Game Designs that Enhance Motivation and Learning for Teenagers

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Abstract

Educational computer games, also known as e-learning games, are slowly becoming a part of the curriculum in secondary education. As e-learning games evolve, learning theory has not always been consciously applied. In the development of a credit card game for high school students, Gardner's multiple intelligence learning theory is consciously applied. When game-play proceeds through these broad areas of multiple intelligences, learners have more places to look for information and maintain engagement in the game. To determine motivation and attitude of users who played the credit card game, a survey is given. Results showed that the majority of students were motivated to play the game and felt it was a positive learning experience. Overall, it is becoming more and more important to supplement traditional education with e-learning games that engage and motivate students.

INTRODUCTION

In secondary education the role of educational computer-based games, abbreviated to e-learning games, is just beginning to evolve. E-learning games allow students to immerse themselves in real-life simulations, which supplement traditional educational methods. For example, an e-learning game that provides a real-life simulation of evaluating, acquiring, and managing credit cards assists the teacher in explaining the importance of prudent credit card use.

The objective of this paper is to discuss how learning theory has been applied to e-learning over time. The paper then explains how a specific learning theory is applied to an e-learning credit card game. A survey that reflects the motivation and attitude of users who played the game is presented to measure effectiveness. Lastly, the paper reviews why e-learning games are an important supplement to the educational process.

Background: e-learning games and learning theory

"The understanding of [learning theory or] psychology offers a framework to developing an educational game that promotes learning while maintaining high motivation of the player" (Siang & Rao, 2003, p. 239). Ravenscroft (2001) evaluated and analyzes a significant collection of research and development in e-learning interaction that has occurred over the last 50 years. According to Ravenscroft, e-learning has evolved without a structured learning theory for design; the "sexy technology" (p. 133) of the time becomes the genesis for development rather than learning theory and user-centered design.

With technology typically driving learning theory within e-learning games, several learning theories inherently exist depending on the current activity. Siang & Rao (2003) discussed how learning theories, specifically behavioral theory and cognitive constructivism theory, are applied to computer games. Behavioral theory, introduced by B.F. Skinner, postulates that behavior is a function of its consequences (Kearsley, 2005).

Behavioral theory in game design is used for learning basic rules of game play and promotes stimuli. Eliciting positive or negative feedback immediately in game play allows the user to respond on the basis of earlier experience (Siang & Rao, 2003). For example, when playing a game, the user sees a missile shooting at his player; he spontaneously moves to miss it.

"When basic rules of [the] game are understood, players start to think cognitively how they should respond in a new situation, actively update existing knowledge to fit what is newly confronted in the game environment" (Siang & Rao, 2003, p. 241). For more complex problem-solving in game play, cognitive constructivism theory, introduced by Jean Piaget, needs to be applied. Cognitive constructivism suggests that learners use known information and supplement it with new information (Kearsley, 2005). Successfully using cognitive constructivism in e-learning applications allows users uninhibited navigation for learning and multimedia interaction for feedback. Computer games allow for discovery learning by immersing the players in a virtual world where they learn by discovery along with trial and error (Siang & Rao, 2003).

Consciously applying learning theory to an e-learning game: *CreditSafe*©

At the request of the Director of the Securities Department, Office of the Illinois Secretary of State (ILSOS), the Usability Testing and Evaluation Center (UTEC) and the Inter-professional Project (IPRO) team at the Illinois Institute of Technology conducted a research project to design, develop and produce an e-learning game for teenagers that would supplement the curriculum. Our goals for the game were to make it:

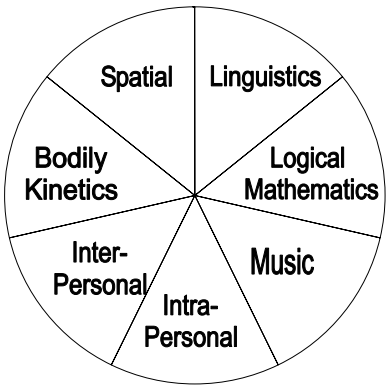
1. Educational to promote transfer of knowledge
2. Motivational to engage users during play
3. Competitive and entertaining to entice users to want to return to the game

When we began the e-learning project, we defined the target population between the ages of 13 to18. The main purpose of this e-learning game was to engage and motivate teenagers to learn more about the basics of credit card use. Our credit card game, *CreditSafe*©, allows the player to select credit cards, use them in real-life scenarios, and compete with other game-players without the risk of using their own money.

