 and 3) met on four ocassions for 2 to 3 hours. Group 1 met on 2 ocassions after class.

All students liked the inclusion of the peer review activity for the different versions of their games. However for some groups this meant more time in fine tuning their design process.

Students did not think the game design activity was applicable to other classes they had taken previously. Many could not see this approach being used in science classes. As noted by Bobby

"Well, as far as science classes go, almost all my science classes have been lecture-based just because that's how science classes are based. But for me, classes that I really enjoy are discussion based as well where everyone's kind of involved and talking about stuff and things like that. It's something a lot harder with a science class because it's not really opinion-oriented, more just factual things, so it's a little bit harder to do that for a science class."

Clint, Venessa and Hannah saw it as being a good approach for their history classes they had taken in freshman year.

4.2.3 How does the "learning by game design" approach within information literacy classes foster the sharing of knowledge among undergraduate students?

This research question explores how students work together to share knowledge during game design. Data analyzed from observations, semi structured interviews, individual and team assessments, peer reviews of games and final report were used to answer this question. The game design process was structured so that knowledge sharing happened within teams and with peers during game demonstrations and play testing. In the following subsections, sharing is first describes among team members and followed by peers.

4.2.3.1 Sharing Among Group Members

Students were placed randomly into groups. The instructor mentioned students needed to be comfortable with different working styles which simulated real world experiences, therefore her support for random grouping. This approach to grouping was also done several times over the class (during game based classes). When students were asked about their views working outside their teams in other class activities, they were split. The four team members from Group 2 and Vanessa (Group 3) like the idea of working with others in the classroom. Three students from Group 1 and Group 3 (Allison and Clint) felt that their teams should have worked together on all class activities to develop a better working relationships and bemoaned the idea of being separated so often over the class.

Initially all groups were made up of 3 members but in the second week Bobby joined the class. He was given the option to choose his team, which was Group 2. Unbeknownst to the instructor he chose to be part of a group with two team members who were his friends and with whom he worked with the research lab.

Members Interdependence

Not all team members assisted one another in achieving success, even though they were working together toward the common goal of creating a game. Since 3 members of Group 2 were already familiar with each other, they adapted quickly to Hannah's quiet and agreeable working style. From class observations, this Group 2 team members worked well together. They shared the responsibilities of exploring the topic, brought articles into the class, discussed their views and were open to each other ideas. According to Hannah *"Everyone's opinion was included in everything."*

The members of Group 1 showed much less evidence of assisting their less-experienced (information literacy) member, Bruno, who had problems understanding the group's topic and therefore developing content for the game. It was obvious that he was not engaging with topic material and his absence and disregard for deadlines frustrated his team members. Unfamiliarity about the topic exacerbated the problem. After a couple of meetings with two members (Diana and Edgar), the instructor's intervention help resolve concerns for Bruno tardiness by having him submit deliverables directly to her. This was an individual task with feedback provided by the instructor and not team members. His misunderstanding about the topic led to submission of multiple versions, before the instructor considered it suitable. His first questions only addressed citations and the second list addressed plagiarism with no representation of falsification and fabrication. He corrected his errors in the third attempt, and this version was included in their final game. Bruno's team members also requested that he submit the final report separately, since they felt his contribution was not significant. Diana and Edgar mentioned they worked well together. Edgar noted in his interview that Diana was very helpful in showing him how to navigate some databases when it came to locating game content.

Vanessa and Allison from Group 3 worked well together but felt that Clint was not always engaged even though he was available at classes and out of class meetings. Vanessa was knowledgeable about their topic so the other team members relied on her guidance through the game design process. This group also chose to submit individual final reports because they thought it would be more reflective of everyone understanding of the game created.

Working Cooperatively

Team members who were familiar with each other worked well together. This was evident with Group 2 whose group members maintained a good working relationship from the first meeting. All groups started off working well together and divided tasks based of members strengths. All team members were responsible for providing game content. Members who regarded themselves as creative took on the responsibility of developing physical components of the game. One team member took the lead in developing the game in Groups 1 (Bruno) and 3 (Vanessa). However, when Group 3 took on the challenge to redesign their game Vanessa noted that all team members were involved in the design process. Group 2 farmed out different design components of their game to their members.

Problematic team members (Group 1 and Group 3), impacted negatively on cooperative working relationships. Edgar and Diana (Group 1) got very frustrated with Bruno being non-communicative and tardy in submitting content deliverable. This led to fracturing of group relationships. Edgar got frustrated that Bruno was only concerned about game aesthetics and ignored exploring the game topic. Both members recognized the game was Bruno's idea but felt priority needed be given to understanding the topic and developing their trivia questions. Diana noted that the development of questions were the learning part of the game design and therefore a requirement for all members. Bruno felt his contribution; the game idea, sourcing game pieces and developing the rules was enough and express confusion when his team members became irritated when he ignored developing the trivia questions. Edgar noted in his team member assessment *"He missed our first presentation day and seems distracted doing the research/development day in class and was focusing on the game already made and not on developing the questions for our game."*

Group 1 was unable to resolve their group problems on their own and eventually the instructor had to intervene to resolve this breakdown. Group 3 concerns were more about getting used to working with different personalities. Vanessa and Allison (Group 3) initially interpreted Clint reticent behavior to mean disinterest. Vanessa did not like the idea of always having to delegate tasks to him. According to her

> *"He did not volunteer to do tasks like Allison. He wasn't really into it as much as me and other members were. We, the two of us were always the ones to initiate the meeting up or even I tried my hardest every class to make sure all 3 of us were on the same page and still working towards getting a nice stack of cards. It could have been a little bit better. In the end it all came out fine and we were all happy with it"*

Allison had similar sentiments about Clint but noted that he was always flexible regarding meeting times and met deadlines. Clint was not aware of his team members' frustrations regarding his demeanor, and this was not communicated to him by his team peers. When asked about his experiences working with his group he mentioned

> *"I am not very creative, the others had the ideas and I helped. I believe we worked well together. We didn't hit heads or anything like that. It was pretty much we had a good idea, and we capitalized on it. The work wasn't cumbersome, and we got the job done on time, so everything was good."*

Because he responded positively by meeting deadlines and being available for meeting these personality conflicts eventually worked themselves especially after the draft phase.

Groups worked together to figure out their game topic. Most teams spent time during the design session exploring their topic. Only one class was dedicated solely towards designing, therefore game development was done outside the classroom. In-class design time for most (7 or 70%) was for discussing and going over the resources they accumulated on the topic. In class conversations Jessica spoke about their game design progress

> *"I think that giving us a new topic for this class it was OK because we can find information we already knew just from taking science classes. I'm not a big fan of being self-taught generally... We looked at a lot of videos about open access and we had to decide which parts we wanted to use. We are thinking more about the social consequences because you mentioned that we were focusing too much on costs… We are rethinking that part."*

Because of her familiarity with their topic, Vanessa contributed to her team starting their game designing earlier than other groups.

Game development was mainly done outside the class. Groups used *Google Docs* to share and edit their trivia questions and game scenarios. Games were only brought into the classroom for play testing.

Distributed Leadership

No team recognized a single individual as a team leader. They expressed having an all hands on deck approach, doing what it took to develop the game. Team tasks were divided based on the strengths of team members. As noted by Diana in her first individual assessment

> *"I think we work well together because we all have different strengthens. Bruno is the create side, Edgar comes up with logistics and rules, I'm good at finding articles and facts to use."*

Other groups mentioned similar views regarding their members' diverse strengths. Every group member was charged with developing specific content for the game. Because there was only one in-class design session it was not possible to observe students developing their games over a long period. Recognizing the limitation of in-class design, the instructor gave students additional time (15mins) at the beginning of some classes.

As the class progressed some members took on a more assertive role. This was noted in some group discussions especially after the playtesting of the game draft. Vanessa was outspoken about inconsistencies noted by play testers and was in favor of doing an overhaul on the game. She also wanted include a new game mechanics, which meant inclusion of additional content. Her group members were not convinced enough time was available for changes. However, the endpoint was a positive resolution, but their extreme edits would not have occurred if not driven by her take-charge attitude.

Level of Participation

Most (8 or 80%) students maintained a high level of involvement in the game design activity. The same four point scale describe used at Site 1 was also utilized at Site 2. Students assess their team members over the four main game design phases. They assessed their team members based on the following: involvement in the design process, constructive use of class time, collaborating beyond their formal class meetings and contribution of original ideas. Table 4.12 shows the frequency of high ratings (4) by their team members. Students rated their peers at high levels of participation over all game phases. As expected, group members gave Bruno

(Group 1) low participation scores (in all criteria) as the class progress. At the end of the class, his highest rating was 2, which was for involvement in the design process. Bobby received mid-range (2) scores from his peers during the design and draft phases. His peers rated him lower on the following criteria: constructive use of class meetings and contribution of original ideas. His peer ratings improved as the class progressed. Clint (Group 3) received low scores in the design and draft phases but his scores improved in the final phase. Group 3 did some significant redesign of their game after the play testing of their draft. According to Vanessa *"We all had to be on board; we really came together as a team, in the end."*

Clint's peers always rated him low on contribution of original ideas. This score did improve in the final phase; he mentioned coming up with the title of the game during their redesign. His lowest score in the final phase was 3.

Table 4.12 Relative Frequency of High Level Participation Scores over Game Design Phases at Site 2

Criteria/Phases	Concept	Design	Draft	Final
Very Involved in Design Process	100%	90%	80%	80%
Used Class Meetings Constructively	90%	70%	70%	90%
Collaborated beyond the Class	100%	80%	80%	90%
Contributed many Original Ideas	90%	70%	70%	80%

Most students were not experts in the content topic used for developing their game. They were unfamiliar with their topics, and spent significant time exploring online resources to understand. Because of this, they did not underestimate the time needed to develop their game. Students worked together to develop simple games. Members from Group 1 and 2 noted that most of their time was spent trying to understand the topic as opposed to developing a complex game which could break when play tested. These 2 teams did not do significant revisions to their game idea after the concept presentation. For example, Edgar (Group 1) noted that they agreed on the first game idea that was proposed by Bruno. Members of Group 2 considered different trivia games but stuck with their original game mechanics. Time limits did not allow them to elaborate or fine-tune other ideas they had considered during game exploration. Group 3 was able to pay more attention to their game design because of the knowledge expertise of a team member. They did significant revisions after the playtest of their draft. Vanessa (Group 3) chose privacy as the group topic because she was familiar with students concerns regarding online reputation. In class conversations, she talked about having friends who were not successful in college applications because of questionable Facebook postings. Her experiences helped in focusing the context. She was passionate about privacy, and successfully convinced her group to choose the topic. However, she did not see herself as an expert on the topic, but having a context gave the team an upper hand on figuring which resources to use when developing their game. Therefore, after their draft version was play tested they did not need to make changes to their content and were able to redesign their game board, include additional mechanics and content.

4.2.3.2 Sharing Among Class Members

Peer assessment is one of the ways in which students internalized characteristics of quality work by evaluating the work of their peers. This section discusses these sharing experiences among students outside their groups. This was mainly done by having other groups play test the games they developed.

4.3.2.3 Structured Peer Sharing

Opportunities of sharing their game among class members challenge groups to reflect on their ideas and design choices. All students responded positively to peer sharing and implemented suggested peer revisions. Feedback was recorded using peer review assessments (See Appendix J). The instructor first reviewed assessments before sharing with teams. This was done to ensure feedback was constructive and students were respectful. There were no instances of comments to cause negative emotions and students were very helpful and reflective in their suggestions. Students interacted without instructor's prompting during these 5 sharing sessions. In fact, discussions had to be facilitated by the instructor so that everyone had an opportunity to be heard. Time needed to play test game drafts spilled over into the following week because of the extensive discussion that ensued after each game was played. This willingness for student to interact in class presentations was surprising for the instructor. She noted that in her prior classes it was always difficult to get students to provide feedback.

Group members relied on these peer-sharing sessions to work out their game mechanics concerns in the draft versions of their games. Hannah noted that there was not enough time for them to play test as they would have liked, because exploring their topic and developing their trivia questions took considerable time. Because students were unfamiliar with most game topics, peer suggestions were around game play and mechanics.

For example, when playtesting Group 3's draft game, because of the many negative scenarios some players were unable to move forward. The team realized that they needed to include additional mechanics to offset this issue. These problems were worked out with peers as they helped them figure alternative solutions. This was done by incorporating trivia aspects at certain points in the game. Peers also suggested improvements in their game board which led them to the idea of individual game board.

Other noted examples suggested by peers was the addition of cards that allowed players to keep the turns the accumulated even if they responded incorrectly to their question. This was an addition to groups' scientific misconduct game. Inclusion of this feature helped players progress through the game more quickly and broke of the monotony of just answering trivia questions. Peers also helped Group 1 in brainstorming a game title. Group 2 incorporated the money idea into their Open Access game. Their peers suggested that having a physical representation of money gave the player a sense of helplessness when money ran out and they were unable to purchase access to articles. Students noted the effectives of peer sharing and the importance of receiving feedback from different perspectives

When content was too minimal or misrepresented, the instructor and researcher got involved in the discussions. A significant amount of time was spent discussing Group 2's representation of open access, which was addressed as being a convenience for students. The instructor advised them on also considering the civic responsibilities of scientific community to make their research findings more visible. Discussions like these occurred at the class level, so that all students benefitted from the conversation. This was similar to a teachable moment to the class. The instructor was seen as the authority regarding the content, and when unsure about their content, group members shared their draft versions for approval.

Having the opportunity to play games on multiple occasions during the final play test enhanced students' understanding of the topic. The instructor viewed game playing was a more effective way for students to understand the topic. She noted that compared to previous information literacy classes' experiences students seem to learn more from playing each other games. Noticeable differences such as student's engagement with each other games as compare to the passively listening to their peer's presentations with bored expressions. Because the game was used to teach the topic, an entire class was dedicated to each group. Students played the designed game on multiple occasions and noted that it helped in understanding the ideas the group was trying to get across in their game. According to Bobby, *"I got a better hang of the disrepute game the second time. Glad I played that round, I could answer the question."*

Students noted that revisiting the questions and scenarios was a fun way of learning the topic.

Ownership

Despite the challenges experienced in understanding their game topic students took personal responsibility to develop a game that was easy to play yet accurately teaching concepts. Some members went beyond to ensure peers saw their games in a positive light. In light of Bruno struggles with developing trivia questions for their game Diana took it upon herself to create additional questions. According to her, *"We could have reduce the number of questions.…Just wanted to be sure we did not fail in front of others. It was not too hard. I really understood scientific misconduct. I will be working in a research lab, so it is important for me… I developed multiple choice questions, just in case."*

She mentioned that these questions were not shared with others, but she felt comfortable having a backup. Group 4 did last minute redesign on their game. Even though Vanessa drove this, she took it upon herself to do most of the changes. Allison noted that she was instrumental in getting the final version done and took on most of the game board redesign. Vanessa expressed gratefulness for the extra time *"Thank goodness we were the last to go. It played so much better with the changes. We all thought so.…"*

In their interviews, students talk about their final finishes and weekend meetings to play test to ensure the game "*did not break*". A concern for all was the wording of questions. All were critical of this and noted in their final reports further improvements were needed here if more time was available. Even though, Bruno wasn't the best team member he talked about holding his breath when players read his questions. He noted, *"I know I did not do a good job with some of them, and I was hoping that they understand the questions. Some did not read well. I know some bombed"*

As expected, his team members were not too happy with the inclusion of unedited content but acquiesced when the instructor asked for the work to be included. Group 2 felt that the editing cycle was helpful in revising the content. Jessica noted, *"Tweaking the game, it was interesting because rather than just myself understanding it I had to make sure everyone else understood it. That was an interesting part of it. More engaged with the content."*

Articulating Understanding

Through sharing among class members students were given the opportunity to provide feedback by expressing their ideas. Feedback from students was mainly about game design aspects since most were unfamiliar with the topic. However, it was an opportunity for teams to be seen as the experts on the topic and respond to questions. When their peers expressed disbelief about Mendel and Newton misrepresenting data, Diana (Group 1) was able to talk in detail about the arguments within the scientific community supporting this theory. Group 2 members got into details about the publication cycle and increasing journal costs in the scientific community and Group 3 elaborated on cases resulting from concerning privacy statistics. Opportunities likes these allow students to reflect on the topic, incorporate the concepts they explored into their own thinking and share their interpretations.

4.3.2.1 Unstructured Peer Sharing

Peer sharing did not extended beyond those structured into the class. This could be attributed to just having one class design session. When additional design time was given groups just interacted with their members.

4.2.4 How do undergraduate students represent information literacy concepts in the game-based artifacts they design? – Site 2

This question addresses the ways students incorporated information literacy content into their games. Data analyzed from observations, individual assessments, final report and responses from interviews was used to answer this question.

Students spent most of their time becoming familiar with their game topic. Most classes focused on playing various iterations of the designed games, therefore students developed most aspects of their game outside the classroom. During the one in-class design session, groups chose to spend the time exploring resources about their topic. Extra design time, given in later classes was spent making edits to trivia questions and cards. Learning objectives were only developed when groups felt they had a good understanding of their chosen topic. At the demonstration of their draft game students articulated these objectives, but mentioned that they were still tying them with the trivia questions they were developing. Therefore, most of their game design was done after the demonstration of the game draft.

