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Keywords
Educational game, Game design, Learner motivation, Learner engagement, Interactive learning, Educational technology, Instructional technology

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Introduction

Background to the Problem

This paper describes research that was carried out at a northeastern U.S. public, comprehensive university, which offers a Master's of Education in Educational Computing (EDC) program. Approximately 90 percent of the students in the program are local and regional K-12 in-service teachers, who require a Master's degree to be eligible to receive permanent teacher certification.

Courses in the program are often beset by a range of challenges, including (a) late-night fatigue and hunger among students; (b) rigorous technical, often abstract course content; (c) stress caused by lack of little prior knowledge or experience in the subject area; (d) stress among commuting students who lack access to course tools; (e) lack of intrinsic motivation in the subject area; and (f) general feelings of *'anomie'*. For instance, some students may be stressed by other factors, such as working at multiple jobs, family issues, uncertainty of the times, information overload, etc.

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Purpose and Research Question

The purpose of this study was to examine the role of games in graduate-level instructional technology courses. The study focused on seeking answers to the following research question: *"How might educational games be used to help make graduate-level instructional technology learning experiences more interactive, engaging, and motivating?"* It is worth noting that this study did not focus on the effectiveness of games for promoting learning, but rather, their effectiveness for promoting student engagement and motivation.

Theoretical Framework

The Nature of Games

A *game* can be defined as a structured or semi-structured activity, typically engaged in for enjoyment, and also sometimes applied to educational purposes and needs. Games are known to have been played as far back as prehistoric times, and seem to be a universal part of human experience (i.e., 'cultural universal'), being present in all cultures.

Games come in a variety of formats, including board games, card games, fantasy games, physical games, simulation games, and computer/video-based games. When used for educational purposes in the classroom, games can serve a number of important purposes: (1) Games can be used to teach new information, and/or to review previously instructed content; (2) Games can be used for socialization purposes, helping students—often in a relatively short period of time—to get to know one another and build the foundations of a classroom community spirit; and (3) Games can help to attract and maintain learners' attention and motivation to learn. It is this last function upon which the study described here was mainly focused.

Engagement in Instruction

The term *engagement* typically refers to "the state of being engaged: emotional involvement or commitment; the state of being in gear" (Merriam-Webster Inc., 2005, p.378). Applying this definition of 'engagement' to the classroom, one could assume that when students are engaged in instruction, they are easy to get 'into gear' during class; they clearly go above and beyond what is required for an activity or assignment; they express satisfaction with their learning experiences; and they demonstrate competence in the knowledge and skills being taught.

Rationale for Using Games in the Classroom

As former U.S. Secretary of Education Terrell H. Bell once remarked, "there are three important things to remember about education. The first one is motivation, the second is motivation, and the third is motivation" (Ford, Alber, & Heward, 2006, p.1). Yet, the ability to maintain attention and motivation in the classroom can be a significant challenge for today's educator, at all levels of instruction. As Hay (2000) pointed out, first television, and now the Internet, has changed the way people think and learn. "Many educators bemoan that they must now be entertainers in the classroom, and that 'edutainment' has undermined the quality of education in this country…We have reached the point where that which is boring in our world, faces the serious risk of being ignored by the masses" (Hay, 2000, p.6).

Squire (2003) pointed out the meteoric rise in popularity of computer/video games in the last 35 years or so, becoming "one of the most pervasive, profitable, and influential forms of entertainment in the United States and across the world…twenty-five million Americans, or one out of every four households, owns a Sony Playstation" (p.1). Squire (2007) also argued that educators (especially curriculum designers) should pay close attention to games

because they offer uniquely designed experiences, in which participants learn though a domain of doing and being.

The use of games to promote learner engagement can be supported by a range of learning theories, including those of Vygotsky, Gardner, Keller, and others. For instance, Vygotsky (1934) believed that learning takes place within the "zone of proximal development" (ZPD), which is "the gap between what a learner has already mastered (the actual level of development) and what a child can achieve (potential development) with the guidance of an experienced and capable assistant such as a teacher or more capable peer" (LEARN NC, 2008, p.1).

In education, the ZPD supports the idea that social interactions are the basis of human learning and that learners grow into the intellectual life of those around them. According to Vygotsky (1934), learning is a dynamic process of social practice. Such a process takes place at two levels: internal and external levels. A person can make learning happen at a certain internal level, but he/she can do it better with external assistance and stimuli. This assistance and stimuli can include such things as people who are willing and able to provide support, and also having access to the proper tools. Educational games are an example of external stimuli that allows and encourages student to interact with, and gain support from others.