This game was meant to supplement, not replace, a classroom lesson on proper credit card use. The game provided a real-life simulation of obtaining credit cards, using them for purchases and then managing bank accounts to pay them off. In addition, the game needed to appeal to all teenage students and to stimulate learning at all levels of our student population.

CreditSafe© incorporated behavioral and cognitive constructivism learning theories similar to other games; however, to increase interactivity within the e-learning game and promote learning, we turned to learning theorist Howard Gardner for a theory of multiple intelligences, a model for teenage learners (Gardner, 1983). He describes learners as people possessing an array of skills and talents in at least seven distinct areas of mental activity (multiple intelligences). These areas are displayed in Figure 1.

Figure 1. *Gardner's theory of multiple intelligences*



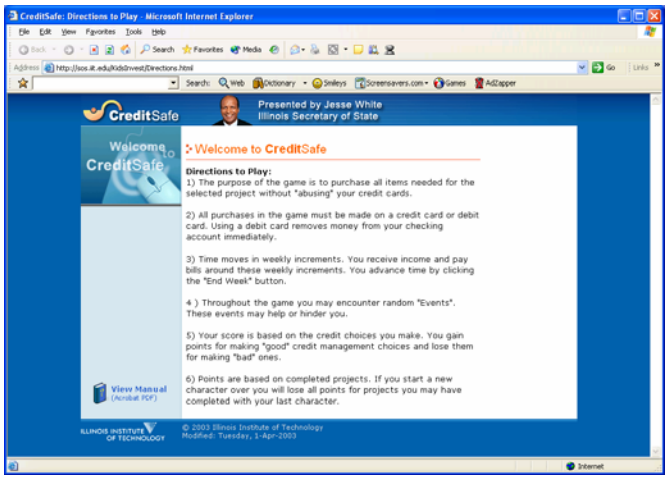
Each individual depends on an array of multiple intelligences for learning, which varies from person to person. When instruction proceeds through these broad areas of multiple intelligences, learners have more places to look for information. Learning is reinforced through the interactivity of these intelligences and can be retrieved at a faster rate.

Although Gardner did not originate the idea of multiple intelligences, he did formulize a framework that can be applied to any educational system (Gardner, 1983). We choose to apply Gardner's seven areas of intellectual activity to the development of our credit card game. In the credit card game that we developed, the player participated in the following intelligences through:

- Linguistics: content and terms from the credit card game
- Logical mathematics: annual percentage rate, grace periods, late fees, and other numerical data explained under credit cards
- Interpersonal activity: activity between the players if the game has more than one player and competitive scores are introduced
- Intrapersonal activity: activity between the person and the game; how is the player going to pay, spend, determine which credit cards to use?
- Bodily-Kinetics: use of keyboard and mouse
- Spatial: player's navigation and eye tracking on the interface
- Music: no sound in game, so this intelligence is not used.

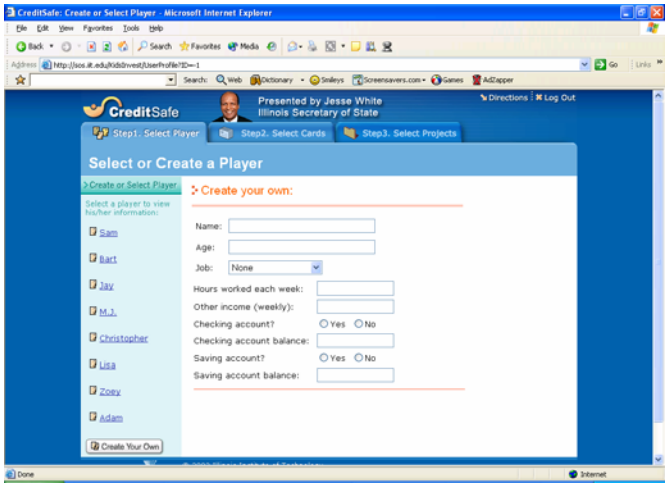
Figure 2 provides an explanation of how the game works along with how each screen activity is built around Gardner's areas of intellectual activity. Two of Gardner's principles apply to the overall game play: spatial intelligence and bodily-kinesthetic. While the user is playing the game, the game itself aids in the user's spatial intelligence through the visual presentation of the game. In addition, the game aids in the user's bodily-kinesthetic intelligence through the hand-on learning experience.