Students were given the freedom to design any type of game and chose to focus their design on tabletop trivia and scenario games. They noted that most library games were developed in this manner and regarded it as the best approach for delivering their topic. Therefore, their content was extrinsically integrated using ideas from mainstream games.

Table 4.13 shows the games that were developed at Site 2. Group 1 overlaid trivia questions on a skill game, *Washers Game.* Group 2 attributed their game idea from the game show *Who Wants to be a Millionaire* but deviated from the rules after the demonstration of their game draft. Players unfamiliar with the game show found the game play too cumbersome. Eventually they described their game as a simulation, where a student without library access tries to locate articles online by making decision on whether to pay to access resources or respond by just reading the article abstract. Group 3 used a combination of game mechanics from *Life, Wits and Wagers* and *Candyland*.

Games developed by Groups 1 and 2 games were mainly trivia with some subtle aspects to improve game play. A sample of the questions developed by these groups and the information literacy skill tested by the player is shown in Table 4.14. These questions were aimed at helping the player understand the game topic. Since students had no prior instruction about the topic, their correct response to questions was mainly through recall from prior gameplay activities. Most (9 or 90%) students, mentioned being able to win the game by recalling or guessing correct answers. In the interviews, Noah and Jessica stated that they recalled the correct answers but did not always understand the reasons behind the correct responses. Players drew on a lower order of cognitive skills (remembering) when playing. Group 2 used trivia questions to simulate the article the player was trying to access. Group 3, exploited mechanics from various games and did not rely heavily on trivia questions. Instead, they used scenarios of good and bad Facebook privacy practices to move players on the board. Table 4.15 provides the title, description and the learning objectives of the games developed by the 3 groups. In addition, Appendix N provides illustration and a more detailed description of these games developed at Site 2.

Table 4.13 Description of Games Developed at Site 1

Group No./ Game Title	Game Description	Stated Learning Objectives
1. Scientific Misconduct: The Game of Disrepute	Group 1 designers used game mechanics from *Washers* game and *Monopoly*. This was a trivia game with multiple choice and True/False questions. ACRL Standards addressed in game play: 3	1. Identify the various forms of scientific misconduct 2. Understand the history of scientific misconduct 3. Understand the importance of reporting instances of scientific misconduct 4. Understand the importance of communicating results with other scientist to avoid bias and gain credibility 5. Apply knowledge learned to evaluate credibility of research and conduct own research ethically.
2. To Free or Not to Free	Group 2 designers develop a game that used the money feature from *Monopoly* and competitive trivia from *Who wants to be a Millionaire.* This game simulated the costs undertaken by the player when an article needed to respond to a question is not openly available. ACRL Standards addressed in game play: 1, 5	1. Understand that open access is necessary to find information. 2. Understand cost to access databases, and the potential barriers to furthering knowledge.
3. Facebook: The Privacy Crook	Group 3 used game mechanics from *Life* and *Candyland* and *Wits and Wagers.* Some trivia components were included at the beginning, but the game mainly featured scenarios of responsible usage and misuse of Facebook. ACRL Standards addressed in game play: 5	1. Understand the importance of managing online reputation 2. Understand ways to be privacy aware.

Table 4.14 Sampling of Questions Developed by Groups 1, 2 and 3 at Site 2

Examples of Questions	Information Literacy Skills Tested by Players
Group 1: Scientific Misconduct: The Game of Disrepute (90 questions)	
1. It is acceptable to only provide readouts of data and not the methods used (True of False) 2. The invention of data or cases is known as ,,,? 3. Tuskegee Syphilis Study involved over 400 men. The experiment was used to study blood of poor African Americans. This was not only a breach of human rights but also…? 4. What are good ways to prevent plagiarism?	Understand the importance of conducting good research and the potential consequences of being dishonest when reporting research findings. behind avoiding plagiarism
Group 2: To Free or Not to Free (20 questions)	
1. What are the two degrees of open access? 2. It is reasonable for a single library to purchase subscriptions to every journal so there is no real concern over Open Access (True or False) 3. What are some of the ways authors can provide open access to their research?	Understand the many economic issues and costs surrounding access of information
Group 3: Facebook: The Privacy Crook (10 questions)	
1. What feature of the Facebook caused the "opt-in" controversy that was regarded as an invasion of privacy? 2. How many active users are there on Facebook? 3. From the 500 top colleges, how many admissions officers acknowledged looking at social networking sites such as Facebook to evaluate applicants?	Understand the importance of maintaining a good online reputation.

Playing games as teams were regarded as a more engaging approach to trivia games. Groups recommended that their games be played as teams because players were unfamiliar with the content. They felt as teams, players could collaborate and there was greater involvement in the game. As Edgar noted, "*We wanted people to cooperate together to answer the questions, scientific misconduct is new and together they could make an educated guess*"

Despite developing trivia games, most groups were not comfortable to begin designing until they had a good understanding of the content. Most (5 or 50%) students felt they could have developed better games if they had an earlier start. Two groups mentioned having to understand the content in its entirety before discussing their game ideas. Group 1 went with the first idea proposed, without making any significant adjustments to the game they modified. Group 2 members talked about trying to figure out the big picture when it came to their topic, open access, and discarded many of their initial ideas. Groups 1 and 2 were observed spending most of their design time searching online databases and library research guides for further information on their topics. Table 4.16 shows the tasks students recalled doing to locate sources about their topic. Only Group 3 were confident about their content and developed their game cards in the classroom. Having a team member (Vanessa) knowledgeable about privacy and online reputation management helped them over the hurdle of relating to their topic and finding resources to help build their content scenarios. They spent much of the design session huddled at the back of the class working on their game cards. Despite having a more developed game in their draft demonstration, they did significant redesign because they did not extensively play test their game.

Group members gather most of their topic information from online resources. They all found YouTube videos as instrumental in jump-starting their ideas. Most members (4 or 40%), especially those of Group 2 did not use topic resources listed in the course website, because they forget about them. According to the instructor, usage of the course website has always been problematic, so this not surprising.

Table 4.15 Tasks Undertaken by Students to Develop Games

Reported Tasks	Percentage of Students (%)
Identify appropriate databases	100%
Fine tuning search strategies using various online databases	100%
Using Google Scholar	100%
Exploring other library games	100%
Using You Tube videos	100%
Evaluating online resources	80%
Exploring online catalog	80%
Reviewing the library’s website (research guides)	80%
Online Class Resources	60%

The instructor used ACRL Standards to guide the class learning goals. Table 4.17 lists the standards and performance indicators that were used to meet these goals. Group members made extensive use of their information literacy skills from other classes to locate sources to develop game content. According to the instructor, game topics expanded on introductory concepts covered in previous classes and assisted outgoing students in being responsible and ethical digital citizens in their respective professions. The fifth ACRL standard was address by their designed games.

Table 4.16 Performance Indicators Undertaken by Students to Develop Game Content

ACRL Standards	Performance Indicator	Groups
Standard One: The information literate student determines the extent of the information needed.	Student can interpret research topic define, articulate and decide what sources would be most appropriate.	All groups - locating resources for game topic
Standard Two: The information literate student accesses needed information effectively & efficiently.	Students able to use advanced search strategies like Boolean operators, truncation, and keyword generation as they search for relevant sources. Make suggestions to improve effectiveness and efficiency.	All groups - locating resources for game topic
Standard Three: The information literate student evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system.	Students evaluate sources critically based on currency, relevance, accuracy, authority, and purpose. Based on these criteria, they select appropriate sources.	Group 1 incorporated some aspects.
Standard Four: The information literate student, individually or as a member of a group, uses information effectively to accomplish a specific purpose."	Students work in groups and applies new and prior information to the planning and creation of the game. They revise the game based on feedback and are able to communicate the learning objectives, rules and other aspects of the game	All groups – games designed and played
Standard Five: The information literate student understands many of the economic, legal, and social issues surrounding the use of information and accesses and uses information ethically and legally.	Student understands many of the ethical, legal and socio-economic issues surrounding information.	All groups – games designed and played

4.2.5 What were undergraduate students' motivations to use information literacy practices they were exposed to throughout their class experiences? – Site 2

This question addresses observed changes by students in their use information literacy skills during and after taking the class. To respond to this question, data obtained from completed IMI, class observations, individual assessments and interviews were used.

4.2.5.1: Intrinsic Motivation Measure at Site 2

Most 7 (70%) students of both genders at Site 2 remained intrinsically motivated over the duration of the class. Perceived competence and perceived choice are regarded as behavioral measures of intrinsic motivation. Perceived competence was maintained over the class, but 4 (40%) male students reported a decrease (Table 4.17). In the interviews, these students noted that the lack of prior knowledge in the game topic made the game design process difficult. One of the students in this group became disengaged in the design process, as an understanding of the topic became a prerequisite in game development.

Providing choice supports a students' experience of autonomy. This is reflected in the increased perceived choice by reported by 9 (90%) students. The researcher observed that students did not appear to be very apprehensive about the game design activity at this site. The tension at the beginning of the class was low and there was a further decrease reported by 9 (90%) students.

Table 4.17 Means from IMI subscales at the Beginning and End of Classes at Site 2

Site 2	Interest/Enjoyment		Perceived Competence		Perceived Choice		Pressure/Tension	
	Begin	End	Begin	End	Begin	End	Begin	End
Male	6.1	6.1	5.4	5.0	5.7	6.0	2.0	1.6
Female	5.7	5.8	5.6	5.6	5.8	6.4	2.2	1.4
All Students	5.9	5.9	5.5	5.4	5.8	6.2	2.1	1.5

These scores are supported by class observations. From interview responses 9 (90%) students responded positively towards the class experiences. Edgar mentioned that he did not like the game design approach even though from class observations he was engaged in team activities. According to him

> *"If I didn't need the credit I was thinking about dropping the class...I took the class because I haven't had the library research transferring back in as a science student from finance...and I took it because I wanted to learn how to do some of the library research stuff. ...I did not care for the group work. It was better than I thought it was going to be, and I think, I don't know, if this game design is worth this type of class. I think it would be better for education-type class where, especially like elementary education, where this is part of what they're doing. For science students, especially planning on going on to graduate school, I think the research component might have helped more...We devoted a lot of the class to the game project. ...A lot of time devoted to the game project and not the actual database searches, which is what I signed up for, yeah.... So I ended up enjoying it a lot more than I thought I would, you know, but it is not my style for learning."*

He also mentioned

> *"I just wouldn't devote so much in-class activities and take away from actual lecture time ....I mean, I learn best by sitting in class in a lecture taking notes with no participation at all. That's how I do best in my classes, so ... collaborating is ... gets in my way, instead of try interrupting to participate or to share ideas...that's just my personal learning style, which I like."*

Edgar did reiterate a number of times in the interview not expecting to enjoy the class and engaging with his team, even though it was not the approach he was expecting from the class. Since, Edgar did enjoy the class, despite his dislike of the approach and his observed participation in class activities could explain his self-reported motivation scores being maintained over the class duration.

4.2.5.2 Students Application and Transference of Learned Skills at Site 2

Students created games around topics that underscore information literary as a lifelong skill, but not all related to its importance in this way. Table 4.18 lists the improvements and awareness in information literacy skills articulated by students in interviews. Group 3's privacy game was relatable to all, students understood the consequences in being irresponsible about their social media presence and in interviews talked about the tips and alarming statistics they learned from this game. They also discussed their responses to this information. All mentioned adjusting or double checking their privacy settings, and being more aware that their online presence did not represent them in a negative light. Since most (8 or 80%) students were heading off the jobs and graduate school the game helped in sensitizing them about the impact of their online reputation.

In class discussions, students never considered research fraud being present in published peer reviewed literature. In interviews, 6 (60%) students articulated the need to maintain some skepticism of all the materials they reference or use in their studies and research. Most (8 or 80%) understood scientific misconduct as plagiarism. Two (20%) of those students did not understand its impact on authoritativeness on scientific work. Half of the class did not understand the importance or impact open access played in the scholarly communication among scientists. Two (20%) of those were from Group 2 (developers of the open access game) who saw open access as a student concern, being accepting that all articles that were not available but could be accessed by using library services such as interlibrary loan.

Table 4.18 Improved Information Literacy Skills Reported by Students

Information Literacy Skill	Reported Improved Skills/Awareness
Managing one's online identity	100%
Potential hazards of not maintaining online privacy	100%
Implications of plagiarism in scientific work	80%
Importance of questioning and being critical of peer reviewed sources	60%
Importance of open access in science	50%

Students who designed the game were more knowledgeable about the topic drawing on a higher order of cognitive skills. They were able to gain an understanding through the research they conducted to develop the game content (trivia questions and scenarios). Because the content was not taught in the classroom and students were tasked with teaching the topic to the class through the game they developed, players found it difficult to relate to abstract topics such as open access and scientific misconduct. However, some students (Diana and Hannah) did note that they did significant exploration of online databases so they had a better understanding of the multiple online offering available through the library.

4.3 Summary

In this chapter, the findings from both sites are reported separately. As seen because the manner in which learning by game design was scaffolded into the information literacy classes there were some differences in students responses to the instructional approach. These differences will be the focus of the discussion in the following chapter through the cross analysis.

CHAPTER V

DISCUSSIONS (CROSS CASE ANALYSIS) AND CONCLUSIONS

5.0 Introduction

In this chapter, findings from cross-case analysis from the two cases are discussed. This is organized into two main sections. In the first section, the major findings from both sites are compared. This is organized by the specific research questions. In the second section, the conclusions are addressed, responding to the primary research question. Discussion about the implications to libraries are noted. The study concludes by presenting directions for future research.

5.1 Participants Demographics and Prior Experiences at Both Sites

Having prior experiences with games was not a class requirement, but studies show that when students can make connections with prior relatable experience their confidence improves (Kolodner & Guzdial, 2000). Consistent with the literature regarding the game playing behaviors of 21st century learners; games were an important feature in students' lives at both sites. Because of their prior game play experience, students were able to established personal and meaningful connections with approaches they were going to experience in the classroom.

There were gender differences regarding the types of games played, with males preferring video games. These findings are consistent with those reported by Fox & Tang, (2014); that is video games are still considered part of the male domain. They also noted that video game players regard themselves as having better gaming abilities. This notion has led to educators expressing concerns that only males favor games, therefore its introduction in the classroom is seen as unfair to female students. At both sites, male and female students were active game players. As Robertson (2012) noted in her study, when it comes to games, girls are not disadvantaged because many of them are experienced players. Also similar to Robertson study, male and female students in this study were active game players at both sites.

Students at Site 1 were beginning their college life, compared to those at Site 2 who were on their last stretch towards graduation. Therefore, Site 1 students were in a new transitional period, interacting with novel experiences and actively establishing new social ties, in the interest of potentially utilizing them for future support. Those at Site 2 did not have this same sense of newness, they were familiar with their space, having already established their social networks, and were more concerned about completing the requirements for graduation.

5.2 How can an instructor incorporate motivational theories into an information literacy class through "learning by game design"?

Given the innate interest of 21st century learners in games, many assume that students will naturally want to do game related tasks. Studies have shown that this is not always the case, and stresses that attention be paid to not only effective integration but student needs and acceptance of game activities in the classroom (Hastie, 2010). Both instructors addressed this by giving students the responsiblity for setting their own actions by providing choices which helps satisfy their need for autonomy and acceptance of the game design activity.

Students at both sites regarded themselves as competent in information literacy before the class began. This is a common phenomenon, where students have an inflated view of their skills. Miserandino (1996) notes the positive correlation between students who perceived themselves as competent and their intrinsic motivation. Therefore, students entered the class with a high level of competence. Through the instructional approaches offered through learning by game design students had opportunities to identify gaps in their knowledge by becoming more involved with the information literacy content. In addition, they were better positioned to resolve these gaps with peers through collaborative design activities

Having students interact with information literacy content using a combination of pedagogical approaches fostered improved relatedness among peers. Student relatedness was more pronounced at Site 1 because they were not only able to share ideas and suggestions regarding game mechanics but also about debate on class content. This also provided chances for experimentation, making and addressing mistakes, "safely" addressing any noticed gaps in their information literacy skills and peer teaching opportunities. The main reason for improved student relatedness was mainly that the information literacy content was scaffold into the class so that students had a solid understanding prior to game design. At Site 2 opportunities like these were limited because students were unfamiliar with the topics that were given to their peers, which limited classroom engagement.

Maintaining self-determination is a critical issue for most instructors and implementing motivating strategies is not a simple one-step process. The consideration made by both site instructors regarding meeting student's psychological needs was instrumental in maintaining students' motivation.

5.3 How does the "learning by game design" approach within information literacy classes foster the sharing of knowledge among undergraduate students?

Opportunities to work as groups during the learning process allowed students to assume different roles by encouraging them to support each other, reinforce their existing skills and view themselves as experts. The sharing technique of learners collaborating with more capable peers eventually resulted in reduced interventions by the instructor at Site 1. This however was not the case at Site 2 where the instructor was called upon for assistance on game content because the student had not been given ample information literacy education on specialized topics before being submerged into their game design.

Heterogeneous groupings based on experiences and demographics was done at Site 1 as opposed to random generation of teams at Site 2. These different strategies towards grouping did not make a difference in the way students engaged within their groups. It was noted that students at Site 1 were more enthusiastic about the how well their team worked together compared to those at Site 2. This could be attributed to them being new to college life and concerns about establishing social networks.

