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ABSTRACT

The focus for games has broadened beyond entertainment only purposes to serve as a vital tool in education, training, marketing, health and fitness, etc. In the paper, a newly designed and developed 2D educational game is introduced by a group of students, librarians, and faculty at Middle Georgia State University. The purpose of the game is to teach college students information literacy. Students are expected to become more comfortable with various facets of the research process such as using keywords in searches, identifying sources, and properly citing references. To increase student interest, the game is woven around an adventure story that uses a variety of mini games designed to both further the plot and teach basic information literacy concepts. The game adopts an interactive branching dialog system that can enforce learning by trial-and-error as well as enhance student engagement.

Keywords

Educational Adventure Game, 2D, Unity, Information Literacy

INTRODUCTION

Games are being developed as effective tools for educating, motivating, and changing behavior (Riterfield, Cody, & Vorderer, 2010). Various studies show that serious games can be effectively used to facilitate deep and sustained learning (Gee J. , 2007; Morrison & Preston, 2009; Soloway, Guzdial, & Hay, 2004). Games are also making their way into education as a means of helping to motivate and engage students in the learning process.

Previously, we presented an educational game, *Chasing the Truth*, developed by a team of university students, librarians, and faculty to teach various information literacy concepts to college students (Casper, Talmage, Hollifield, Nylund, & Kwak, 2015). However, the team found that it does not provide much entertaining features and does not engage game playing students. Therefore, the team decided to completely revamp the game.

The new version of the educational game under development still has the same objectives as those intended for *Chasing the Truth*. The overall focus of the game is to increase a college student's information literacy through the introduction of an interactive learning tool. Once developed, the educational software will mostly be used for information literacy courses, but it will be a necessary tool to refer to across disciplines for the vital, and entertaining research concepts that are addressed. In the updated version of the game, an innovative, engaging adventure story cushions the learning concepts to provide an alternate

method for obtaining knowledge about a specific concept. An interactive and branching dialog system is used to enforce learning by trial-and-error. Contrary to the format of *Chasing the Truth*, *Tesla's Revenge* includes a series of mini games that were introduced and designed to teach various information literacy concepts. The new design for the game consists of three acts. The level of difficulty increases with each act, and serves as a means to build upon learned concepts and to assess a student's comprehension of concepts. The rate of completion for in game tasks will indicate whether a student has learned and understood a concept or whether a student requires more practice. After completing the first act, we conducted a pilot study using the pre-test and post-test method to see if the new design of the game would work as intended. In comparing the pre and post-tests, the pilot test results showed slight performance improvement in selecting search terms and in describing research procedures.

RELATED WORK

Games have been used in many different educational settings. Morrison and Preston studied how gaming has been suffused into the computing curriculum of major universities in the United States and found that many programs use gaming in their introductory courses to increase motivation and improve retention (Morrison & Preston, 2009).

Librarians also have been using games to teach information literacy to college students, but their attempts have not been met with much successful. Van Leer bemoans the quality of "games" that librarians have been using, stating that these *games* are more of a vehicle for exposition (VanLeer, 2006). These *games* often lack the element of interaction that users expect from games. Oftentimes, such games come across more like quizzes or tutorials than something that is played for enjoyment. Gee argues that a *good game* should be interactive, give the player feedback, and expose them to new and *well-ordered* problems, a concept very similar to the idea of scaffolding (Gee J. P., 2005). With this approach, the problems encountered by the player should be solvable based on the knowledge that they have acquired and built upon during the course of the game.

Schiller explores the similarity between the principles of sound game design and sound instruction by analyzing the elements of teaching and learning utilized in the video game *Portal* from Valve Software (Schiller, 2008). Within the game, the player is asked to complete tasks, which become more complex as the game progresses. Schiller reasons that the game design provides "more intervention to players who need it most and then gradually removes support as players demonstrate a skill level that allows them to stand on their own" (Schiller, 2008).