Figure 2. *Screen shots and description of CreditSafe©*



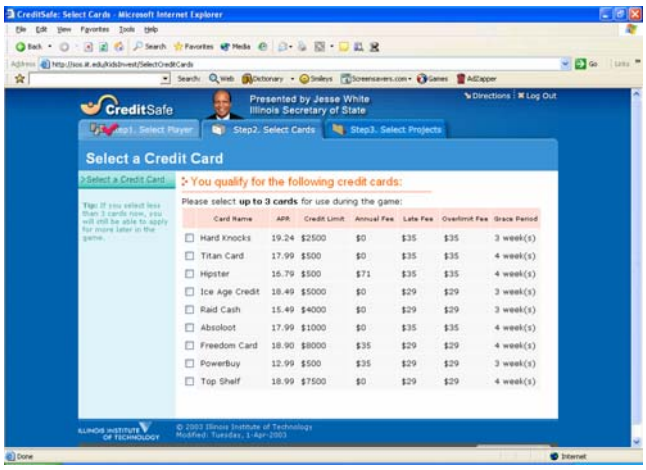
How it works:
The user logs onto the game and the initial screen for new users appears with directions for playing the game.

***Intellectual Activity:**
This screen aids in linguistics by introducing words and concepts of the game.



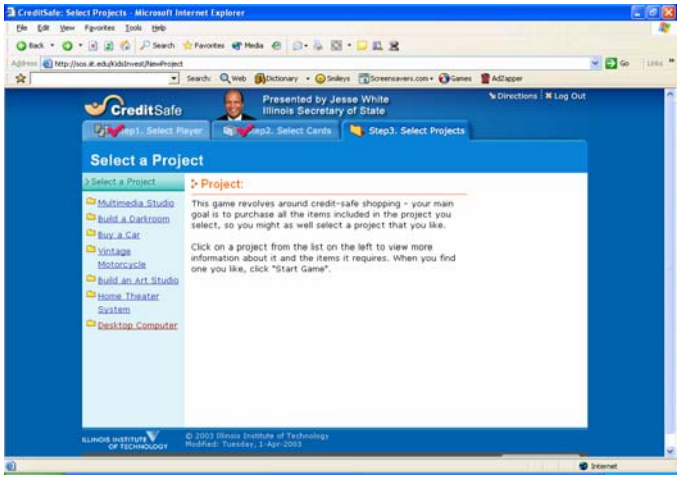
How it works:
Users must create or select a player and can choose from 7 characters or customize their own. For realism, users should try to mirror their own life.

***Intellectual Activity:**
This screen aids in the users' intrapersonal activity by having them select a character that they relate to themselves.



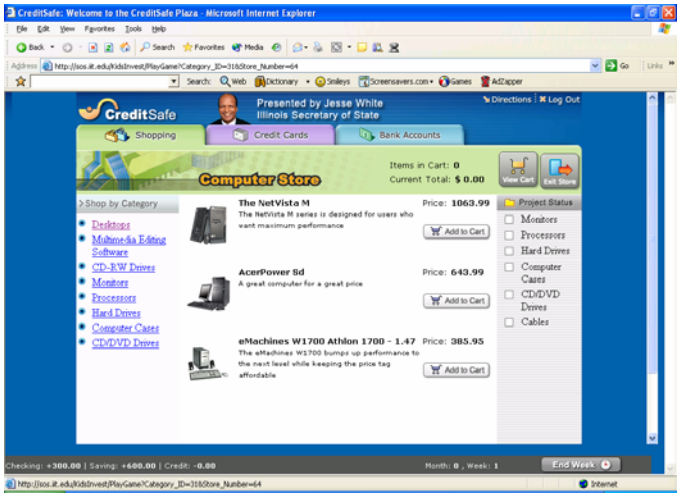
How it works:
The user may select up to 3 credit cards. Each credit card varies in its aspects such as APR, annual fee, grace period, late fee, over-limit fee, and credit limit.