At both sites, students interacted well together, filtering their design ideas and solutions with expert members, teaching less knowledgeable peers, recognizing gaps in their own knowledge and working it through with team members, and addressing revisions in their game artifacts. Students addressed peers concerns as a team. There was no reporting of group leaders, even though some group members took the initiative to manage tasks. Group members did not challenge each other and were open to ideas when posed. Students' developed a sense of ownership of their own learning when it came to developing the game content. Group members willingly shared information and resources with each other in order to assist one another in making further sense of their learning and understanding. Novices were able to participate in skills beyond those that they were capable of handling independently. The internalization of the shared cognitive process by the novice extended their existing knowledge and skills. These findings concur with the views of the constructive theories posed by Vygotsky (1978), Papert (1991), Perkins (1986) and Kolb & Kolb, (2009) that is necessary in developing collective cognition.

Students at both sites welcomed feedback from other students in the class. They worked together to understand failure points in the game play, made suggestions for optimizations, and offered content suggestions and edits. At Site 1, peer sharing extended beyond the structured classes and because of this became less dependent on the instructor. Having the prior instruction in the class content assisted in students in becoming more independent in their learning and relying more on their peers. The entire class worked more as a collaborative unit where students were able to debate not on just specific aspects about their game but also such things as accuracy of each other's content. This was similar to Vygotsky's views of interaction, where students move closer to the zone of proximal development becoming less dependent on the instructor. This form of interaction did not occur at Site 2. This was mainly because students were unfamiliar with the content and therefore communication about the topic was limited within the confines of the group. Therefore, most of the assistance offered from non-group peers at Site 2 was focused on enhancements to the games that were created by their peers.

5.4 How do undergraduate students represent information literacy concepts in the game-based artifacts they design?

The primary purpose of information literacy is to enable student to apply higher order skills similar to those described by Bloom, (1956). Through the act of designing games, students were able to draw on a higher order of thinking. Students at both sites did modifications of existing games, at times combining game mechanics from multiple games. Since these games were used as a template, most of their game design activities focused on developing their information literacy content instead of developing game mechanisms. Through this activity, they were able to explore content in meaningful ways, engaging with information literacy concepts and fine-tuning their skills.

At both sites, through developing their game content students were able to meet the learning objectives of the class, addressing competencies articulated in the 5 ACRL standards. By employing cognitive skills from the lowest four levels of Bloom's Taxonomy - knowledge, comprehension, application and analysis - students determined their information needed, identified resources, and applied search strategies to locate resources for their game content. As groups, they were able to work together at the highest levels of Bloom's Taxonomy – Synthesis and Evaluation - to evaluate sources located and integrate them into their games. Having to develop learning objectives, analyze and integrate content into their created game, students drew upon a higher order of thinking having attained prerequisite knowledge and skills at the lower order.

This leads to an important finding; while information literacy skills tend to require thinking at the higher levels of Bloom's taxonomy to use in applied settings, most traditional library classes teach information literacy by using methods that address the lower levels of Bloom's taxonomy. Lectures and fact-finding assignments and activities do not require students to apply information literacy concepts at the higher levels of Bloom's Taxonomy (Yang & Chou, 2014). Therefore, students are unprepared when they are required to use those skills for more complex assignments.

Through learning by game design, students created information literacy games. This process required them to use higher order thinking skills to develop content for their games. Through the game design process students were able to break up concepts into parts and resynthesize those pieces as a group to integrate into their created artifacts. As a group, they needed to not only evaluate their own work but the work of other teams. Therefore, students required an understanding of the content to express their personal opinions and awareness of the connections of information literacy concepts to the research process.

This was especially notable at Site 1 where content was taught up front before the design activity. The activity of only playing games created by other groups did not draw out higher order of thinking skills since most games were predominantly trivia based requiring students' low-level skills such as recall, understanding meaning of terms and applying procedures. We saw that an active student-centered approach offered through learning by game design helped in better preparing students to apply information literacy to complex assignments and the real world situations.

Because students at Site 2 were unfamiliar with their assigned game topic, they did extensive exploration of library resources. However, because all students were knowledgeable of the content at Site 1 they were more engaged, as a group and with other peers. Students were in continuous dialogue with their own ideas and those of intended game players, which drove the game design process and nurtured continued exploration.

Despite the time spent to introduce students to game design basics and expose them to alternative ideas through designer games, they chose to develop their games around a trivia game model. Students extrinsically integrated information literacy content onto their game in the form of questions and non-decision scenarios. This was similar to Kafai's (1995) and Baytak and Land's (2010) findings, where most students overlay questions on their created game. Even though intrinsic integration positions the designer to think more deeply about the particular concept and extrinsic integration see game and content as unrelated, students still explored the information literacy in detail. This was noticeable at Site 2 where students spent most of time in game related classes trying to understand their game topic.

Student designers used a combination of close-ended and open-ended forms of trivia questions to keep the experiences of challenge and success at an optimum level. Table 5.1 provides a summary of the types of questions that were used in the games developed and the level of thinking it addressed among players. Closed-ended questions did not require the students to construct an answer themselves. Instead, the correct answer was among possible options. These types of questions were suitable in testing recognition; that is, the student's ability to recognize the answer, and were predominantly used for factual and procedural questions. Types of closed ended questions used were as follows:

- True-False questions were the easiest types used to address factual information that were naturally dichotomous.
- Multiple-choice questions were regarded as being more difficult because students had to recognize the correct response from more choices. At times, there were multiple correct responses.
- Matching questions was the most challenging among this group, keeping the probability of guessing low. Students responded correctly by recognizing associations.

Open-ended questions were considered the most difficult in the trivia category and were predominately short-answer or fill in the blank questions. To respond to these question students were unassisted with choices. Therefore, they needed to recall information rather than answer by recognition. To add more complexity to trivia, some questions were built around scenarios that required students to first think with the information provided in order to determine the correct response.

Some students incorporated simulated events in their trivia games. Scenarios were constructed with details on an incident that occurred and the actions taken. This mechanic was used in games with card drawing spaces that resulted in moving the player on the board. It served as interplay between player's luck and skill. Therefore, players were made aware of consequences of good and bad scenarios but were not actively involved in making meaningful decisions. True simulations were more immersive and attempted to help players understand the situation by imitating the real world process. This required some form of decision making from the player.

Players' progress in the games was mainly done through recalling memorized knowledge correctly. The trivia model was very similar to the library games the students explored. Taking into consideration the cognitive objectives of Bloom Taxonomy, students created games that required lower level skills compared the tasks done to develop game questions (Table 5.1). Players depended on learning the content only through playing games created by peers, engaging in a lower order of thinking. This was especially noted at Site 2 where players drew on memory (recognition and recall) to respond to trivia during multiple play sessions.

Table 5.1 Summary of Design Characteristics of Student's Games

Sites/ Student Groups	Game Title	ACRL Standards Addressed in Game Design and (Game Play)	Game Mechanics	Bloom's Cognitive Levels Used in Game Design	Bloom's Cognitive Levels Used in Game Play
Site 1 - Group 1	Trivial Searchopoly	Standard 4, (1, 2, 5)	Trivia (Multiple choice, True-False, Short answer. Ordering)	Knowledge – Remembering, Comprehension Understanding Application - Applying Analysis – Analyzing	Knowledge – Remembering, Comprehension Understanding
Site 1 - Group 2	Library Rush	Standard 4, (1, 2, 5)	Trivia (Multiple choice, True-False, Short answer). Scenarios	Knowledge – Remembering, Comprehension Understanding Application - Applying Analysis – Analyzing	Knowledge – Remembering, Comprehension Understanding
Site 1 - Group 3	Connect Trivia	Standard 4, (1, 2, 3) .	Trivia (Multiple choice, True-	Knowledge – Remembering,	Knowledge – Remembering,

Sites/ Student Groups	Game Title	ACRL Standards Addressed in Game Design and (Game Play)	Game Mechanics	Bloom's Cognitive Levels Used in Game Design	Bloom's Cognitive Levels Used in Game Play
			False, Short answer)	Comprehension Understanding Application - Applying Analysis – Analyzing	Comprehension Understanding
Site 1 - Group 4	Internet Land	Standard 4, (3)	Scenarios, Trivia (Multiple choice)	Knowledge – Remembering, Comprehension Understanding	Knowledge – Remembering, Comprehension Understanding
Site 1 - Group 5	Climate Change Citation Match	Standard 1, 2, 4 (5)	Trivia (Matching)	Knowledge – Remembering, Comprehension Understanding	Knowledge – Remembering, Comprehension Understanding
Site 2 - Group 1	Scientific Misconduct: The Game of Disrepute	Standard 1, 2, 4, (3, 5)	Trivia (Multiple choice, True-False, Short answer)	Knowledge – Remembering, Comprehension Understanding Application - Applying Analysis – Analyzing	Knowledge – Remembering
Site 2 - Group 2	To Free or Not to Free	Standard 2, 4, (1, 5)	Simulation and Trivia (Multiple choice, True-False, Short answer)	Knowledge – Remembering, Comprehension Understanding Application - Applying Analysis – Analyzing	Knowledge – Remembering
Site 2 - Group 3	Facebook: The Privacy Crook	Standard 1, 2, 4, (5)	Scenarios, Trivia (Multiple choice, True-False, Short answer)	Knowledge – Remembering, Comprehension Understanding Application - Applying Analysis - Analyzing	Knowledge – Remembering, Comprehension

( ) Indicates that these ACRL standards were addressed in game play as well as game design
[1] See footnote for description of ACRL Standards

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[1] ACRL Standards
Standard One: Determines the extent of the information needed.
Standard Two: Accesses needed information effectively & efficiently.
Standard Three: Evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system.
Standard Four: Individually or as a member of a group, uses information effectively to accomplish a specific purpose.
Standard Five: Understands many of the economic, legal, and social issues surrounding the use of information and accesses and uses information ethically and legally.

Overall, the process of developing games was more meaningful and engaged students in higher levels in the cognitive domain. Playing peer designed games allow students to demonstrate knowledge of concepts. This mainly helped towards achieving the foundational or lower learning skills (remembering, understanding, applying). Through the design process of developing trivia questions, scenarios and simulations students were encouraged to follow their own paths through the content, access secondary content, and create interactive activities that help them assess and evaluate, connect ideas, and create their own solutions in their games, therefore achieving higher levels (analyzing, evaluating, creating).

5.5 What were undergraduate students' motivations to use information literacy practices they were exposed to throughout their class experiences?

Even though students entered the class with different levels of intrinsic motivation, with the integration of learning by game design, this improved at both sites. There were improvements in IMI scores at both sites; exception to this were male students at Site 2 who reported lower perceived competence scores at the class end. This was attributed to the minimal guidance offered to students regarding their game topic. Instead of the instructor presenting essential information that students needed; her guidance was limited to offering introductory resources which students built upon as they explored their topic as a group. Constructivist approaches stress the importance of learners being engaged in constructing their own knowledge (Mayer, 2004). An assumption among some instructors is a minimal guided approach to discovery helps in the learning process. The use of this approach at Site 2 was not very successful and could have been solved with better support and scaffolding between the students and the content by the instructor.

An interesting finding was the initial IMI scores at Site 1, which were lower on all subscales, except perceived competence. Even though most students at Site1 had taken the initiative to complete the information literacy class early in their college life, as opposed it just being a requirement for graduation in their senior year they did not come into the class highly motivated. However, at the end of the class the IMI scores had increased markedly in all subscales. In comparison, students at Site 2 reported higher initial IMI scores and these were sustained to the end of the class. These high initial scores may have resulted from having prior contact with the instructor in one-shot information literacy classes. Therefore, students were familiar with the instructor and her teaching style. Despite male students having reported more experience in playing various types of games. At Site 2 inadequate scaffolding contributed to low scores in perceived competence among male students.

Students at both sites reported improvements in various information literacy skills. Even though students reported being familiar with information literacy concepts, they were still challenged by the class material. Through the practice offered by developing game content, they were able to address gaps in their skills. Those at Site 1 were able to make explicit connections between the information literacy skills they learnt for academic work as transferable to everyday activities. This was not very apparent at Site 2, as those who were involved in the design process mainly understood the topics. Those who only played games at Site 2 did not have a good enough grasp of the abstract concepts taught in the games to transfer to other situations.

An exception was the Facebook (online reputation) game, which was relatable to students. They were more aware of the importance of maintaining their privacy in public forums and playing this game created awareness and prompted action. The learning objectives of content from other games were not clearly understood. This was mainly because the instructor provided minimal guidance in topics that were used to design games. Only game designers explored their topics, deeply with other students exposed to the content only during game play. Since these games were largely trivia, their learning was limited, because they did not have a sufficient understanding of the concepts to perform well in these games.

Through designing process and the playing of peer created games students addressed the performance indicators the instructors used from the ACRL standards[2]. Students at Site 2 addressed different aspects of Standard 1 during their game design because they were tasked with finding information about a particular topic. Their exploration was more situated on topic, identifying the best online sources to use for their inquiry, and used background information located in general sources to develop their understanding, which informed the search terms used in more specific online databases. At Site 1, many students were not focused on one topic (with an exception of Group 5), they did however illustrate a sense of identifying the best subject specific sources to use for explicit questions. This understanding was articulated in the trivia questions developed for their games. In addition, students were able to articulate on such concepts as publication cycle by describing experts on different topics in their games. They also developed trivia that asked players about the value between popular and scholarly, and primary, secondary and tertiary resources and locating resources beyond local sources (interlibrary loan, other libraries through *WorldCat*) Therefore, by playing the games developed at Site 1 by Groups 1, 2 and 3 players were informed of some of the outcomes stated in Standard 1.

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[2] ACRL Standards
Standard One: Determines the extent of the information needed.
Standard Two: Accesses needed information effectively & efficiently.
Standard Three: Evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system.
Standard Four: Individually or as a member of a group, uses information effectively to accomplish a specific purpose.
Standard Five: Understands many of the economic, legal, and social issues surrounding the use of information and accesses and uses information ethically and legally.

Based on the performance indicators, students at both sites addressed Standard 2, demonstrating the ability to construct search strategies using commands such as Boolean operators, truncation, wildcards, and proximity. Students at Site 2 used these search statements for finding information about their game topic. Those at Site 1 articulated these strategies in their game questions. In addition, students at Site 1 also discussed exploring authorized subject headings and descriptors to improve their search results. There were a number of trivia questions addressing this standard in the games developed by Groups 1, 2, and 3.

Not all groups at Site 2 addressed Standard 3. Group 1's game adhered to this standard by focusing on the steps that might help a reader identify deception in scientific publications. At Site 1, Groups 1, 3, and 4 included questions and, occasionally, scenarios that helped the player become more aware of the steps necessary to ensure that journal articles, news articles, and claims were authoritative and contained minimal bias. Students from these groups had to understand the criteria for evaluating sources before incorporating it into their game.

Through design activities, students at both sites were able to work together to create a product, thus representing the skills required in Standard 4: organizing content, articulating knowledge, and demonstrating their ability to support planning, presenting, and demonstrating the game they developed.

All groups at Site 2 represented Standard 5 in their games. Students explored the specifics from this standard in the design process. Group 1's game addressed the issues surrounding the ethical use of information, Group 2's game provided insights into the economic aspects surrounding information, and Group 3's game helped players become aware of the importance of maintaining their privacy and reputation online. At Site 2, students from Groups 1, 3, and 5 explored documentation styles to record bibliographic information. However, Group 5 was more explicit on this topic because it was the focus of their game.

Through the game design, students required conceptual understanding to develop the game content, which thus addressed most of the ACRL standards. Site 1 games represented several ACRL standards. Site 2 games addressed only Standard 5, but, through the design process, students became savvier about information literacy.

At Site 2, the concrete experience step of the experiential cycle, where connections are made to the topic was not addressed. Kolb refers to this as a requirement since it allows students to engage in the cognitive and affective domain. Learners input information from concrete experiences and process information from either internally from engaging with on the experience (reflective observation) or acting externally on the conclusions drawn (active experimentation). Even though content covering introducing the topic was made available, this was not utilized by students, therefore engagement with these resources was minimal. Perkins, (1987) also noted that cognitive transfer to new situations rarely occurs automatically and without suitable instruction, students are less likely to be capable of applying higher-order thinking skills to novel situations.

5.6 How can an instructor incorporate motivational theories into an information literacy class through learning by game design and how do students engage with the content and each other in this environment?

The findings from this study lead the researcher to conclude that learning by game design is a viable option for teaching information literacy classes, regardless of the student gender. It can serve to stimulate student interest and persistence in engaging with the content that has a reputation of disinterest among students. It can potentially modify the way students think about their information literacy skills they acquire and help in relating to other non-academic situations. This study findings show that when learning by game design is applied effectively, student engagement with content is improved in several ways. This includes an increase in intrinsic motivation, higher participation levels at class activities, deeper interaction with class content through the usage of various research methods and reported improvements in information literacy skills and ability to transfer skills to novel situations.

The goal of the incorporation of learning by game design in the classroom is to draw the student learning curve dynamics nearer to Vygotsky's zone of proximal development with the instructor functioning as the knowledge mediator. Therefore, the intent is, students are pushed by their own intrinsic motivations rather than being pulled into the learning process by the instructor.

To achieve this there are a number of considerations when integrating learning by game design as an instructional approach. Through learning by game design, innate psychological needs were met by offering student choices and opportunities for improving competence and relatedness. Social interactions were successfully scaffolded, with instructor supporting peer interactions and encouraged sharing of knowledge. Peer sharing was helpful to students in terms of improving their understanding, creativity and their self-determination. From Vygotsky's perspective, through intersubjectivity, joint problem solving occurred among students leading to shared understanding. The game design process better enabled contextualized learning that was meaningful and useful through meta-cognitively guided processes.