In the final analysis of the merits of *Portal*'s game design as a model for effective instructional design, Schiller suggests the idea that there is value in learning through trial and error and that this is something that Google and the idea of federated searching has taken away due to their focus on ease of use (Schiller, 2008). The focus on ease of use means that failure is not always visible to the user. Even if your search fails, there will be results on the page, this takes away the element of "trial and error." If the search hides your failure, where is your motivation to try something else, or to try to find better results? It could be argued that this is the true challenge for effective instruction through interactive learning to make failure not only evident, but a part of the learning process.

Games are structured in such a way as to make difficulties and challenges not only expected but also enjoyable. Gumulak and Webber found that the students they interviewed found long and difficult games are more enjoyable because of the excitement and sense of achievement that they felt when these obstacles are overcome (Gumulak & Webber, 2011). Gumulak and Webber's study examines the nature of gaming, learning, and literacies among teenagers. They set out to investigate the various ways that teenagers interact with video games. A qualitative study was run on a convenience sample of 28 young people from five local schools, in Northern England, with interviews taking place in 2009. The sample group was predominantly male, comprised of 24 males and 4 females ranging in age between 11 and 17 years old. Questions focused on identifying the types of games that the interviewees played and enjoyed, how they selected games, and what they enjoyed about them (Gumulak & Webber, 2011). Interviews were recorded and transcribed verbatim. Transcripts were read and analyzed with particular emphasis on verbal cues related to information behavior, literacy, and learning. The main reasons cited by study respondents for playing games are "challenge" and "entertainment." Interviewees also indicated seeking out games that were long and difficult. The most frequently mentioned type of game played was the first person shooter, a game where you see the world through the eyes of your chosen player and the objectives are usually killing other people or creatures (Gumulak & Webber, 2011). When asked about game related learning, students seemed to have a harder time connecting their efforts within the game to real world learning, and older respondents were especially hesitant to identify game related learning (Gumulak & Webber, 2011). While some students mentioned problem solving as a learning feature, others mentioned that learning how to play the game was applicable to real world learning.

The study also identified elements of textual literacy that can be associated with gameplay. Interviewees would identify keywords and meanings in on screen text in order to solve in-game problems, or determine what to do next. If they were having

issues with gameplay, they would realize that the text and provided information within the game could help them progress. This demonstrated that they were able to identify an information need, and were able to use resources to find necessary information to satisfy it. In summary, study participants did make active use of the text within the games to improve gameplay and solve problems within the game world (Gumulak & Webber, 2011). The study also suggested that young people are "focused on finding information to solve problems" and that they want to discover information and apply it. Games that focus too much on finding information but not enough on using it to solve a problem may not keep the player's attention (Gumulak & Webber, 2011). They concluded that an attractive appearance, effective gameplay and relevant activities, which are specific to the context, and goals of the learner are key components to creating enthusiasm when implementing well-planned game based learning.

According to information obtained from the article "Get in the Game: Developing an Information Literacy Classroom Game," the game "Quality Counts" was developed and designed to be played in class. Before a gaming session, the librarian will decide on a topic for students that is relevant to the course content for the class. Usually the topics will be newsworthy and suitable for scholarly research (Smale, 2012). Groups will search for resources related to their topic. They will try to satisfy specific criteria to judge the quality of the sources that they find. Once the students have found their suitable sources, they will have time to evaluate them using the agreed upon criteria, and the librarian leads them in a discussion. The article outlines the gameplay, the scenario, and the materials needed for playing the game in class. Smale (2012) also discusses how the gameplay scenario proceeded in class, both with students in her regular class, and when she was a visiting lecturer in another instructor's class. Two qualitative methods of assessment were used, informal observations and surveys. During each game session, observations were recorded and analyzed immediately after class. The whiteboards where the research topics and criteria were outlined were photographed. Smale discusses the importance of playtesting. She draws on previous work by Winn and Heeter (Winn & Heeter, 2007) when emphasizing the critical nature of playtesting when designing educational games. This is crucial to ensuring that both gameplay and learning outcomes are sufficiently addressed in the game design.