Howard Gardner (1983; 1993) formulated a provisional list of eight or more "intelligences"—i.e., different ways of thinking, perceiving, learning, and problem solving. Gardner's list of intelligences includes: (1) linguistic intelligence, (2) logical-mathematical intelligence, (3) musical intelligence, (4) bodily-kinesthetic intelligence, (5) spatial intelligence, (6) interpersonal intelligence, (7) intrapersonal intelligence, and (8) naturalist intelligence.

In regard to our educational system, as Gardner (1999) pointed out, the first two intelligences are ones that have typically been valued in schools; the next three are usually associated with the arts; and the next two are what Gardner called "personal intelligences", with "naturalist intelligence" falling into this latter category as well.

Gifted & Creative Services Australia (2007) agreed with Gardner, claiming that traditional teaching techniques tend to be designed for auditory learners, whereby concepts are typically presented in a sequential, step-by-step fashion, practiced with repetition, assessed under timed conditions, and then reviewed. The auditory-sequential system, then, "involves analysis, progression from simple to complex, organization of information, and linear deductive reasoning. It is influenced by hearing and language, and an awareness of time." (p.1).

Yet, this approach does not always work well for visual-spatial learners who tend to understand concepts better when they are presented within a context and related to other concepts. According to Gifted & Creative Services Australia (2007), "once spatial learners create a mental picture of a concept and see how the information fits [in] with what they already know, their learning is permanent…Visual thinkers and learners can literally see pictures in their heads, whereas auditory thinkers and learners hear streams of words" (p.2). A main advantage of spatial thinking and learning is that it is believed to be eight times faster than auditory-sequential thinking and learning.

An advantage of educational games is that they can address many of Gardner's multiple intelligences—either separately or collectively. For instance, there are many games involving words only—either spoken or written. Examples would include popular board games such as *Catch Phrase* (Hasbro, 2008), *Scrabble* (Hasbro, 2008)*, Trivial Pursuit* (Hasbro, 2008)*, Who*

Wants to Be a Millionaire (Disney*ABC Domestic Television, 2008), and others. These games can presumably help to address the needs of, and advance learners' *linguistic intelligence*.

Popular visually-based board-based games such as *Pictionary* (Hasbro, 2008), *Win, Lose, or Draw!* (Burt and Bert Productions, 1987), and *Quick Pics with Ben Wicks* (Canada Games Company Ltd., 1987) can presumably help to address the needs of, and advance learners' *spatial intelligence*. This could be particularly important, what with the preoccupation of many of today's youth with visually-oriented tools and activities, such as video and online games, Web surfing, virtual chat rooms, social networking tools, television, movies, video cell phones, etc.

Also, multimedia-based games, such as board-based or computer-based versions of the popular television game show *Jeopardy* (Sony Pictures Digital Inc., 2008), can help to address both *linguistic* and *spatial intelligence* simultaneously, by utilizing screen elements from a range of media, including text, graphics, photographs, animation, audio, and video. As such, this type of game might help to promote learners' *multimedia literacy* knowledge and skills.

Games can also promote student use of technology in the classroom, which is another way that both student motivation and learning can be enhanced. For instance, Anderson (2000) demonstrated that technology use has the potential to increase student motivation. According to Heafner (2004), promoting student use of familiar instructional tools as part of instruction can engage students in the learning process and motivate them; improve their self-efficacy, self-confidence, and self-worth; and lead to greater student achievement.

In terms of what it is that can make games so powerfully motivating, Malone (1981) analyzed video games—using observations, surveys, and interviews—to determine what can make video games so engaging. He discovered that the three most important elements are challenge, fantasy, and curiosity. Applying these findings to education, Malone (1981) argued that, to be effective, instruction (particularly educational games) should include the following elements: (1) clear goals that students find meaningful; (2) multiple goal structures and a scoring system that provides students with feedback on their progress that is immediate and unambiguous; (3) multiple levels of difficulty to adjust the game difficulty to student skill level; (4) random elements of surprise imbedded within the game; and (5) an emotionally appealing storyline fantasy and/or metaphor that is related to game skills. Many games—both computer/video-based games and non-computer games—include many, if not all of these features.

John Keller (1987) provided some interesting insights into the challenge of learner engagement and motivation with his ARCS model of motivation. According to Keller, there are four essential aspects of learner motivation: (1) *Attention* (i.e., whether learners perceive the instruction is interesting and worthy of attention; how well the instruction is able to attract and maintain learners' attention throughout the learning experience); (2) *Relevance* (i.e., whether the instruction is perceived as being able to meet some personal or professional need(s)); (3) *Confidence* (i.e., whether learners gain increased confidence and expect to be able to succeed better, based on their own efforts, after the instruction); and (4) *Satisfaction* (i.e., whether learners enjoy the learning experience or gain other intrinsic or extrinsic rewards from the instruction).