Content teaching should begin with a traditional instructional approach and move towards a constructivist approach. As seen in Site 2, game players were only involved in discussions about developing game ideas, designs, and strategies but not the fully grasp the topic.

Therefore successful implementation depends on effective scaffolding of content necessary to engage in game design activities. As noted by Mayer (2003) for meaningful learning to occur the leaner must be able to select relevant information, organize it into a coherent structure and integrated it with organized knowledge. Therefore, giving students the freedom of interacting with content through pure self-discovery may lead to failure of coming in contact with relevant materials to be learned as well as understanding its context and application.

Findings from this study show that this absence of guided traditional instruction resulted in the negative consequences when it came to providing supportive assistance to the learner within the parameters of the zone of proximal development. At Site 2 where learners were unguided in the explorations of their game topic, the experience to gain the required knowledge, skills and confidence to cope with the full complexities of the abstract contexts was not fully realized. At Site 1, the instructor attempted to address content before game design using more traditional instruction approaches, resulting in better learning of content.

This study's findings provides insights in the process by which learning by game design affects students as they develop their understanding by designing and sharing their created artifacts. Scaffolding content makes learning more manageable by making complex tasks more understandable within the learner's zone of proximal development (Vygotsky, 1978). Addressing content needed to develop games was crucial in the success seen at Site 1 and students became less dependent on the instructor. The limitations of self-guided approaches at Site 2 were apparent, as students were not primed to take responsibility for their own learning and relied on the instructor guidance throughout the design process. They did not have a good grasp of the content needed to develop their games, which impacted negatively on their motivation. This resonates with Bloom's Taxonomy, which states that remembering and comprehension (lower-order thinking skills) are crucial because they form the foundation for a student to transfer the skills to novel situations (higher-order thinking skills). Therefore, students needed to have an understanding of the content before being confident enough to transfer that knowledge over to the game they designed.

The researcher concludes that the instructor needs to play a continued supportive role throughout the entire process of learning by game design that begins as a sage on the stage gradually transitioning to a guide on the side. This is made more apparent by including the instructor's role in the phases of the game artifact design shown in Figure 3.2. This modification highlighting the role of the instructor is illustrated in Figure 5.1.

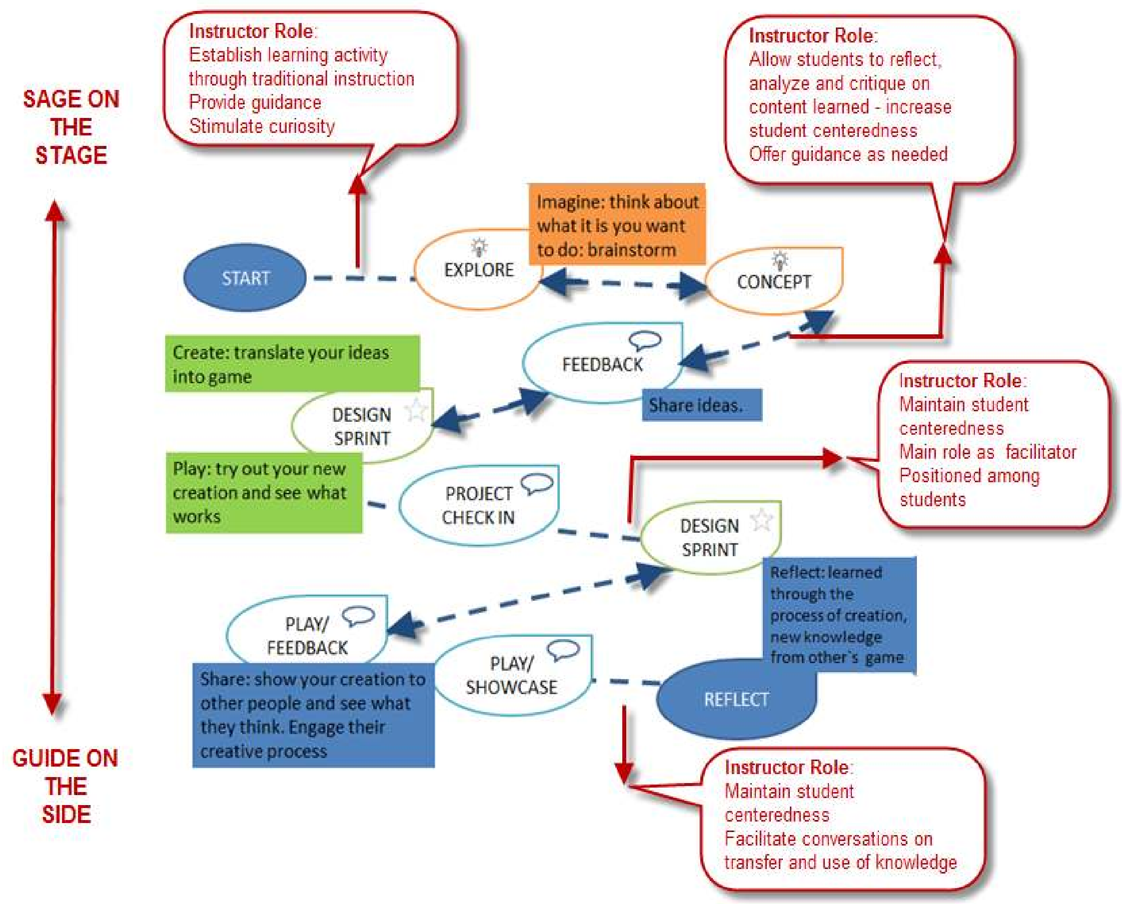

Figure 5.1- Instructor's Role and Actions in Learning by Game Design

Learning by game design supports a number of teaching strategies, all of which requires continued instructional support. The importance of a balanced approach to instruction as a sage on the stage and a guide on the side is emphasized in Figure 5.1. A more traditional form of instruction is useful at the beginning stage. This approach complements the student-centeredness as some depend on traditional structure of instruction before venturing out on their own exploration of content (Walsh, 2011). The instructor plays a more dominant role in transferring information, establishing objectives behind the learning activity and showing its importance of the content to arouse students' interest and motivation. Use of models and examples can be used to stimulate curiosity and help situate the content. It is important that the instructor has an understanding of what is known by students and fill in these gaps of missing information. One way is to ask students questions in order to help them establish links between what was learnt earlier and what is being addressed in the classroom. As the class progress, the instructor allows the learner to think through situations increasingly placing the learning responsibility onto the student. Eventually the instructor begins to remove themselves, as the person with all the answers. The class should increasingly become more student- centric allowing students to articulate their understandings and using their peers as resources. The instructor should therefore aim to give students a more autonomous role, responsible for their own learning. Therefore, the instructor role is to hand over the proverbial reins to the students thereby serving more as a guide on the side. As the guide on the side, the instructor role is about providing encouragement, leading students to the useful resources and articulating ways to help them stay on course so that they engage deeply with the content.

Overall, this study shows that learning by game design had positive learning outcomes in information literacy classes. Students assumed the roles as active learners, engaging with the content to become creators rather than passive consumers in the classroom.

5.7 Implications for Libraries

Within recent years, the increased number of studies looking at the potential of game design to teach students certain knowledge, skills and improve attitudes towards learning has begun to increase. The findings of this study help further the discussion by providing empirical support for the potential benefits of using learning by game design in instructional environments. The majority of literature focuses on the creation of online games. This work deviates by considering games more broadly and embracing the creation of game types on different platforms (physical or online). This consideration can potentially make the approach of learning by game design more acceptable, especially in libraries where limited knowledge in online game development tools can be a hurdle to adoption.

Within libraries, games have become commonplace, with librarians taking initiative to design games or game based instruction to support their teaching in information literacy classes. This study offers an alternative having students develop games thereby becoming active participants in their own learning. The efforts taken to design games for libraries will serve a better purpose if the design component is passed on to the student. The numerous hours taken to research and prepare library games engages the librarian who ultimately is the one who develops a sophisticated understanding of the content. Players of library games do not invest as much cognitive skill to engage and interact with the content as designers of the games, and therefore, develop a more superficial understanding. By placing the design role onto the student, offers opportunities for learners to engage and interact with content in rich and complex ways, allowing them to be more likely to develop a sophisticated understanding of information literacy content. The goal of the game design project is not the outcome of the finalized game, which will likely be weak as an educational tool, but the process of game creation.

Findings in this study show the learner as being involved in design decisions and developing their fluency in information literacy through learning by game design. More specifically, findings show increases in:

- engagement among students engagement in the classroom motivated to take control of their own learning
- opportunities for the practice of information literacy skills and concepts thorough game design and play
- student participation
- relatedness among students and with instructor.
- intrinsic motivation
- transferability of content

While the process described in this study was time consuming, taking most of the semester, it can be modified to fit within a smaller period. The Game Jam model has learners creating a game in just a few hours around tight constrains. This can be done by limiting the choices offered to students and creating a more in-depth template for them to follow. In addition, more traditional forms of assessment can be incorporated with game based evaluation to test learning in the classroom.

5.8 Limitations

Like any research study, there are limitations associated with this work. In this study, the convenience sample was limited to undergraduates. The sample was also limited in size, with only 22 participants at Site 1 and 10 at site 2. Because of the small number of participants, analysis of the IMI instrument was limited to a descriptive approach. In addition, regarding applicability, the findings should not be generalized to larger communities only based on this study.

It should be noted that not all instruction librarians will be motivated to try innovative ideas and therefore may not be willing to adopt learning by game design as an approach. As noted by Hall and Hord (2001) the comfort level with an innovation increases as the concern level decreases in the community. This was apparent in this study as librarians played safe by not being too restrictive in the game design activity. For example, when the researcher advised that students be asked to avoid trivia type games they were against the idea. Even though learning by game design has been explored and continues to be tested in other disciplines (see Table 2.1) the student-centeredness purported by this approach is still a novel idea in libraries.

On completion of the study, both instruction librarians found learning by game design as a better instructional approach than their more passive styles. Like their students, they felt that there was a good mix of game design activity and lectures. Overall, they noted that more students were engaged with the class content. The Site 2 librarian noted that having other students play peer created games allowed them to interact more with the content than approaches done in prior classes. According to her, students were tasked with preparing class presentations and many of their peers tuned out during their talks. She adopted the game design approach in her teaching making her classes more active through game based learning. She liked the idea of game creation but felt that students should be given a game template to design their games. From her perspective, this would make the activity more structured as she felt students struggled with developing good games. The Site 2 librarian also noted the potential benefit of providing more structured instruction on the topics used in the game design. She mentioned that having students in future classes play the games created in this study might be useful in helping pique interest. The instructor at Site 1 mentioned using game design in future face-to-face classes. She expressed interest in incorporating a pre and posttest so that she will have concrete figures to show the impact of the game design approach.

Despite the interest for continued use of learning by game design both librarians were concerned of about the time needed to implement. Both spoke about involving their student assistant to offset some of the tasks. In addition, they felt that there were too many assessments done during the design process. While they saw the value for research purposes, they noted that it should be reduced since submissions needed to be reviewed and graded leading to more time to assess students' work. Site 1 librarian was involved in many roles; therefore, the planning time needed to rethink instructional approaches was problematic. Understanding the time investment required is therefore important. There is a possibility that this approach may be dismissed by other librarians because of the time required to implement. As it stands, not all libraries have information literacy classes that extend over a semester. Learning by game design will therefore not be a suitable option in these environments. To help mediate this, funding can be acquired to help in the development of toolkits that can provide explicit guidance to librarians who wish to use game design in the classroom over different instruction scenarios.

Learning games can be categorized into two groups: extrinsic vs. intrinsic integration of subject matter. Games developed by students used simple mechanics and content was extrinsically integrated, thus most games were more like a classroom quiz. Without game mechanisms learners could still ask trivia questions and explore the content. In intrinsic integration, game designers integrate the subject matter with the game idea such that the game mechanisms cannot be separated from the conveyance of content, as seen in many simulations. To do this involves deeper thinking of the content, which could help in improving the transfer of understanding to other situations. Situated learning theory (Lave &Wenger, 1991) addresses this more explicitly, where the learner needs to connect concepts and facts actively appropriating information.

The scope of this study is limited within academic libraries therefore its application to other types may not produce similar results. The results may not be the same for all disciplines, Participants at both sites were science students adding similarities among the participants.

To gain traction in libraries, stronger evidence is needed in the form of pre and posttests to determine the level of content that was learned by students. The effectiveness of instructional intervention is often measured using a pre-test followed by the intervention, followed by a post-test; differences in the pre- and post-test scores. This qualitative case study was designed to explore the concepts and set the groundwork for a quantitative exploration of the topic. This was not accomplished in this study. Games were assessed for representations of information literacy learning. Improvements in information literacy skills that were noted in the findings were from what was articulated by students in interview and reflections. However, one cannot ignore student's behaviors and attitudes and their deeper engagement with course content. An additional approach, if viable is to interview students after an extended time to examine the application of learning to other contexts.

5.9 Future Work

The appeal of games is widespread, and a defining feature of the younger generation of learners. While this approach shows great potential, these insights are still preliminary. As librarians re-conceptualize current pedagogies, there is need for more formal research to understand the best way to support learning by game design in information literacy learning. Future work will attempt to identify specific approaches for learners with different learning styles. Exploring game aspects that can foster the creation of games that are more sophisticated in its integration of content should be addressed in future. Development of a game design toolkit specific to library standards can help support integration of the game design. This framework should be flexible enough to support existing information literacy activities, be it one-shot or semester long. Additional forms of measurable assessments, such as non- quiz pre – and posttests that simulate information literacy tasks. This can be used to complement assessment of game artifacts in future studies.

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APPENDICES

APPENDIX A: Pretest And Post Test Administered To Students In Pilot Study

Library Gaming Activity Questionnaire Summer Start Program

Please take a few minutes to answer the following questions. When completed return to your Summer Start instructor.

1. Bird Library is open 24/7 during the semester.
   a) True
   b) False

2. How can you contact library staff?
   a) Telephone
   b) Text
   c) Email
   d) IM
   e) All of the above

3. What is Proquest?
   a) A Web site for purchasing college text books
   b) An online database of journal articles
   c) Email software
   d) A catalog of library items

4. Do you feel comfortable using a library databases for a research assignment?
   a) Yes
   b) No
   c) Other comments ______________________________

5. When do you think you will use SU library?

6. What items are you most likely to borrow or use at SU library?

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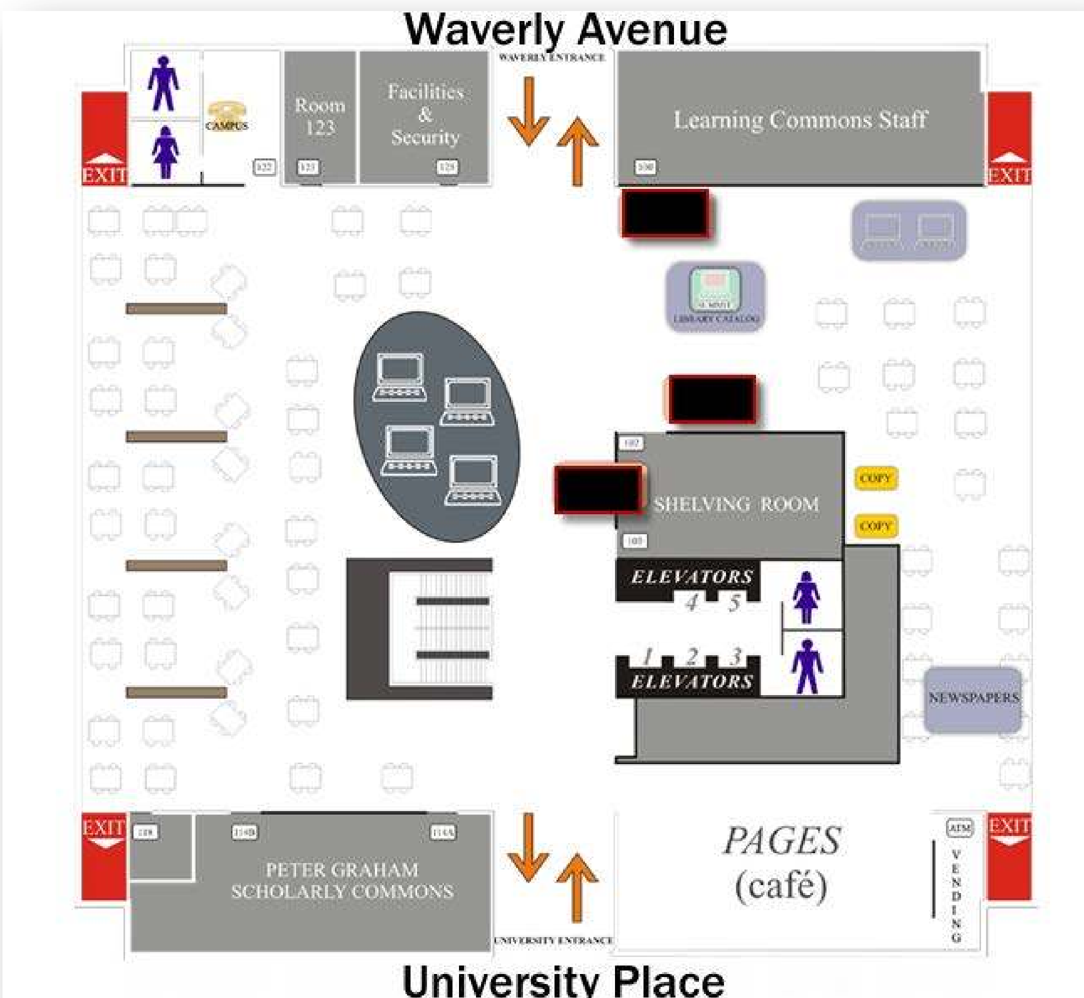
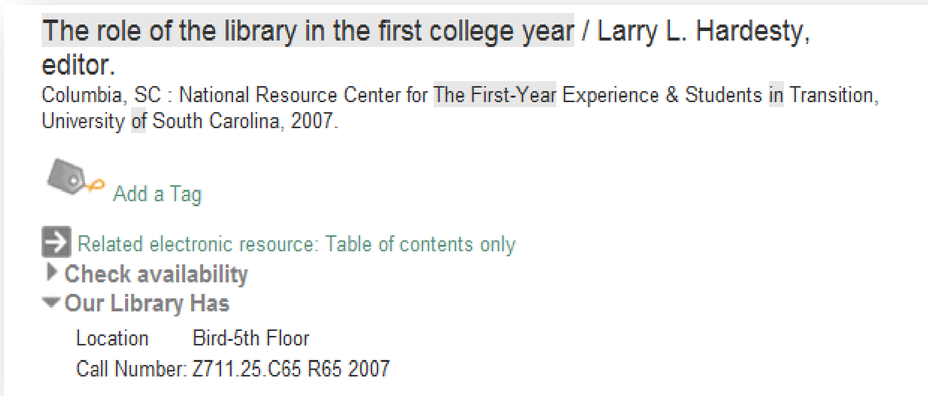
7. Here is a floor plan of the Syracuse University Library. Circle where you can ask for research help?