GAME DEVELOPMENT: *TESTLA'S REVENGE*

Gameplay and Story

Designing and developing a game usually requires a long and iterative process, and the first version of a game can be radically different from the final version. Such is the case with *Tesla's Revenge*. The development of *Tesla's Revenge* started in the summer of 2014. The first iteration of this game was titled *Chasing the Truth*, a mystery narrative, and it was a lot different from the game presented in the paper. Far along into the development cycle, our team realized *Chasing the Truth* lacked a number of features of an entertaining educational game, the most important being the overall lack of fun. The previous version, *Chasing the Truth*, was not enjoyable to play in many ways as it was too linear and unengaging in the gameplay. It was more of an instructional software that uses little gaming features and focuses on transferring knowledge. Therefore, the development team decided to reconstruct the overall design of the game.

Figure 1. Basic Game Level

For revamping the game, a game storywriter joined the team and wrote an interesting script for the new game entitled *Tesla's Revenge*. The game was transformed from a mystery game into an adventure game in which the player is a student in a library. When a mysterious malefactor blasts a hole in the middle of the building, the player is sent on a journey to uncover the mystery regarding who would cause such destruction and what would serve as motivation for the destruction. Figure 1 shows the game level depicting the destroyed library. The identity of the perpetrator remains unknown to the player until the end of the game. At the end of the game it is revealed that the enemy is an undead Nikola Tesla who is consumed with enacting revenge on the world for forgetting about his scientific contributions. Tesla uses his death beam invention to etch the hole in the middle of the library. The death beam is so appropriately named for its ability to destroy any object it passes through. Beyond its ability to enact death thoroughly, the death beam also releases chaotic energy that infuses objects around the library and turns them into monstrous creatures.

Figure 2. Player Confronting Monstrous Creature, Quotron

Figure 3. Mini-Game with Quotron for Correcting Punctuation Errors

Throughout the game, players are confronted with creatures that have been infected with the chaotic energy (as displayed Figure 2). Each encounter opens a mini game which is used to teach specific types of information literacy concepts (as shown in Figure 3). The first enemy the player will encounter in the game is *Quotron*, a giant pair of floating double quotation marks. The creature is ugly and intimidating, but if the player successfully removes the incorrect punctuation in the mini game, the *Quotron* will be cleansed and leave in peace. Other mini games (as shown in Figure 4 and Figure 5) include a keyword search game that is used to recalibrate the search engine within the library computers, and a word sorting game that unclogs the water pipes so the fires around the building will be put out. These mini games have three purposes: to engage and entertain the player,

to teach a learning concept, and progress the story. These purposes are shared by the entire game. Learning from our past mistakes, *Tesla's Revenge* is an interactive, fun, and wacky educational game that will entertain students of all ages.
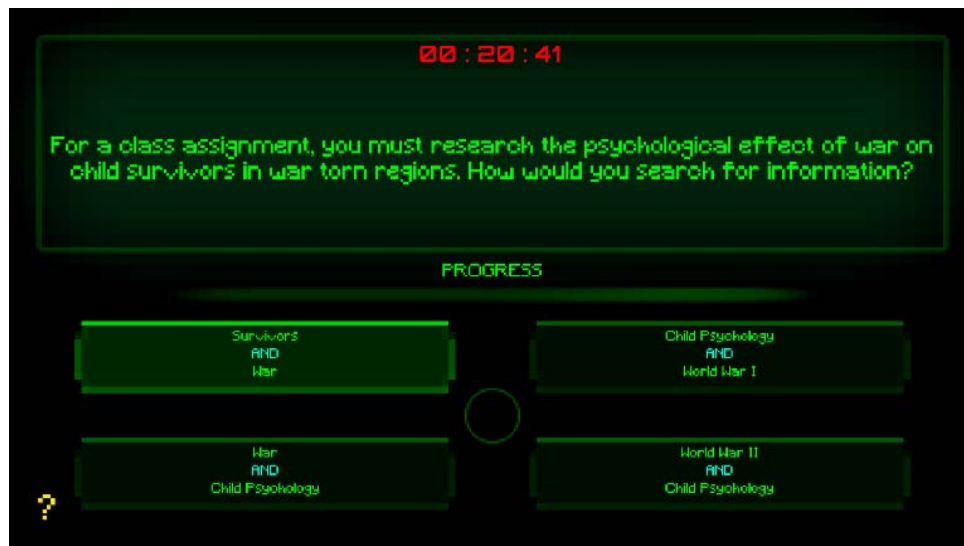