Games can help to address all four of Keller's (1987) components of learner motivation. For instance, games can help to attract and maintain attention to instruction. Games can be relevant to the learners' needs and wants as long as games can promote the learning of relevant content. Games can help to increase learners' confidence by helping to promote the

learning of important content. Finally, games can help to promote satisfaction among students by helping to make instruction more enjoyable and fun.

Methodology

Research Approach

The study utilized a qualitative research approach, a constructivist paradigm, and a participatory action research (PAR) strategy. As Denzin & Lincoln (1998) pointed out, qualitative research implies "an emphasis on processes and meanings…the socially constructed nature of reality, the intimate relationship between the researcher and what is studied, and the situational constraints that shape inquiry. Such researchers…seek answers to questions that stress how social experience is created and given meaning" (p.8).

The study was constructivist in nature, in that it assumed "a relativist ontology (there are multiple realities), a subjectivist epistemology (knower and subject create understandings), and a naturalistic set of methodologies [in this case, the classroom]" (p.27).

The study entailed a participatory action research (PAR) strategy, in that the study was "concerned with the development of effective action that may contribute to the transformation of organizations (in this case, graduate level instructional technology classes, as well as area K-12 schools)" (Reason, 1998, as cited in Denzin & Lincoln, 1998, p.273). As with most PAR research, one aim of this study was to "produce [and deliver] knowledge and action that is directly useful to a group of people" (p.269)—in this case to various groups of university and K-12 instructors.

Sample

A convenience sample was used in this study. The participants were graduate students (i.e., K-12 in-service teachers) from three different intact Educational Computing (EDC) graduate courses—all of which were offered during both Fall 2007 and Spring 2008 semesters. The courses were: (1) EDC 601—Instructional Technologies, (2) EDC 604—Authoring for Educators, and (3) EDC 594—Creative Thinking and Instructional Technology, for a total of 50 participants in all.

Procedure

Research activities were conducted during both Fall 2007 and Spring 2008 semesters. The research procedure included two sets of activities: (1) using the graduate course instructor as a game designer with the graduate students serving as game players (i.e., in all three courses during both semesters), and (2) using the graduate students as game designers (i.e., only in EDC 601 and EDC 594 courses during both semesters).

During the course of the study, depending on which courses students were enrolled in, they might serve in one or both roles of game player and game designer. In the EDC 601 course, game design activities focused on the design and development of a Microsoft PowerPoint-based computer game, such as a game similar to *Jeopardy* (or any other format that could be built using Microsoft PowerPoint software (Microsoft Corporation, 2008) or any other related multimedia development software). In the EDC 594 course, game design activities focused on the design and development of a paper-based board game, such as *Snakes and Ladders*, etc.

Research Activity #1:
Course Instructor as Game Designer and Graduate Students as Game Players

Stage 1. Game Design by Course Instructor

The design and development of instructional materials typically follows one of three approaches: (1) *Adopt*—i.e., use an existing product without change, following suggestions for use exactly as given; (2) *Adapt*—i.e., change a product from its original form to suit one's specific needs (e.g., removing the audio portion of a video and adding one's own narration to address specific aspects of the video); and (3) *Develop*—i.e., create a new product, after eliminating the possibility of adopting or adapting an existing product.

Three games were developed by the instructor for use in the three graduate courses as a way to review course material, which had been previously covered either in class presentations or in course readings. Course material being reviewed included: multimedia concepts, methods, and tools; Internet and Web concepts, methods, and tools; hardware concepts and tools; software concepts and tools; and various types of visual design principles and tools.

The three games developed were: (1) *"Articulate"* (a text-oriented game, similar in concept to *Catch Phrase* (Hasbro, 2008)), (2) *"Imaginary"* (a visual-oriented game, similar in concept to *Pictionary* (Hasbro, 2008)), and (3) *"Deduction"* (a text- and visual-oriented game, similar in concept to *Jeopardy* (Sony Pictures Digital Inc., 2008)). All three of these games are competitive in nature, whereby students compete in teams against one another, and either amass points (*Deduction*) or advance on a game board (*Articulate* and *Imaginary*).