8. Here is a picture of a catalog record image. Circle the part of record that would tell you where the book is located in the library?



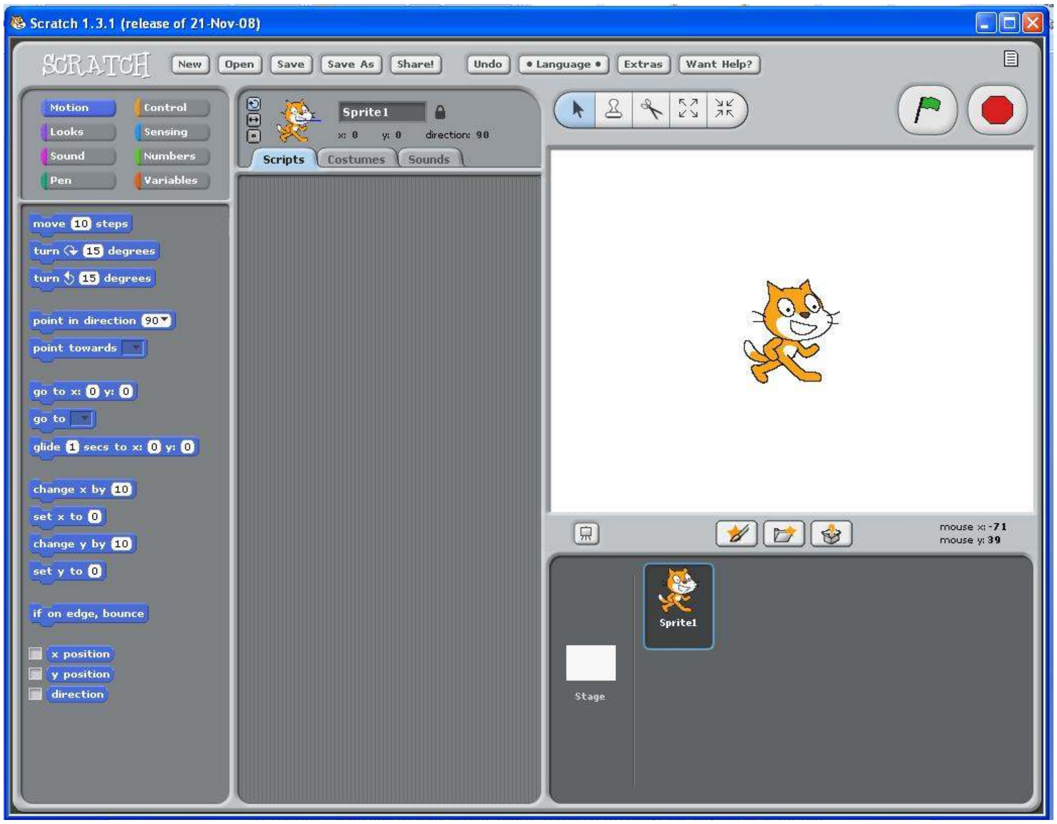
9. Where do you find current issues of magazines?
   a) All floors
   b) Floor 2
   c) Floor 3
   d) Floor 1

10. List three possible resources you would use to find information to assist you in completing assignments.
    a) ________________________________
    b) ________________________________
    c) ________________________________

11. How do you think you will use the SU library?

For Students Exposed to Scratch

1. Here is a picture of the Scratch design page. Circle the image on the screen where you would build program code.



2. When designing a game with Scratch, a sprite is a…
   a) Character
   b) Goal
   c) Player
   d) Program code

3. Which script will you use to move your sprite 10 steps forward?
   a) Looks
   b) Motion
   c) Control
   d) Pen

APPENDIX B: Course Syllabus at Site 1 And 2

SITE 1

Instructor:

Removed

Teaching Assistant:

Angela Rieks
PhD Candidate
Room 221, School of Information Studies. Syracuse University
Website: http://my.ischool.syr.edu/People/auramnar
Email: auramnar@syr.edu
Work Direct Phone: 315-440-2480

This semester my teaching assistant is Angela Rieks. She is a PhD candidate at the School of Information Studies at Syracuse University. Prior to the doctoral program, she worked as a librarian in a developer and administrator role. Angela is doing research on the incorporation of games as a teaching and learning tool in the classroom. She will be primarily responsible for the game creation (final project) part of the course. So please do direct those questions/concerns her way.

About this course:

This is a five week course to be completed at the **beginning of the semester**. One credit is earned upon successful completion of the course. This course is required by several departments. Students cannot be exempted from this course by library faculty.

Students are required to participate fully by sharing searching experiences, interacting in question and answer sessions and other constructive activities.

Learning Goals:

The learning goal of this course is to develop the student's "information literacy" as defined by the American Library Association: ***"Recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information."*** Information is increasing at an exponential rate and finding the information needed can be confusing and overwhelming. ESF 200 has been designed to help students better understand information and how to access it. Students who have completed ESF 200 should be less anxious and be more comfortable with information seeking processes.

Course goals:

Instructors for this developed this course to fulfill many of the American Library Association's specific Information Literacy Competency Standards (listed below).

1. **The information literate student determines the extent of the information needed.**

   - Student can define and articulate the need for information
   - Student can identify a variety of types and formats of potential information
   - Student considers the costs and benefits of acquiring the needed information
   - Student reevaluates the nature and extent of the information needed

2. **The information literate student accesses needed information effectively & efficiently.**

   - Student selects the most appropriate investigative methods or information retrieval systems for accessing needed information.
   - Student constructs and implements effectively-designed search strategies.
   - Student retrieves information online or in person using a variety of methods.
   - Student extracts, records and manages the information and its sources.
   - Students refines the search strategy if necessary.

3. **The Information literate student evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system**.

   - Student articulates and applies initial criteria for evaluating both the information and its sources.
   - Student compares new knowledge with prior knowledge to determine the value added, contradictions, or other unique characteristics of the information.
   - Student determines whether the initial query should be revised.

4. **The information literate student, individually or as a member of a group, use information effectively to accomplish a specific purpose.**

   - Student applies new and prior information to the planning and creation of a particular product or performance.
   - Student revises the development process for the product or performance.
   - Student communicates the product or performance effectively to others.

5. **The information literate student understands many of the economic, legal and social issues surrounding the use of information and accesses and uses information ethically and legally**.

   - Student understands many of the ethical, legal and socio-economic issues surrounding
   - information and information technology.

- Student acknowledges the use of information sources in communicating the product or performance.

Course Outline:

Unit 1: Library Basics

Unit 2: OneSearch - Library Catalog Searching

Unit 3: Databases - Citations - Plagiarism

Unit 4: Internet Searching - Wikipedia

Grading - Overview

Assignments	Points
Unit 1 Library Basics	15
Unit 2 OneSearch - Library Catalog Searching	20
Unit 3 Databases - Citations - Plagiarism	20
Final Project – Game Design	25 (total)
1. Debriefing on game exploration/ Concept presentation	*5*
2. Progress report	*10*
3. Final Game, presentation and reflection	*10*
Attendance and Participation	20

COURSE SCHEDULE

Class	Meeting Room	Topic/Activity	Assignment
1 - Monday Aug 25, 2014	110 Moon	Introduction to the course Gaming Final Project overview & Game Experience Survey	
2 - Wednesday Aug 27, 2014	110 Moon	Library tour assignment Group assignment- Final Project	Due: In House Library tour assignment.
3 - Friday Aug 29, 2014	110 Moon	Complete Consent Forms Choose topic for game development (topic list will be provided) In class - Questionnaire Brainstorming and exploring games Question students on exploration	

Monday - Sept 1, 2014	-----------	College and Library closed – No Class	
4 - Wednesday Sept 3, 2014	310 Baker	Onesearch – Library Catalog Lecture	Due: Debriefing on game exploration
5 - Friday Sept 5, 2014	310 Baker	Onesearch – Library Catalog - Hands on time – Assignment	
6 - Monday Sept 8, 2014	310 Baker	Databases – RefWorks – Plagiarism	Due: Onesearch – Library Catalog Assignment
7 - Wednesday Sept 10, 2014	310 Baker	Databases – RefWorks – Plagiarism – Hands on time – Assignment	
8 - Friday Sept 12, 2014	310 Baker	Review – Progress on game development and ideas Question students on exploration Give students time to work together In class – Questionnaire	Due: Databases – Refworks – Plagiarism Assignment
9 - Monday Sept 15, 2014	310 Baker	Presentation – Game concept In Class Peer Assessment	Due: Concept presentation (15 minutes). Due: Peer Assessments
10 - Wednesday Sept 17, 2014	310 Baker	Presentation – Game concept In Class Peer Assessment	Due: Concept presentation (15 minutes). Due: Peer Assessments
11 - Friday Sept 19, 2014	310 Baker	Internet Searching - Wikipedia - Lecture	Due: Team Member Assessments
12 – Monday Sept 22, 2014	310 Baker	Presentation on progress report	Due: Progress report
13 - Wednesday Sept 24, 2014	310 Baker	Presentation – Game Draft	Due: Draft of game presentation and feedback
14 - Friday Sept 26, 2014	310 Baker	Play each other games In class Peer Evaluation In class discussion - What will you change	Due: Game presentation - Version 1
15 - Monday Sept 29, 2014	310 Baker	Play each other games In class Peer Evaluation In class discussion - What will you change In class - Questionnaire	Due: Game presentation - Version 1

SITE 2

LIB 380/BIO 380

Information in the Biological Sciences

Course Overview

This course will introduce the basic principles and processes surrounding information in the biological sciences. Students will learn about information flow in the sciences and how to access, search for, and retrieve information in a variety of formats. They will become effective database and "free web" searchers, while also learning to evaluate the quality of the information that they retrieve. Students will also become familiar with the social and ethical issues relating to the production and use of scientific information in an increasingly technological society, while gaining experience with Web 2.0 creation tools.

Course Objectives

Upon completion of this course, a student should be able to:

- Understand the different types of biological information available, and how that information is created, distributed, and used.
- Recognize and become proficient in the changing information environment in the sciences, particularly open access sources.
- Utilize the information sources and tools available for accessing this information, particularly the advanced search features.
- Evaluate and analyze the scientific information obtained through searching.
- Read, summarize and discuss scientific information with peers.
- Describe the ethical and social issues relating to the use of scientific information.
- Utilize methods for keeping up to date with new information in the field.
- Employ Web 2.0 tools for the discovery of information, and to share information.

Course Materials

There is no required text for this course. When readings are assigned they will be provided for you.

Course Grading

This is a graded course (A-F in accordance with Le Moyne's grading policies and criteria). Completing each of the following assignments satisfactorily is essential to success:

Weekly Class Participation	35%
Game Design Project	65%

The Game Design Project grade includes the following components:

• Exploration Questions	10%
• Concept Presentation	10 %
• Progress Report	10 %
• Draft for feedback in class	20 %
• Final Game and Report	50 %

Grading Scale

93+	A
90-92.9	A-
87-89.9	B+
83-86.9	B
80-82.9	B-
77-79.9	C+
73-76.9	C
70-72.9	C-
65-69.9	D
0-64.9	F

Course Assignments

Weekly Class Participation
Each week there will be exercises to participate with during class. You will be graded each week on your participation with these search exercises, and the degree of your participation in class. Failure to attend class or participate will *seriously impact* this portion of your grade.

Game Design Project: This project includes the following components:

Choosing a Topic:
Your group will choose a topic from this list, and notify Kari of your choice:

- Wikipedia
- Open Access
- Privacy Online
- Scientific Misconduct

Exploration Questions:
You and your group will explore different games to find ideas for your own game. There will be physical games available during Class 3 and also resources in Canvas to assist you with your exploration and group brainstorming. These questions will be given to you at the beginning of Class 3. They are also available in Canvas.

Concept Presentation:
During Class 4, you and your group will present your game concept in a 10 minute presentation. The class will give you feedback regarding your concept so that you can move forward in the design process. This presentation should be about 10 minutes long, and it should include a working title, topic, learning objectives and outlined game idea.

Progress Report:
This report will be verbally delivered to either Kari or Angela. It will describe the progress that you have made since your concept presentation. It will explain what you have accomplished so far and what you still need to accomplish before Class 8. It will also describe how work is being distributed in your team.

Draft of Your Game:
During Class 8, you will present a draft of your game to your peers for their feedback. You should use their feedback to improve your final game. This presentation should last 10 minutes and will be followed by feedback. It should include all the components of a complete game, including: learning outcomes, content, rules, and description of game.

Final Game Report:
On your assigned day (either Class 10, 11, or 12), the class will all play and evaluate your final game. After that, you and your group will complete the Final Game Report. This will be handed out to you in class, and is also available on Canvas.

Team Assessment:
This gives you the opportunity to discuss the participation of your team members, and how well your team functioned overall.

Peer Evaluation of Game:
During the class when you play each game, you will have the opportunity to evaluate the game for a number of different criteria.

Course Calendar

Week	***Date***	***Class Activities***	***Assignments Due***
1	Aug 25	**Welcome & Introduction to Course** • Introductions • Go over syllabus and assignments • Groups assigned	
No class September 1 – Labor Day			
2	Sept 8	**Scholarship as conversation**	**Choosing a Topic** **Library Basics Search**
3	Sept 15	**Explore game options** (Game Design Project)	
4	Sept 22	**Concept Presentations** (Game Design Project)	**Exploration Questions** **Concept Presentations during class**
5	Sept 29	**Evaluating Scientific Information**	
6	Oct 6	**Group work day** (Game Design Project)	**Progress Report due at the end of class today**
No class October 13 – Fall Break			
7	Oct 20	**Advanced Searching:** **Journal Articles & Books**	**Team Assessment I**
8	Oct 27	**Draft of game for class feedback** (Game Design Project)	**Draft of game presented in class today**
9	Nov 3	**Keeping current in your field**	
10	Nov 10	**Final game presentation by group**	**Peer Assessments**

11	Nov 17	**Final game presentation by group**	**Peer Assessments**
12	Nov 24	**Final game presentation by group**	**Peer Assessments**
13	Dec 1	**Debriefing**	**Final Game Reports** **Team Assessment II**

APPENDIX C: Final Project (Game Design) Rubric

Category	Beginning	Developing	Proficient	Exceptional
PRIORITY (REQUIRED)				
Learning Components	Learning goals were unclear The game provides no activities to help students increase their cognitive skills, such as analysis, synthesis and evaluation	Learning goals covers the basics The game provides limited activities to help students increase their cognitive skills, such as analysis, synthesis and evaluation	Learning goals were through and clear The game provides some activities to help students increase their cognitive skills, such as analysis, synthesis and evaluation.	Learning goals were well articulated and well integrated The game provides multiple activities to help students increase their cognitive skills, such as analysis, synthesis and evaluation.
Concepts/Content area	Does not include ideas about the topic. Ideas are incorrect and vague	Includes a few ideas about topic, shows some understanding	Focuses and understands important concepts about the subject matter	Makes important connection between topic concepts, shows in-depth understanding
Integration	Mechanical elements of the game (for example points or challenges) did not fit together well. Play was not engaging or challenging.	Some mechanical elements of the game (for example points or challenges) did not fit together well. Play is somewhat engaging and challenging.	A few mechanical elements of the game (for example points or challenges) did not fit together well. Play was challenging and somewhat engaging.	The mechanical elements (for example points or challenges) and the theme of the game integrate well. Play was fun, challenging and interesting.
Clarity	Game rules were unclear Unable to	Game rules were somewhat unclear Had a fair	Game rules were somewhat clear and easy to understand	Game rules were clear and easy to understand

	understand the content	understanding of the content	Able to understand the most of the content.	Understood the content
NICE TO HAVE				
Layout and Design	There is no variation in layout and/or the colors interfere with the readability.	There is limited variation in layout. Nice use of colors.	There is limited variation in layout. Design elements sometimes assist in understanding concepts and ideas	There is variation in layout. Design elements assist students in understanding concepts and ideas.
Flow	Lots of unnecessary procedures	Included some of unnecessary procedures	Included a few unnecessary procedures	No unnecessary procedures. Very streamlined

References

Randall, K and Rusk, N. 2009. Rubric for assessing Scratch projects. Retrieved from http://scratched.media.mit.edu/resources/rubric-assessing-scratch-projects-draft-0
Gamifi-Ed. Rubric to Evaluate Learning Games. Retrieved from https://gamifi-ed.wikispaces.com/Rubric+to+Evaluate+Learning+Games
Educational Electronic Games Rubric . Retrieved from http://www.csus.edu/indiv/k/kaym/rubric/edgamesrubric.html

APPENDIX D: Final Project Template

This document is meant to be used as a guide in developing your final deliverable. Feel free to add and delete as applicable.