***Intellectual Activity:**
This activity aids the users by allowing them to apply their knowledge of logical mathematics to numerical data (i.e. APR, grace periods, late fees, etc.). In addition, it aids in the users' intrapersonal activity by allowing them to act on their self-knowledge.



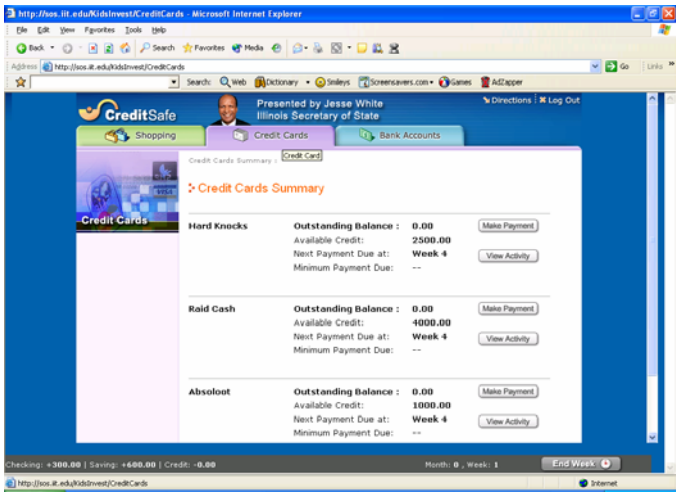
How it works:
Now the user may select a project. In order to complete a project, the user must purchase all the items within the project.

***Intellectual Activity:**
This activity aids the user's intrapersonal activity by allowing the user to select a project of interest and familiarity.



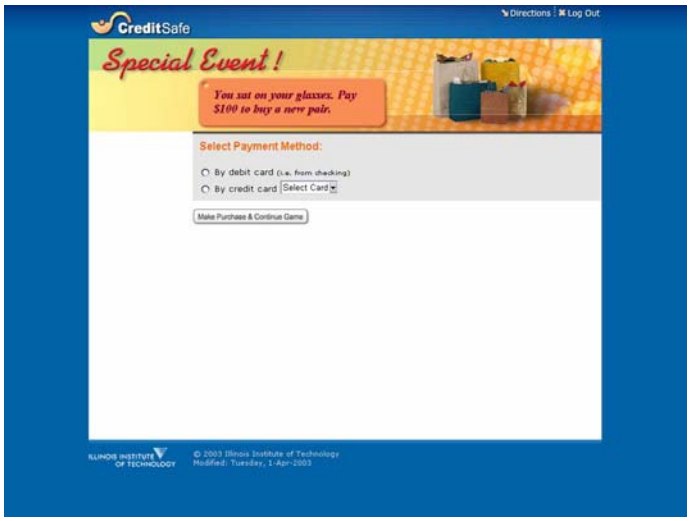
How it works:
The shopping screen allows users to select from several stores by clicking on the type of store they need to shop. The layout of each store's shopping screens is consistent from store to store.

***Intellectual Activity:**
This activity aids the user's intrapersonal activity by using a familiar e-commerce layout and icons. In addition, it aids in the user's spatial intelligence through familiar navigation.