Articulate is a game whereby one player on a team randomly selects a popular word or phrase from a stack of typed cards, and then provides verbal clues to other members of the team, who must then try to guess the identity of the word or phrase. *Imaginary* is a similar type of game as *Articulate*, except that instead of verbal clues being provided, players must create hand-drawn, picture clues about the concept being guessed at, using only whiteboard and dry erase marker, and without using any alphabetic or numeric characters. *Deduction* is a game whereby players are provided textual and visual clues related to various types of concepts, and then must guess what the concept is, providing their answer in question format. The various concepts being guessed at are grouped under one of six different categories.
The process involved in adapting each of these games to classroom learning needs included the following four steps: (1) Understanding the rules and materials of the existing commercial games; (2) Adding instructional content to each game; (3) Adapting the existing game materials and/or adding new materials; and (4) Modifying the existing game rules, where necessary, so as to maximize possible opportunities for learning. For instance, any rules that promoted excessive competition were modified to reduce competition and increase collaboration.

Stage 2. Game Play with Graduate Students
In all three courses, educational games were employed during several regular classroom sessions during both Fall 2007 and Spring 2008 semesters. The games were typically used to review and reinforce material covered in course readings and/or previous class sessions.

When playing the games during class, students were first randomly placed into small groups—i.e., 2-3 students per group, depending on the type of game. Game rules and materials were then explained and demonstrated to the students. Depending on the game involved, one student typically volunteered for the role of timer/scorekeeper. Once the game rules had been read and materials displayed and demonstrated, a practice round was typically conducted to iron out any confusions that students might

have had about the game rules. Once the practice round was complete, a formal round of the game was played which typically lasted for approximately 45 minutes.

Research Activity #2:
Graduate Students as Game Designers

For this activity, students in the EDC 601 and EDC 594 classes were asked to design and develop educational games for use in the their own K-12 classrooms. Students in the EDC 601 classes were asked to design and develop teacher-led computer-based games by (a) adapting any popular board game, computer game, or television game show format; (b) using any type of multimedia development software (such as Microsoft PowerPoint, OpenOffice Impress, etc.); and (c) incorporating content relevant to their teaching area and grade level.

Students in the EDC 594 classes were asked to design and develop paper-based, group-oriented board games by (a) using any popular board game format; and (b) incorporating content relevant to their teaching area and grade level. Also, for both EDC 601 and EDC 594 projects, students were expected to develop detailed storyboards that described how they planned and designed their games, and they were also expected to provide detailed instructions about how to play their game in a classroom setting.

Data Collection and Analysis

Sources of data for this study included: (a) classroom observations of student behavior and reactions (which were periodically recorded in digital format), (b) informal verbal feedback provided by students, (c) formal written feedback provided by students on weekly and end-of-semester course reflection papers, and (d) completed student game design projects.

During game play in some of the classes, students and the course instructor were photographed using a digital camera. Throughout both semesters, students in all sections of each course were asked to keep a 'Weekly Journal' about their course experiences. At the end of the semester, students were asked to prepare and submit a 'Journal Summary', which was a summary of their Weekly Journal entries, and included their reflections on course 'Pluses', 'Potentials', 'Concerns', 'Ways to Overcome Concerns', and 'Overall Course Recommendations'. As mentioned previously, in two of the three courses used in this study (i.e., EDC 601 and EDC 594), students were asked to design and develop educational games; these projects accounted for (on average) 20 percent of students' final course grade. At the end of the semester, students submitted their completed game design projects for evaluation.

Once all of the data had been collected, the various still images, student verbal feedback notes, student written feedback records, and completed student game projects were reviewed and analyzed for ideas and possible conclusions about the effects of the games on the instructional process.

Results and Discussion

Findings from the analysis of the still images and videotapes, classroom observations, informal student verbal comments, and formal student written feedback on their course experiences, all showed that students generally enjoyed participating in both game play and game design.

Research Activity #1:
Course Instructor as Game Designer and Graduate Students as Game Players

During the periods of game play, students were generally more engaged in the game activities than they were during traditional teacher-led classroom instruction. Students also demonstrated close cooperation with their team members. Among the range of interesting findings, the following are particularly noteworthy:

Attention and engagement

During the playing of the games, students paid close attention to the rules of the game, the play of the game, and the course-related concepts being explored via the games. For instance, at the start of each game, when the instructor explained the rules of the game, all participants listened intently to make sure that they understood the rules of the game. Students paid close attention to the instructor when players became stuck trying to explain some of the course-related terms, or when students defined the term incorrectly and the instructor provided the correct definition. During the playing of *Articulate*, each team player paid close attention to the clue-giver to catch the meaning of the new concept being explained. In general, in order to win at any of the games, all team members had to be engaged and cooperate well with one another.