Game Title
What is the name of your game ?

Your Audience:
Who are your typical players?

Goal
What is the goal of the game? What is the win state?

Challenge
What is the player's challenge?

Learning Outcomes (add more outcomes, if applicable)
After playing this game the player will be able to …

1.
2.
3. ……

Mechanics
Describe the mechanics used for this game? For example how are objects used in the game. Is there guessing. Think of mechanics as verbs are actions.

Game Components
What are the components used in the game? For example dice, chips, cards…

Game Rules and Instructions
What are the rules of the game ? For example. How many players are required to play the game? What does the player do on his or her turn? How is the first player determined…..
Here is an example of the rules and setup for bingo https://www.fgbradleys.com/rules/Bingo.pdf . Some more examples can be found here https://www.fgbradleys.com/game_rules.asp

Space
Where does the game take place? For example game board, classroom.

Setup

How is your game set up? Where applicable provide illustrations to help in describing your set up.

Constraints (answer as applicable)

1. Time to play
2. Is this is one time game or can there be multiple sessions
3. Does your game play get more challenging as the player contines?
4. Is this a cooperative or competitive game? Describe the play.
5. Describe the end point or win state of the game
6. Groups or individual players. What are the least and most amount of players your game can accommodate.

Narrative (if applicable)

Is there a background story for your game? If so, provide the back story or narrative.

Content

Provide the topic and content that you will be integrating in your game design

References

How did other games help you in developing your ideas? Provide examples

Revisions and Updates

This part will be completed after the other teams has reviewed and play tested your game
Based on the feedback you received and by watching others play test your game tell us..

1. What revisions will you make?
2. How will these changes improve the game?
3. Providing you had the time and resources? Do you think this will be a good digital game. Explain.

APPENDIX E: Note Taking Template

SUMMARY
Date:
Place:
Overview:

Documentation:
Keep track of documents, recordings, artifacts

Acquired
Item
Medium
From
For
Description

Expanded Notes
Topics: space, actors, goals, feelings, objects and artifacts, acts that make up the activities, activities that make up the events, events that occur over time that relate to this event

Memo
Reflections, notes, highlights.

Questions
New questions

Comments
Later expansion or comments on notes

APPENDIX F: Class Presentation on Game Design Basics

Slide 1

Game Design Project

BIO 380
Fall 2014

Slide 2

Overview

You and your team will be creating a game (digital or physical). The game will be designed around the following topics

Wikipedia
Open access
Privacy Online
Scientific Misconduct

Slide 3

Requirements

- The game should be easy to learn and intuitive.
- Possess learning objectives.
  - "The player will be able to …"
- Delivered online or in a face to face class or both.
- The game should take **no more than 30 minutes** to complete.

Slide 4

Parts of a game

- Goal – What does the player have to do to get to endpoint?
  - Cross the finish line, collect the most card…
- Challenge – What obstacles are put in the way to make reaching goal interesting
  - Leg tied to teammate, marbles are hidden
- Mechanics – What actions or moves does the player do?
  - Solving clues, jumping
- Components – What parts that make up the materials of play
  - Chips, dice, spinner, key…
- Rules – What players can or cannot do
  - Must start at the same point, finish in 10 rounds
- Space – Where does the game take place and how does space affect the game
  - Board, a circle

Slide 5

Rock, Paper, Scissors

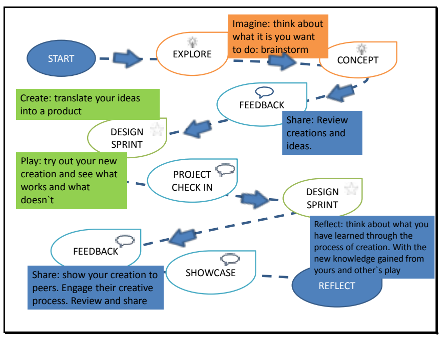
Goal	to "throw" the winning shape
Challenge	to anticipate which shape your competitor will "throw" so you can "throw" the shape that beats it.
Mechanics	Players "throw" an object, meaning they make the shape of an object with their hand and extend their arm to "throw" it
Components	Three shapes: rock, paper, scissors
Rules	Each person throws a shape with one hand. Rock beats scissors, scissors beats paper, paper beats rock. Whoever wins gets a point. If is a tie each person throws a shape again, Winner is the person who wins two out of three rounds
Space	Anywhere enough space exist for two people to stand or sit facing each other and extend one arm

Slide 6

Rock, Paper, Scissors - Mod

Goal	to "throw" the winning shape
Challenge	to anticipate which shape your competitor will "throw" so you can "throw" the shape that beats it.
Mechanics	Players "throw" an object, meaning they make the shape of an object with their hand and extend their arm to "throw" it
Components	Three shapes: rock, paper, scissors. Two hands used
Rules	Each person throws a shape with one hand. Rock beats scissors, scissors beats paper, paper beats rock. Whoever wins gets a point. If is a tie each person throws a shape again, Winner has two chances to win with two hands.
Space	Anywhere enough space exist for two people to stand or sit facing each other and extend one arm

Slide 7

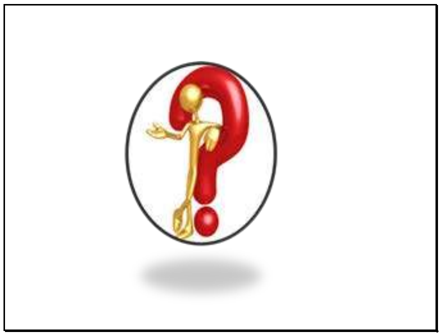


Slide 8

Deliverables

- Game (alpha or beta version)
- Report
  - Name of the game
  - Learning objective of the game
  - Time required to complete the play
  - Rules of the game and other player aids
  - Similar games that helped in your game development
- Assessments

Slide 9



APPENDIX G: Intrinsic Motivation Inventory Questionnaire

Name _____________ Date ________

For each of the following statements, please indicate how true it is for you, using the scale provided. Your responses will not impact on your grade for this class. Completion of this questionnaire is voluntary

1. While I was working on this task I was thinking about how much I enjoyed it.

   1 2 3 4 5 6 7
   not at all true somewhat true very true

2. I did not feel at all nervous about doing the task.

   1 2 3 4 5 6 7
   not at all true somewhat true very true

3. I felt that it was my choice to do the task.

   1 2 3 4 5 6 7
   not at all true somewhat true very true

4. I think I am pretty good at this task.

   1 2 3 4 5 6 7
   not at all true somewhat true very true

5. I found the task very interesting.

1 2 3 4 5 6 7
not at all true somewhat true very true

6. I felt tense while doing the task.

1 2 3 4 5 6 7
not at all true somewhat true very true

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

1 2 3 4 5 6 7
not at all true somewhat true very true

8. Doing the task was fun.

1 2 3 4 5 6 7
not at all true somewhat true very true

9. I felt relaxed while doing the task.

1 2 3 4 5 6 7
not at all true somewhat true very true

10. I enjoyed doing the task very much.

1 2 3 4 5 6 7
not at all true somewhat true very true

11. I didn't really have a choice about doing the task.

1	*2*	*3*	*4*	*5*	*6*	*7*
not at all true			*somewhat true*			*very true*

12. I am satisfied with my performance at this task.

1	*2*	*3*	*4*	*5*	*6*	*7*
not at all true			*somewhat true*			*very true*

13. I am anxious while doing the task.

1	*2*	*3*	*4*	*5*	*6*	*7*
not at all true			*somewhat true*			*very true*

14. I thought the task was very boring.

1	*2*	*3*	*4*	*5*	*6*	*7*
not at all true			*somewhat true*			*very true*

15. I felt like I was doing what I wanted to do while I was working on the task.

1	*2*	*3*	*4*	*5*	*6*	*7*
not at all true			*somewhat true*			*very true*

16. I felt pretty skilled at this task.

1	*2*	*3*	*4*	*5*	*6*	*7*
not at all true			*somewhat true*			*very true*

17. I thought the task was very interesting.

1	*2*	*3*	*4*	*5*	*6*	*7*
not at all true			*somewhat true*			*very true*

18. I felt pressured while doing the task.

1	2	3	4	5	6	7
not at all true			*somewhat true*			*very true*

19. I felt like I had to do the task

1	2	3	4	5	6	7
not at all true			*somewhat true*			*very true*

20. I would describe the task as very enjoyable.

1	2	3	4	5	6	7
not at all true			*somewhat true*			*very true*

21. I did the task because I had no choice.

1	2	3	4	5	6	7
not at all true			*somewhat true*			*very true*

22. After working at this task for a while, I felt pretty competent.

1	2	3	4	5	6	7
not at all true			*somewhat true*			*very true*

APPENDIX H: Interview Questions

Think back to the beginning of the class. What were your thoughts when the instructor mentioned the use of game design as a final project?

Possible Probes: Have you ever designed a game before? Do you play games frequently? Was it your choice to design a game or would you have preferred to do something else. Would you have preferred a class with lectures and assignments?

Did you find the game design task interesting?

Possible Probes: What specific aspects did you find fun interesting? Were you able to use any information literacy skills? Can you describe how you used them? Do you think you are better able to design a game in the future? What are some things you would have liked to change in your game?

Did you enjoy the game design process?

Possible probes: Do you see this teaching experiment as useful for other classes? Are there any specific classes?

What are your thoughts now that you have actually gone through the process?

Possible Probes: Was the process difficult? How easy or difficult was it to work as a team? Do you see this process as useful in other classes? Did you feel that there was enough time for class content? How did you feel about the game design activity? Did you play any of the games created by others?

How did you and your team come up with the idea for your game?

Possible Probes: Did anyone in particular come up with the idea? If yes, who? Was the game exploration activity useful? Was there anyone on the team you thought took a leadership role in developing the game?

Describe your main responsibilities in the game design project?

Possible probes: Did you at any time have to make compromises? Can you describe how those affected the final product? Was everyone in agreement with compromises made?

Can you describe the game design process?

Possible probes: Can you walk me through the steps? Did you take an idea and change it or use it in a new way for the purpose of your game? Did you find new ways to do things to complete your project that saved you and your team time and effort?

How did you collaborate with your team members to exchange ideas, opinions, questions or experiences during the game design process?

Possible probes: Did you need to seek assistance from anyone outside your team? How useful was it? Did your team need to meet after class? What were some of the things that were addressed in these out of class meetings?

How did you collaborate with other teams?

Possible probes: How useful was it to have other teams play test your games? How did your game change after the first review process? What were your thoughts seeing others play your game?

Were there any specific problems you encountered?

Possible Probes: How were you able to overcome those problems? Can you describe?

What would you have done anything differently?

Possible Probes: How would you approach designing the game differently if you have a chance to redo your game. If there was more time what are some modifications you will like to make?

Prior to this class, how did you typically find resources for assignments?

Possible Probes: Can you describe certain information literacy sources you have found to be valuable? Was the content covered in the class new to you?

What type of research did you conduct to help in developing the game?

Possible Probes: Did you talk to other people who were knowledgeable about the topic? Did you use books, library resources or the Internet? If yes, what type of resources? Did you use the class resources? If yes, which ones in particular? Were there any useful resources you found during this process?

What were some of the things you learned?

Possible Probes: What aspect of the class content did you incorporate into the game? Were there any specific skills you perfected? Did you learn better from designing a game, playing game created by others or the class lectures?

How has your approach to finding information change?

Possible Probes: Can you describe what influenced those changes?

How have you applied these skills in other situations?

Possible Probes: Do you just use these skills for class assignments or do you see it applicable in everyday life. Please explain.

Is there anything else about the class experience that you will like to share?

Possible Probes: What were some things you think would have made the class better?

APPENDIX I: Interview Protocol

The researcher will use the following protocol before, during, and after the interview.
The researcher will follow these steps:

Before the interview

Schedule interview with student during convenient time.
If face to face schedule room with public presence
Request permission ahead of time to record the interview.
Assure the participant that results will be kept confidential.
Test recording equipment, ensure that it is fully charged and has available memory
Have all materials organized and ready for the interview.
Take USB extension for your recording equipment.

During the interview
Begin with small talk to put the participant at ease
Before beginning the questions, the record students' name, date.
Ask the questions in a conversation format. If the participant seems to misinterpret the question or to get "off track" with his/her response, asks probing questions for clarification.
Let the participant do the talking.
Do not prompt the participant.
In conclusion, asks the participant if she/he have any questions or comments.

After the interview

Write up (or verbally include) a brief report right after the interview.
Make sure to clarify any unusual occurrences (such as an interruption in the interview), or your impressions of strange responses from the participant. (e.g., Were there any questions that he/she seemed to find offensive or threatening? Were there any questions that were difficult to answer?).
Supplement notes by defining any special terms or explanations used that might be unknown to you.
Describe any insights that may not have registered through the audio recording, or any other unusual occurrences during the meeting.

APPENDIX J: In-Class Assessments

Individual Assessment - Concept

Your Name: ____ Group #

What knowledge skills and talent do you see yourself contributing to game design project?
What were some of the tasks assigned to you? List.
How well do you see yourself interacting with your team?

Individual Assessment – Group Workday

Your Name: ____

What were your contributions towards the game design project?
What were some of the tasks assigned to you? Describe
How well do you think you interacting with your team?
Was hearing ideas and obtaining feedback from other groups useful? Explain?

Individual Assessment – Group Workday- #3

Your Name: ____

1. What were your contributions towards the game draft?
2. What were some of the information literacy skills you have used? Describe
3. How well do you think you interacting with your team?
4. Has feedback obtained from other groups been useful? Explain?
5. How is developing this game helping with better understanding the topic? Explain.

6. Did reviewing other games help in better understanding the topics? Explain.

Individual Assessment – Final

Your Name: ____

1. What were your contributions towards the game final deliverable?

2. Given the time and resources, what further modification would you make to the developed game?

3. How well do you think you interacted with your team?

4. How did developing this game help in understanding the topic? Explain.

5. Did playing other games help in better understanding the topics? Explain.

6. What are some of the information literacy skills you used to design the game? Describe.

7. How have you used these information literacy skills in other situations? Describe.

Team Member Assessment

Your Name: ____

Use this form to evaluate your team members. You will complete one form for each team member.

After reading through a row, decide at what level your team member functioned (1,2, 3, or 4) and note the number in the final column (Your Assessment).