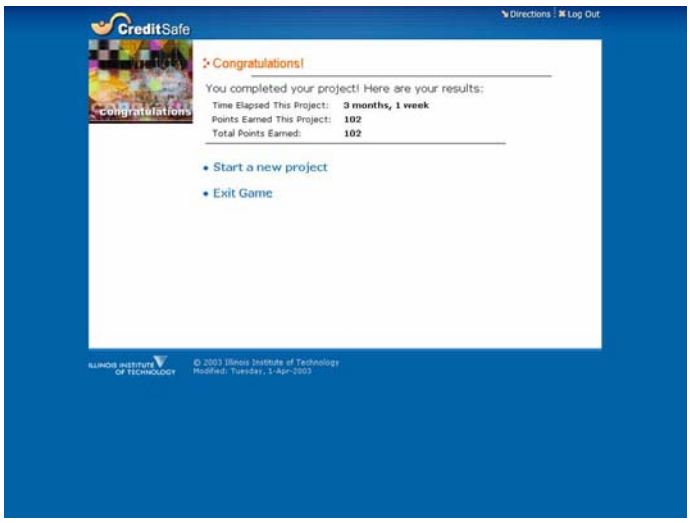
How it works:
The credit card screen allows users to view and control their credit card finances. A similar screen is the bank accounts screen, which allows users to view and control their checking and savings accounts.

***Intellectual Activity:**
This activity aids in the users' logical-mathematical activity by applying critical thinking to the management of credit cards. In addition, this aids in intrapersonal activity by using self-knowledge to act on finances.



How it works:
Pop-up events occur randomly throughout the game, similar to special events that occur in daily life. Users need to determine the most financially prudent way to pay-off the new debt or to deposit the new income.

***Intellectual Activity:**
This activity aids in logical-mathematics activity by applying critical thinking to financial events. In addition, this aids with the user's intrapersonal activity by using familiar scenarios that occur in everyday life.



How it works:
In CreditSafe, the final score is based on the decisions users make throughout the game. Good decisions are those that show prudent credit card practices. Good decisions will earn you points. Users may lose points for making bad decisions.

***Intellectual Activity:**
This activity aids in both intrapersonal and interpersonal activities by applying competition to the game through scoring.

Figure Note: Spatial intelligence and bodily-kinesthetic intelligence are functioning throughout the game-play along with the screen-specific intellectual activity. All images © IPRO Program, Illinois Institute of Technology.

Motivation in *CreditSafe*© Game Play

By applying multi-intelligence to *CreditSafe*©, the motivation and attitude toward playing the game should be positive in nature. To determine the motivation to playing the game and determine the attitude toward the game after game play, we surveyed 99 high school students. In the survey, we asked students three pretest questions to determine motivation for playing *CreditSafe*©. After the test, we asked them three attitudinal questions regarding what they perceived that they learned playing the game along with likes and dislikes of the game.

The overall demographics of the users surveyed were 43 females and 56 males ranging in ages from 13 to 18. All users had computer experience, so they were able focus on the functionality of the *CreditSafe*© game and not struggle with general computer functionality. The significant piece of information from the demographics is that only 4 out of 99 actually had a credit card. Therefore, for most users playing *CreditSafe*© was their first experience using and managing credit cards.

Users' motivation to learn more about credit cards and their use was tested and applied in our analysis. In the pre-test section of our testing procedure, each user was asked to answer a predetermined set of questions (See Table 1 below).

Table 1. Questions from the Pre-test

Do you want to learn more about credit cards and how to use them?

Yes ☐ No ☐

Do you think you need to learn more about credit cards and how to use them?

Yes ☐ No ☐

Do you think teaching students in high school about credit cards is important?

Very important ☐ Important ☐

Not important ☐ No need at all ☐

The first two questions were worth one point if answered 'yes' and zero points if answered 'no'. The third question was worth two points if the user answered 'very important', one point if the user answered 'important, and zero points if the user chose any of the other two options. Each user could attain four points for this section.

Below, Table 2 shows that 85 out of 99, or 84%, of the students playing the game were highly motivated to learn about credit cards and how to use them.

Table 2. Motivation Level for Learning about Credit Cards

	Very High (4)	**High (3)**	**Moderate (2)**	**Low (1)**	**Very Low (0)**
Number of Students	37	48	9	2	3

The post-test included attitudinal questions regarding what students perceived that they learned from the game. Below, Table 3 contains the results of the user's perspective on learning from the game. Seventy-seven percent of the students felt principle learning occurred while playing the game. This correlates closely with 84% of the students describing themselves as highly motivated to learn about credit cards and their use.