Relevance

Since all the adopted games were perceived as helping to meet students' professional needs of gaining greater knowledge and understanding of the technological concepts being explored via the games, students generally seemed to find the game playing as being a relevant activity. For instance, after a game, students displayed some excitement about the concepts and talked about them. Some students commented: *"I did not know it before, but now I know."*

Confidence

As students developed their knowledge and understanding of course concepts through the playing of the games, their confidence developed as well. For instance, this could be seen during the playing of the game *Deduction*. At the beginning of the game, participants tended to choose the categories that they were most familiar with, usually selecting challenges with lower points. However, they quickly climbed to higher level challenges to deal with more thought-provoking problems. With each success, they became more confident in their ability to successfully solve challenges. Students also often displayed keen enthusiasm and eagerness to ring their bells to answer the questions when the time limit was over for the group initially addressing the question. Students also often felt very proud of themselves when they answered the tough questions. They cheered and encouraged each other—both members of their own team, as well as members of other successful, competing teams—when correct responses were given.

Satisfaction and motivation

When each of the three games used were first introduced to the graduate students, they typically showed a high level of interest in the game. For example, *Figure 1* depicts students engaged in learning and communicating the meaning of terms from the course textbook, in an enjoyable and fun manner. It is worth mentioning that students often mentioned that they would like to introduce the games used to their own students and make their own classroom learning experiences more enjoyable.

Figure 1. Graduate Students as Game Players—Learning with joy

Student written comments on their game playing experiences included the following:

> "One of the biggest highlights of the semester was Deduction. Deduction was a great game because it forced our class to learn the terminology and the concepts in a fun way, not to mention that it demonstrated a great way to utilize technology in the classroom. Since we are all teachers, or will be future teachers, that would be something great to do with our classes as a method of review. It definitely would engage the student because our whole class was engaged and we were learning. It's miraculous what a little technology can achieve."

> "The activities we participated in, such as Deduction, helped reinforce the knowledge you shared with us, as far as terminology, hardware, and design."

> "The enjoyment that all the students in class seemed to get from playing Jeopardy was a good reminder that review of material can be made fun; it just takes a bit more of the instructor's time in the planning phase of a lesson—but what a payoff!!"

Research Activity #2:
Graduate Students as Game Designers

From this activity, a range of interesting and useful educational games resulted. An analysis of the games submitted showed that, in general, in designing and developing their games, the students went above and beyond what was expected in the game design project guidelines. Student written comments on their game design experiences included the following:

> "The purpose of this game is to review the Revolutionary War unit, using a hands-on, interactive, well-known game. Many students will benefit from using this tool to review, rather than reading and studying notes. Students are more engaged and are more likely to achieve and remember key concepts when they are having fun and playing a game."

> "I enjoyed learning how to create educational games. As a middle school teacher, I truly believe in the importance of learning through play, and

> educational games are a great way to engage students in learning. Educational games are not only fun and enjoyable for students, but they can also make a teacher feel that their students are truly understanding the concepts they are teaching."
>
> "[Before this class,] I did not know how to create a game on the computer. I was irritated and enthusiastic at the same time to find out how easily I can make a computer-generated game in only a fraction of the time it takes me to sketch everything out myself [and create a cardboard-based game]."

Conclusion

In summary, this study answered the research question *"How might educational games be used to help make graduate level instructional technology learning experiences more interactive, engaging, and motivating?"* with positive results. Educational games can be engaging to play. In general, the student participants in this study found the game playing activities presented to them to be satisfying and engaging. To support this conclusion, many of the K-12 teacher students participating in this study expressed plans to introduce educational games into their own classroom teaching practices to try to engage their own K-12 students better and provide more enjoyable learning experiences.

Some of the results of this study have been confirmed elsewhere. For instance, prior to its use in the current study, a game similar in format to *Articulate* had previously been adopted and used by one of the authors for helping to develop student teachers' linguistic intelligence at a Canadian University. During that experience, participants displayed notable engagement in their learning environment while playing the game.

It was also found in this study that educational games can be engaging to design and build. Numerous examples showed that students can become very engaged and be willing to go the extra mile in designing and developing games that are both fun to play and instructionally useful.

Through this preliminary study, the authors draw a cautious but affirmative conclusion that educational games can play a positive role in facilitating learning among students with different learning styles and also help to develop multiple intelligences. At the same time, it must also be emphasized that, to be relevant and useful to curriculum needs and ultimately pedagogically effective, educational games must be selected and adopted or adapted with care, with close attention paid to overall instructional goals and objectives. Also, it must be noted that these results have not addressed the pedagogical value of using educational games in the classroom. This question would be better addressed in a separate study that addresses a research question such as: *"How effective are educational games for promoting learning?"*

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