Team Member Name:				
1	**2**	**3**	**4**	**Your Assessment**
Team member was not involved in the design process	Team member sometimes participated in the design process	Team member participated in the design process	Team Member was very involved in the design process	
Did not use class or meeting time well	Used class or meeting time well	Used class or meeting time constructively	Used class or meeting time constructively and included additional elements	
Did not collaborate	Collaborated at times	Collaborated appropriately	Found ways to collaborate beyond class structure	
Did not contribute any original ideas	Contributed a few original ideas	Contributed some original ideas	Contributed many original ideas	

Peer Game Critique

Critique By _____

Name of Game …………………………	NO	SOMEWHAT	YES
The learning objective(s) of the game is clear			
This game did a good job at meeting the learning objectives.			
What I learnt from this game will be useful in understanding the topic and concepts.			
The content was well constructed and got more challenging as my skills improved			
The game was too challenging			
It was easy for me to following the directions. I was able to play without much help.			
I was confused about what to do in the game			
The game looked nice and had pretty colors and graphics.			
The game took too long to play			

Specific Critique
What was something that does not work or could be improved?
What was something that was confusing and could be done differently?
What was something that works well and you really liked?
What are your recommendations?
Other Suggestions

Progress Report Questions

1. What is the main idea behind your project?

2. What has been the favorite part of the process so far?

3. What parts of the project still need to be worked upon?

4. What part of the project will each of you be working on?

5. What are some information literacy tasks you used to help in your game deign?

6. What might you need help with in order to make progress?

APPENDIX K: List of Code Categories

Code Category	Description
Class Participation	Participant willingness to present, demonstrate, and ask questions.
Engagement	Participation engagement in lectures, game design and game play activities. Participant involvement in game evaluations.
Enrollment	Participant years in college
Evaluation	Librarian feedback on class objectives and game artifact
Game Artifacts	Game mechanisms and ideas used.
Game Knowledge	Participants prior game experiences
Group Relationship	Participants' relatedness with peers group members and non-group members. Level of agreement within groups.
Information Literacy Skills	Skills participant used for game design, and class assignments. Participant's prior information literacy experiences. Skills librarian noted.
Interpretation	Participant understanding of class content
Motivation	Participants' additional efforts to develop game. Views on class activities.
Prior Knowledge	Other knowledge that participant brought to the class
Project Lead	Participants assuming the responsibility to move team forward
Seek Instructor	Reaching out to the instructor for assistance
Sharing /Team Dynamics	Participant's willingness to share and assist peers.
Tasks	Specific tasks undertaken by participants
Time	Participant use of time in class and after class
Understanding Long Term Impact	Participants reflection on information literacy skills in different situations
View	Participant and librarian view of class activities

APPENDIX L: Letter of Informed Consent

School of Information Studies
SYRACUSE UNIVERSITY

Letter of Informed Consent
Title of Study: Learning by Game Design For Library Instruction

My name is Angela Ramnarine-Rieks, and I am a PhD candidate at the School of Information Studies at Syracuse University working with this study's advising investigator Dr. Scott Nicholson. I am inviting you to participate in a research study. Involvement in the study is voluntary, so you may choose to participate in it or not. This sheet will explain the study to you and please feel free to ask questions about the research if you have any. I will be happy to explain anything in detail if you wish.
I am interested in learning more about learning outcomes of the game design process, which will be implemented in ESF200: Information Literacy. You will be asked to share the pre and posttests that you completed in the classroom with the researcher. I will also ask you to fill out a questionnaire at the beginning, during and at the end of the class. This will be strictly voluntary and you will not be penalized in any way should you mot want to completed the questionnaires. We will also be recording some of the classroom activities and I will be taking supporting field notes. As soon as the recording activities are transcribed, the supporting field notes will be shredded and the recordings will be erased. At the end of the class I will contact you for an interview where we will talk about your experiences with the game design activity. I will ask you about challenges you experienced and how whether it help in better understanding, the content covered. I will also ask for suggestions on how the game design activity could have been better incorporated in the class. If we have your permission, I would like to record the interview. Your responses are only recorded for transcription purposes. All transcribed electronic files will be stored in password protected electronic folders. All questionnaires and results for pre and posttest will be stored in a locked drawer that will only be accessible by me. All activities with the exception of the interviews will take place during the class. The interview will require additional time that will not exceed 30 minutes.
All information will be kept confidential. We will assign a number to your responses and only I and the advising investigator will have the key to which number belongs to which participant. For example, we will change details about where you live and your name. In any articles we write or in any presentations made we will use a pseudonym or made up name for you, and we will not reveal any identifying details.

The benefit of this research is that you will be helping us to better understand the learning outcomes of new teaching approaches that and explore new and engaging ways of getting students involved in the class content. You will also be helping us in designing future exciting and more engaging library activities. The use of gaming activities in education provides a framework for teaching new literacies needed for living, working and citizenship in the 21st century. Moreover, it paves the way to mastering the skills required not only for your courses but for lifelong learning in a constantly changing world. This study would help contribute to the discussions surrounding these new approaches to literacy.

The risks to you of participating in this study are that you may enjoy the game design activity or you may find the recording of the class to be inconvenient. These risks will be minimized by making the activities voluntary so that those who do not wish to engage in the game design activity may choose not to. If you do not want to take part, you have the right to refuse to take part without penalty.

If you decide to take part and later no longer wish to continue, you have the right to withdraw from the study at any time, without penalty.

If you have any questions, concerns, complaints about the research, contact Dr. Scott Nicholson and Angela Ramnarine-Rieks at srnichol@syr.edu or 315-443-1640 and/or auramnar@syr.edu or 315-440-2480 respectively. If you have any questions about your rights as a research participant, you have questions, concerns, or complaints that you wish to address to someone other than the investigator, if you cannot reach the investigator contact the Syracuse University Institutional Review Board at 315-443-3013.

All of my questions have been answered, I am over the age of 18 and I wish to participate in this research study. I have received a copy of this consent form.

___ I agree to be, videotaped. ___ I agree to be, recorded (audio).

___ I do not agree to be videotaped. ___ I agree to be, recorded (audio).

____________________________ __________________
Signature of Participant Date

____
Printed Name Participant

____________________________ __________________
Signature of Researcher Date

____
Printed Name of Researcher

APPENDIX M: Game Experience Survey

Game Experience Survey

We will like to have a sense of your game playing experiences.
Please answer all applicable questions

1. Your Name : ….
2. Your age range
    - o 12-17 years
    - o 18-24 years
    - o 25-34 years
    - o 35-44 years

3. Do you currently play any games?
    - o Yes
    - o No

4. If YES. Which of the following best describes the types of games you play? Choose all that apply.
    - o Party Games (e.g. guessing, drinking, daring games)
    - o Tabletop games (e.g. board, card, dice games)
    - o Video games (e.g. computer, role playing, shooter games)
    - o Skill games(e.g. quizzes, word, crossword puzzles)
    - o Other ……….

5. If YES. How long have you been playing games?
    - o About 6 months
    - o One year
    - o Two to five years
    - o Five to ten years
    - o Over ten years

6. If YES. How did you begin playing games?
    - o Self interest
    - o Friends
    - o Internet
    - o Other …..

7. If YES. How often (approximately) do you currently play games?
   - Daily
   - Once a week
   - Once a month
   - 2-3 times per month
   - Once in 6 months
   - Once a year

8. If **NO**, why don't you play games? Choose all that apply.
   - Too expensive
   - Not interested
   - Not enough time
   - Lack of skill
   - Other ……….

9. How good do you feel you are at playing games?
   - Very good
   - Moderately good
   - Not very skilled
   - No skill

APPENDIX N: Games Developed at Both Sites

Games Developed at Site 1

Trivial Searchopoly – Group 1

Game developed using the board design of *Monopoly* and the game mechanics of *Trivial Pursuit*. Using a dice, players move around the board by correctly answering trivia questions. Questions are split into six categories; constructing searches in databases (green), finding library resources using the catalog and library services (orange), tips for searching Google and protecting your privacy (yellow), constructing citations (blue), open category of true/false questions, super computer category; open category of more challenging questions. When questions were answered correctly, players kept the card. They needed to collect a card of each color to be eligible to answer a super computer question. When this question was answered correctly, that player won the game.

Library Rush – Group 2

Game was developed using game mechanics of *Clue* and *Trivial Pursuit*. The scenario: the player has to use multiple library resources to complete their assignment. Blue action cards stresses the benefits of good research practices (for example finding reputable resources using databases) moves the player forward. Bad research practices (for example not using citations) lead to players losing a turn or other negative consequences. To win the game players need to collect cards of six colors by answering the questions that focus on using the library catalog, research guides and other services.

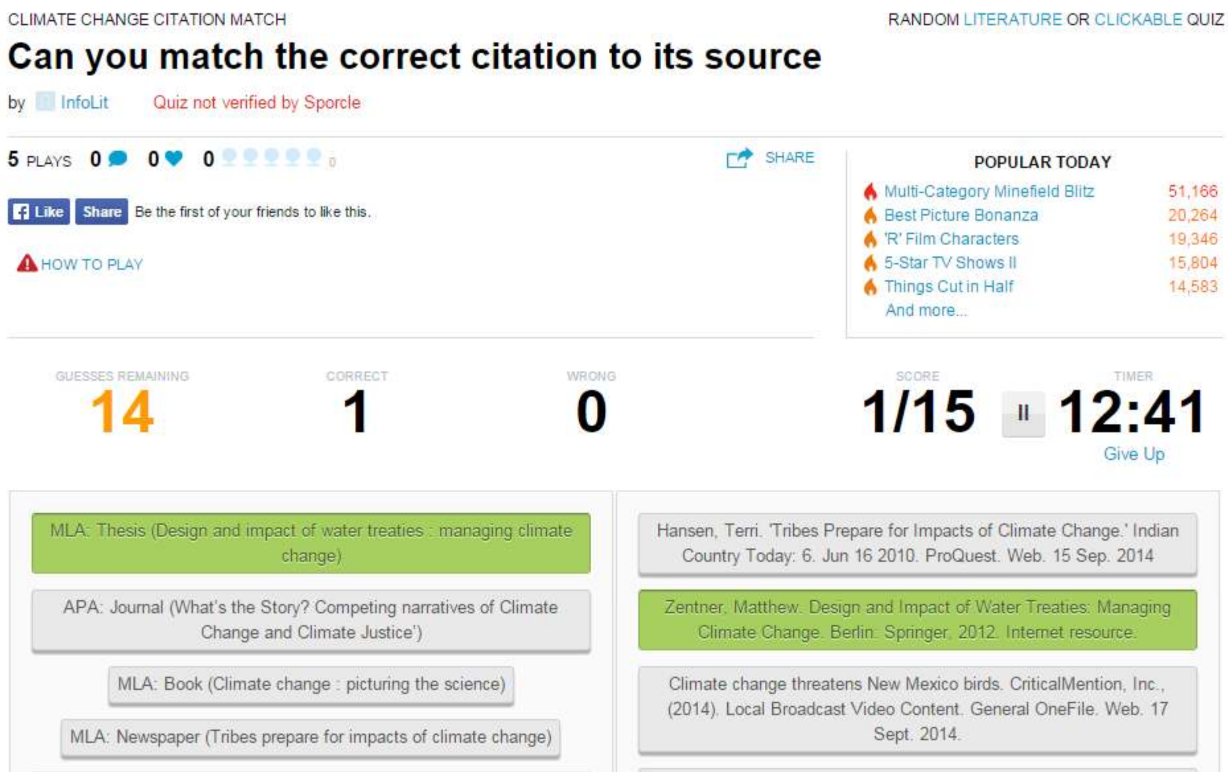
Connect Trivia – Group 3

Trivia questions were overlaid on the game *Connect Four*. Two teams chose a color. They take turns dropping colored discs from the top into a seven-column, six-row vertically suspended grid. To be eligible to drop a disc the team must answer questions correctly. Teams win when they connect four of their discs of the same color next to each other vertically, horizontally, or diagonally before the opposing team.

Internet Land – Group 4

A modified version of Candyland helps identify reliable web sources. Players draws card with different web extensions and move to the corresponding website on the game board. These are domain site cards (.org, .gov, .net, .com, .edu.), bad website cards are (Wikipedia, Facebook, Twitter and breaking copyright by not getting permission to print) and good website cards (library sites and Google Scholar). Selecting a bad site card results in the player moving backwards, good site cards move the player forward. Squares with black dots represent the computer infected with a virus. To move forward the player must select a card with the same web extension from the play preceding landing on the black dot. To win a player must reach the end of the path.

Climate Change Citation Match – Group 5



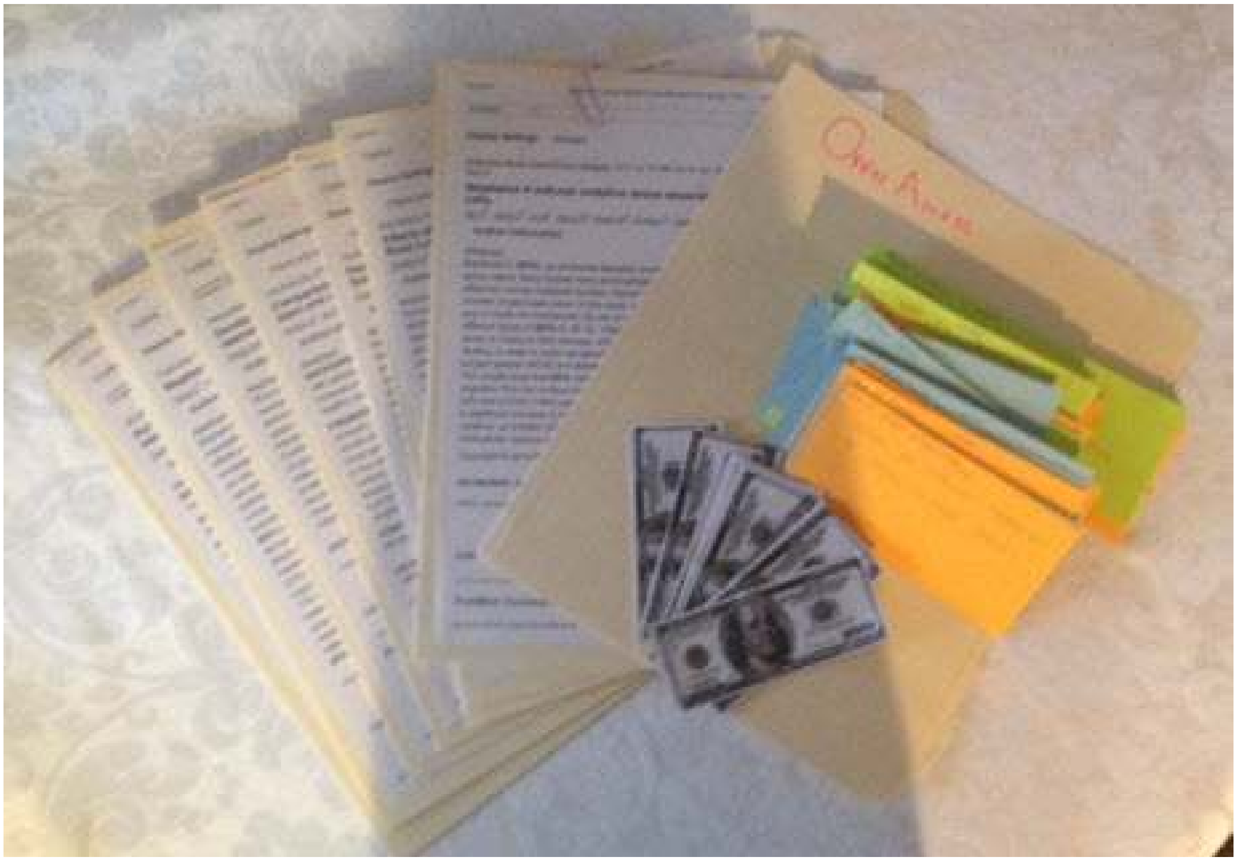
An online matching game, where individual players matched 15 hints to citation styles (APA, MLA and Chicago). Resources cited were are specific to climate change resources. Players had 15 minutes to complete correct matches. Players' wins when all 15 hints are match correctly to the citation. Correct matches are not given at the end of the games therefore players can only win after multiple attempts by playing repeatedly to find correct matches.

Games Developed at Site 2

Scientific Misconduct: The Game of Disrepute

Group 1 designers used game mechanics from *Washers* game and *Monopoly*. Players organized themselves in 2 teams. The objective: answer trivia questions in order to obtain chances to toss washers into pits, which are place 10 feet apart. If players successfully toss washers in the cylinder located in the pit, they score more points. Players can earn three shots per round by answering three questions correctly. If the player answers any question incorrectly they lose all their accumulated shots. Thirty question cards (3 questions per card) and 2 "Save the Day" (similar to chance card from *Monopoly*) cards are divided between two players. Questions got more difficult as the players attempts to accumulate shots in a round. If the player draws a "Save the Day" card they can use it avoid losing their accumulated shots. The player with the most points wins.

To Free or Not to Free



Group 2 designers develop a trivia game that used the money feature from *Monopoly* and competitive trivia from *Who wants to be a Millionaire.* Teams are given $1000 in fake money. Players choose question cards. If they are unable to answer the question, they choose from a list of journal articles (in folders). They choose articles by reading the abstract. The question card also has guides to direct the player to the article. If the team is still unable to answer the question from the abstract, they can chose to purchase access. On opening, the folder if it is an open access article they are not charged. If it is not open access, they pay $200 to access. There are bonus open access trivia questions, which do not require players to find articles. If the player does not wish answer non-bonus question they can pass it over to the other player. They must do so when they draw the question card. The team who answers the most questions correctly wins.

Facebook: The Privacy Crook

Group 3 used game mechanics from *Life* and *Candyland* and *Wits and Wagers.* The game accommodates 4 players or teams. Each team is given a game board. First play is determined by answering a trivia question. The player closet to the correct answer goes first. Play continues in a clockwise direction. Scenario cards describing positive and negative uses of Facebook dictate if the player moves forward or backward. When a risk cards is drawn the player has the option to stay in place if they respond incorrectly or move forward should the response be correct. Players can play risk cards to avoid moving back in another turn. Once used, it is returned to the card deck. First team that crosses the finish line wins.

APPENDIX O: Pre Test – Site 2

- Find a popular article. Label it, and attach it here.
- Find a scholarly article. Label it, and attach it here.
- Find a source that has been peer-reviewed. Label it and attach it here.
- Find a source that has not been peer-reviewed. Label it, and attach it here.
- Find a primary research article. Label it, and attach it here.
- Find a review article. Label it, and attach it here.
- Does the library have a copy of **Woznicki, Robert. *Madame Curie, daughter of Poland*. Miami, Fla.: American Institute of Polish Culture, 1983?**

  If not, how would you get a copy?

- Do we have access to the journal *Cell* (Cambridge) through the library?
  If so, do we have it in print, online or both formats?

- Where is the following style guide located?
  A Short Guide to Writing about Biology by Jan Pechenik. Boston: Pearson, 2013.

- Find the Subject Guide for CHM 224: Organic Chemistry. Write down the name of one spectroscopy database that is recommended there:

- Does the library have the title *Before the Lights Go Out: Conquering the Energy Crisis Before It Conquers Us* by Maggie Koerth-Baker. If so, what type of resource is it?
- Find a copy of the following article and attach it here:
  Gouri Yogalingam and Donald S. Anson (2003). Molecular cloning of feline CD34.
  Veterinary Immunology and Immunopathology, Volume 95, Issues 1-2, 53-61.