Table 3. Learning Experience using Credit Cards

	Number of Students	Selected Comments
Learning Occurred	76	"You learn about the value of money and how to use a credit card."
		"Gives us better understanding how to use credit cards"
		It teaches "how to transfer money and pay off bills"
No Learning Occurred	17	"Yes and no, taught me some small things"
		"I didn't learn anything"
Unsure if Learning Occurred	3	"Kind of, we learned that you can't spend too much at one time"
		"Somewhat, lessons learned was to help figure what you should and should not do."
No Response	3	

Below, Table 4 shows the average motivation level for those students who felt no learning occurred or were unsure whether learning occurred. Most of the students who felt no learning occurred fall into the moderate or low motivation level to learn about credit cards and their use. However, three students who were unsure whether learning occurred were highly motivated students. We can only speculate that the game did not meet their expectations or that they did not like e-learning games.

Table 4. Average Motivation of Students with No Learning or Unsure Responses

Motivation Level	Avg. Motivation	# of Students
No Learning Occurred	2.6	17
Unsure if Learning Occurred	3.3	3

Although we determined that most students felt they learned prudent credit card usage, the next step in our research is to test the type of learning that actually occurred. Further testing of Gardner's learning theory as applied to *CreditSafe*© is necessary

because the research providing a clear link between theory and practice in e-learning is just emerging (Ravenscroft, 2001).

Discussion: Why e-learning games should supplement secondary education

Prensky (2001) explained that games are a form of fun and play that provides enjoyment and pleasure to all of us. Games have goals, rules and win states that give users structure and motivation. They also are very interactive providing users positive and negative outcomes and feedback throughout play. Other features of a game are the challenge for adrenaline, the problem solving for creativity and the representation and story for emotion.

Computer games provide straightforward navigation and increased motivation, which is easier for students to stay with the game in order to learn the concepts. One popular and fun learning game that is familiar to most people is Scrabble, now played online. The game attracts users with clear stated goals and brief instructions. Scrabble is easy to get started and keeps users focused. As game plays continues, Scrabble increases in challenge and competition, which keeps users motivated to continue to play and win.

Secondary students demand to be engaged and tend to "find school much less interesting than the myriad of devices they carry in their pockets and backpacks" (Prensky, 2005, p. 60). Prensky (2005) further described how technology has provided something to engage each student whether it is to download music, play computer games, make movies, etc. Yet in school they receive "for the most part, stale, bland, and almost entirely stuff from the past" (Prensky, 2005, p. 62).

Many times in traditional education, students feel that the curriculum provided has limited relevance (Prensky, 2005). When students are using games to learn, they are actively seeing and doing, rather than listening and reading. Depending on the learning style of each student, playing a game where they are actively engaged and personally invested motivates them to retain the information presented (Whelan, 2005).

Chen (1998) discussed their "methodology to promote the learning motivation and prevent navigation disorientation by using a multi-user game" (p. 1). Through playing the game, the students are motivated to learn through practice. In addition, they focus on problem solving and rapid acquisition of skills.

Implications for future research

The objective of this paper is to show how a learning theory is applied to a specific e-learning credit card game and to discuss the importance of supplementing traditional education with e-learning games to engage and motivate students. It is imperative to supplement classroom lessons with educational computer games. This interaction between the learner and the e-learning game provides learners with a realistic scenario through which they can perform tasks and learn.

Implications for future research needs to focus on the learning objectives of e-learning games and the learning theories applied to them. Since e-learning has evolved without a structured learning theory for design, the "sexy technology" of the time becomes the genesis for development rather than learning theory and user-centered design (Ravenscroft, 2001). Our belief is that the learning objectives, user-centered design and learning theories must be applied and tested. This is the next step for CreditSafe. To determine that learning objectives are met, proper usability testing and evaluation need to occur.

Contributors

Laura Batson is a PhD candidate in Technical Communication at the Illinois Institute of Technology (IIT). In addition, she is an accomplished technical communication specialist skilled in usability, instructional design, technical writing, and project management. She has managed projects for over 9 years, managing all phases of the product development life-cycle.

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