CURRICULUM VITAE

ANGELA U. RAMNARINE-RIEKS

School of Information Studies
221, Hinds Hall, Syracuse, New York. 13244.
Email: auramnar@syr.edu

EDUCATION:

Information Science and Technology (PhD)
Dissertation: Learning by Game Design for Library Instruction: A Multiple Case Study
Syracuse University, Syracuse, New York
Completed: September 2015

Information Management (MS)
Syracuse University, Syracuse, New York
Major: Project and Data Management
8/2001 to 12/2004

Library Science (MLS)
Syracuse University, Syracuse, New York
Major: Information Systems
8/2001 to 8/2003

M.Sc (Food Technology) Distinction
The University of the West Indies, St. Augustine, Trinidad, West Indies
Trinidad, West Indies
9/1996 to 10/2000

B.Sc. (Agriculture) (Upper Second Class Honors)
The University of the West Indies, St. Augustine, Trinidad, West Indies
9/1993 to 6/1996

TEACHING EXPERIENCE

INSTRUCTOR

Graduate Courses:

IST 558: **Technologies in Web Content Management. Online**
Taught 5 semesters. Fall 2011 to present
Introduces concepts and techniques in website content representation, organization, presentation, management and focuses on the incorporation of XML technologies.

IST 676: **Digital Libraries. (renamed Foundations of Digital Data). Online and Face to Face**
Taught for 7 semesters. Spring 2008, Summer 2011 – 2015, Spring 2009 (face to face with Dean of Libraries, Suzanne Thorin).
Introduce students to conceptual thinking and high-level processes involved in digital environments. Foundation course for students enrolled in the certificate in Digital Libraries and Data Science.

IST 637: Digital Information Retrieval Services. Online
Taught for 4 semesters. Spring 2007 - 2008, 2010, 2013.
Introduces students to the information retrieval theories and digital searching tools

IST 667: Information Technologies for Libraries and Information Centers. Online
Taught for 1 semester. Fall 2007.
Introduction to library systems and technologies

GUEST INSTRUCTOR

Graduate Courses:

IST 676: **Digital Libraries. Face to Face**
Spring 2010. Guest lectured for 5 classes on topics that introduced technological concepts related to digital libraries.

IST 605: Information Services and Retrieval. Face to Face
Fall 2008. Invited as a guest lecture on a information retrieval class.

Undergraduate Courses:

IST 444: Information Reporting and Presentation. Face to Face
Part of my teaching practicum. Guest lectured for 2 semesters. In fall 2008 guest lecturer in three classes Adobe InDesign. In spring 2009 invited to guest lecture on developing logos.

ESF 200: Information Literacy
Integrating a game design component.

TEACHING ASSISTANT

Graduate Courses:

IST800: Doctoral Gateway Seminar. Online
Summer 2010, 2011 and 2012. Introductory class for Executive Doctoral Students. My role as teaching assistant with the Executive Doctorate Director involved course planning and locating articles for inclusion in the class readings, discussion board monitoring and management, maintain presence, handling student questions about course policies and the learning management system and other requirements in orienting new students to online learning.

IST997: Doctoral Thesis
Summer 2009. Co-developed syllabus and reading list for the class with Executive Doctorate Director. As a teaching assistant I worked in small group sessions with the first cohort of Executive Doctorate students in exploring various research methods for their thesis. I facilitated synchronous conferencing session with instructor and students and small groups

TEACHING PRACTICUM
IST 600: Participatory Libraries
Fall 2009. Help develop syllabus, graded, administered assignments and maintain presence through discussion boards.

RESEARCH INTERESTS

- New Literacies. Game/Media design and play in constructive learning environments
- Experiential learning using education technologies.
- Collaborative and constructive learning environments among digital youth
- Collaboration, Facilitation and Group Decision Making in Distributed Environments
- Evolution of information systems in libraries and information centers
- International Librarianship (focus on the Caribbean)

PUBLICATIONS

Refereed Conference Proceedings *(Accepted and Presented)*

Nicholson, S.; Ramnarine-Rieks, A.; Heidler, A. and Bratt, S. (2015). Creating a Customizable Alternate Reality Game (ARG) toolkit for Academic Libraries. Proceedings of Games and Learning Society Conference. (GLS 11, Madison). July 7-10 (presented on July 9th)

Ramnarine-Rieks, A. (2014). Incorporating Collaborative Game Design in Information Literacy Classes: A Case Study. Proceedings of International Conference of Education, Research and Innovation (ICERI 2014, Seville, Spain) November 17-19, 2014. (to be presented virtually)

McKnight, L. W. and Ramnarine-Rieks, A. (2013). Enhancing Learning through Wireless Grids. Society of Applied Learning Technology August 14 -16, 2013. Reston Virginia. (presented by L.W. McKnight)

Ramnarine-Rieks, A. (2012). Making Learning Relevant. Exploring New Approaches Using Constructionist Learning Technology. Proceedings of International Conference of Education, Research and Innovation (ICERI 2012, Madrid Spain) November 19-21, 2012. (presented virtually)

Ramnarine-Rieks, A. (2012). Improving Information Literacy Classes Using Scratch. A Quasi Experimental Study. Scratch@MIT 2012 Conference. Jul. 25-28, 2012. Cambridge, Mass. (presented on July 26th)

Ramnarine-Rieks, A.; de Vreede, G.J. and Boughzala, I. (2012) Technology Support for Collaborative Work: A Preliminary Study on a Framework for Studying and Analyzing Group Facilitation. Group Decision and Negotiation (GDN). 2012 (Recife, Brazil). May 20-24, 2012. (presented by G.J. de Vreede)

Ramnarine-Rieks, A.; McKnight, L.W. and Riina, G. and Gardeazabal, C. (2012). Wireless Grids for Cultural Self-Preservation: Assessing e-Readiness in a Native American Nation. Proceedings of Hawaii International Conference on System Sciences (HICSS 45, Hawaii) January 4-7, 2011. (presented with L.W. McKnight)

Ramnarine-Rieks, A.; McKnight, L.W.; Wong, P. Y. and Venkatesh, M. (2011) Learning Together Through New Technologies: Exploring Classroom Interactions through Legitimate Peripheral Participation in a Community of Practice. Proceedings of International Conference of Education, Research and Innovation (ICERI 2011, Madrid Spain) November 14-16, 2011. (presented virtually)

Ramnarine-Rieks, A.; de Vreede, G.J. and Boughzala, I. (2011) A Framework for the Study of Facilitation of Technology Supported Collaboration. Organizations and Society in Information Systems (OASIS). 2011 Pre-ICIS Workshop. (Shanghai, China). December 4, 2011. (presented by G.J. de Vreede)

Ramnarine-Rieks, A. (2011). Investigating Learning Outcomes through Game Design in Information Literacy Classes. Proceedings of the 2011 Great Lakes Connections Conference. Works in Progress. (Milwaukee). May 20 -22. (presented May 21st)

Treglia, J.V., McKnight, L.W, Kuehn, Andreas, Ramnarine-Rieks, A., Venkatesh, M. and Bose, T. (2011) Interoperability by Edgeware: Wireless Grids for Emergency Response. Proceedings

of Hawaii International Conference on System Sciences (HICSS 44, Hawaii) January 4-7, 2011. (presented by J. Treglia)

Ramnarine-Rieks, A. McKnight, L.W. and Small, R. (2011). Collaborative Learning through Wireless Grids. Proceedings of Hawaii International Conference on System Sciences (HICSS 44, Hawaii) January 4-7, 2011. (presented Jan 5th)

Ramnarine-Rieks, A. McKnight, L.W. and Small, R. (2010) Exploring Cyberlearning in Wireless Grids. Proceedings of International Conference of Education, Research and Innovation (ICERI 2010, Madrid Spain) November 15-17, 2010. (presented virtually)

Cogburn, D.; Ramnarine-Rieks, A.; Espinoza Vasquez, Fatima and Levinson, N. 2009. Learning Across Borders: Socio-Technical Strategies for Globally Distributed Teaching and Learning. Proceedings of International Conference of Education, Research and Innovation (ICERI 2009, Madrid Spain) November 16-18, 2009. (presented virtually)

Cogburn, D.; Levinson, N., Ramnarine-Rieks, A. and Espinoza Vasquez, Fatima. 2009. A Decade of Globally Distributed Collaborative Learning: Lessons Learned from Cross-National Virtual Teams. Proceedings of Hawaii International Conference on System Sciences (HICSS 2010, Hawaii) January 5-8, 2010. (presented by D. Cogburn)

Treglia, J., Ramnarine-Rieks, A. and McKnight, L. 2009. Collaboration in a Wireless Grid Innovation Testbed by Virtual Consortium. Paper Presented at Second International Workshop on Wireless Grids collocated with GridNets 2009, Athens, Greece. 7 -9 September 2009. (presented Sept. 8)

Ramnarine- Rieks A. and Buss, D. 2007. Disaggregating the Library: Embedding Library Resources into the Management School. Paper presented at Coalition for Networked Information Project Briefing: Task Force Meeting, Washington D.C. 10-11 December 2007. (presented Dec. 11)

Comissiong, E. and Ramnarine, A. 2001. The manufacture of tofu and okara and its derived products. Paper presented at Institute of Food Technologists (IFT), Annual Meeting and Food Exposition. New Orleans, Louisiana . 23-27 June 2001. (presented with E. Comissiong)

Refereed Book Chapters

Ramnarine-Rieks, A. (May 2011) Introduction to Learning Theories. In The Atlas of New Librarianship. R.D. Lankes. MIT Press. Cambridge.

Ramnarine-Rieks, A. (2007) Digitization Initiatives in Trinidad and Tobago. In Caribbean Libraries in the 21st Century: Changes, Challenges and Choices. A Collection of Selected Articles. Information Today. New Jersey, USA

Refereed Journal Publications

Dedrick, J; Venkatesh, M.; Stanton, J.; Zheng, Y. and Ramnarine - Rieks, A. 2014. Adoption of Smart Grid Technologies by Electric Utilities: Factors Influencing Organizational Innovation in a Regulated Environment. Electronic Markets: The International Journal on Networked Business. August.

Refereed Poster Presentations

Ramnarine-Rieks, A. (2014). Designing Games in the Classroom: Learning Benefits. Poster. ASIST Annual Meeting 2014. Connecting Collection, Cultures and Communications. Oct 31 – Nov 5, 2014. Seattle, Washington.

Ramnarine-Rieks, A. (2014). Using Game Design for Improving Engagement and Supporting Learning by Undergraduates in Information Literacy Classes. Poster. North American Simulation and Gaming Association Annual Conference, Playing Stories – Sharing Worlds – Learning Games. Oct. 8-12, 2014. Baltimore, Maryland.

Ramnarine-Rieks, A. (2013). Learning by Game Design: Exploring Its Potential in Undergraduate Information Literacy Instruction Poster. ASIST Annual Meeting 2013. Rethinking Information Boundaries. Nov. 1-6, 2012. Montreal, Canada.

Ramnarine-Rieks, A. (2012). Learning through Game Design: An Investigation on the Effects in Library Instruction Sessions. Poster. iConference 2012. Culture, Design, Society, Feb. 7-10, 2012. Toronto, Canada.

Ramnarine-Rieks, A. (2011). Bridging theory and practice: Connecting coursework to internships in LIS programs. iConference 2011. Seattle, Washington. February 8-11, 2011.

REFEREED WORKSHOPS

McKnight, L. and Ramnarine-Rieks, A. WiGiT: A Testbed for Wireless Ad-Hoc Network Application Innovation. Half day Workshop. Hawaii International Conference on System Sciences (HICSS 2013, Hawaii) January 7-10, 2013.

GRANT WRITING

Assisted as part of a writing team for the following grants

July 2011 Research Experiences for Undergraduates. Research Experience for Syracuse University Undergraduates in the Partnerships for Innovation #091793 Wireless Grids Innovation Testbed (WiGiT) . PI: Lee McKnight **Successful award of $24,000 in August 2011**.

March 2011 National Science Foundation. Transforming Stem Learning. PI: Ruth Small. Unsuccessful.

January 2011 National Science Foundation. Computing Education for the 21st Century. PI: Ruth Small. Unsuccessful.

February 2009 National Science Foundation Partnerships for International Research and Education (PIRE). PI: Lee McKnight. Unsuccessful.

December 2008 National Science Foundation Partnerships for Innovation (PFI) grant. PI: Lee McKnight**. Successful award of $400,000 in August 2009**.

AWARDS, FELLOWSHIPS AND HONORS

June 2014
North American Simulation and Gaming Association (NASAGA) awarded from competition - paid attendance to annual conference.

October 2009
Golden Key International Honor Society- Syracuse University Chapter
Awarded for scholarly achievement (PhD level) at Syracuse University.

August 2008 - August 2012
Laura Bush 21st Century Librarian Program
Sponsor: Institute of Museum and Library Services (IMLS)
Purpose: To pursue PhD in Information Science and Technology

Feb. 2002, 2003
Phi Beta Delta Honor Society. Syracuse University Chapter.
Awarded for scholarly achievement (Masters level) at Syracuse University.

Aug. 2001 – Sept. 2003
Fulbright (LASPAU), Exchange Visitor Program

Sponsor: United States Department of State.
Purpose: To pursue MLS program at Syracuse University.

August 2001 (did not pursue)
Organization of American States (OAS) Scholarship
Sponsor: Organization of American States.
Purpose: To pursue MLS program at University of Western Ontario.

GRADUATE ASSISTANTSHIPS – Syracuse University

NSF funded project : Adoption of Smart Grid Technologies by Electrical Utilities (PI: Jason Dedrick) - 2012 -present

IMLS funded project: Developing an Alternative Reality Toolkit for Libraries (PI: Scott Nicholson) - May 2013 – September 2014

NSF funded project : Wireless Grids Innovation Testbed (WiGiT) (PI: Lee McKnight) – Summer 2009 -2012

STUDENT SERVICE – Syracuse University

PhD Student Representative. Personnel Committee – Academic Year 2011-2012

PhD Student Representative. PhD Committee. – Academic Year 2009 -2011

Part of student organizers team for Global Game Jam - 2009 -2011

Assistant Director. Wireless Grids Innovation Testbed. Project funded under the National Science Foundation Partnerships for Innovation (PFI) grant - 2008 – 2012.

Liaison to the Doctorate of Professional Studies students -Kept distance students updated and in communication with on campus PhD students and faculty. - Fall 2008.

PhD Student Representative. Curriculum Committee –2008 -2009

Lab Assistant - Because Play Matters Game Lab –2008 - present

PROFESSIONAL SERVICE

Development and coordination of an online peer reviewed journal entitled *Caribbean Library Journal*. (*With Systems Manager Main Library, The University of the West Indies, Trinidad.)*

Development, deployment and support of a content management system (UltraWeb) using Macromedia Cold Fusion. This is currently utilized by the Business, Finance and Administrative group at Syracuse University. (*With Information and Technology, Director, Syracuse University)*

Reviewer - Conferences and Publications.

Hawai'i International Conference on Systems Science, 2010 – present
CHI Play
iConference, 2011 – present
North American Simulation and Gaming Association (NASAGA)
Caribbean Library Journal 2006 – present
International Journal of Electrical Power and Energy Systems
Book Series: Experiential Learning: Emerging Perspectives, Strategies and Educational Outcomes

EMPLOYMENT AND PROFESSIONAL EXPERIENCE

Web Specialist II
Bird Library, Syracuse University, Syracuse, New York.
Manage web related projects at Syracuse University Library. Responsible for the implementation, coordination and maintenance of finding aids for accessing all electronic resources.
1/16/2007 to 8/2008

Librarian II – Electronic Resources Manager/Systems Librarian (tenure track)
Main Library, The University Of The West Indies, St. Augustine, Trinidad.
Responsible for the development, coordination and maintenance of solutions designed specifically towards accessing electronic resources and serials regularization across three campuses.
01/2004 to 08/2006 (resigned)

Librarian I – Systems Librarian/Reference Librarian (tenure track)
Main Library, The University of The West Indies, St. Augustine, Trinidad.
Part of the digitization and web team. Assistance in preparation of request for proposal (RFP) for a new integrated library system (ILS). Assisted in development of home grown solutions such as a reserve service to facilitate online global graduate programs and the implementation of intuitional repository system (DSpace).
10/2003 to 01/2004

Library Assistant (granted study leave from 08/2001 to 09/2003)
Main Library, The University Of The West Indies, St. Augustine, Trinidad.
Assisted in planning and developing instruction and training classes, developing web library's presence and strategic direction of the pilot information commons.
11/95 to 08/2001

Food Quality Assurance Manager
Turban Brand, Tunapuna, Trinidad, West Indies.
Developed of critical control points on the production floor, supervised production flow, Implemented and trained on an automated record keeping system, assisted in new product development.
11/93 to 6/95

PROFESSIONAL AFFILIATIONS

American Library Association (ALA)
The Association for Information Science & Technology (ASIST)
Association for Library and Information Science Education (ALISE)
Association of Computing Machinery (ACM)
Library Association of Trinidad and Tobago (LATT)
Society for Learning Technologies (SALT)
Digital Games Research Association (DiGRA)
North American Simulation and Gaming Association (NASAGA)