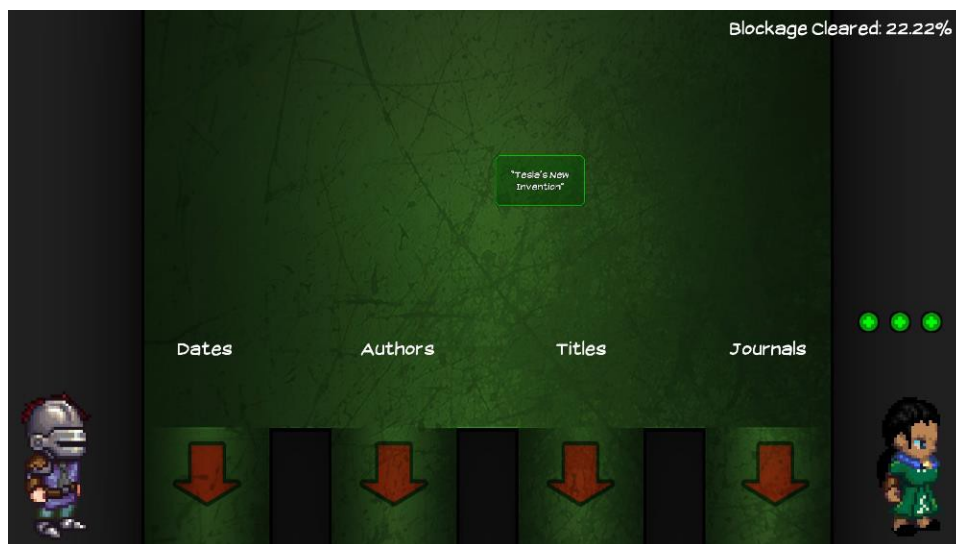**Figure 4. Mini-Game for Selecting Appropriate Search Keywords**

Figure 5. Mini-Game for Word Sorting

Art Work and Development

Tesla's Revenge is a 2D, 8-bit style game. The art style is modeled after older 2D games. The style chosen for the game not only makes it fun to develop, but also game designers and programmers thought it would make the game more appealing to any age player. The art designer responsible for all of the art generated every artistic element himself. The only items that constructed by the art designer are the temporary placeholder pieces and plugins that will not be present in the final version of the game. These images were created using Adobe Photoshop.

Tesla's Revenge is currently being developed using the Unity 3D game engine. Unity, a powerful and versatile tool, has been an integral part of the developmental process. Unlike its predecessor, which relied solely on gameplay using the mouse, *Tesla's Revenge* uses keyboard input to control the character and mouse interaction for extra control. The player may control their character with the arrow keys and the "F" key to interact with the world. Mini games are controlled in much of the same fashion.

The game is split into three major scenes and progress in the story is made by completing Quests and speaking to the right people in the library. Each of these scenes will take place on one of the floors of the building.

The User Interface (UI), what the player sees on the screen, is very simple. The Quest panel can be found in the top left corner, and the player can access the panel to see what quests need to be accomplished during a specific phase of the game. Unity's new UI system made it possible to build an inventory system for the game. The player to look at what he or she is currently holding. A dialogue system has also been included in the game. The dialogue system allows players to interact and converse with other non-playable characters (NPCs) within the game. Players will be able to extract vital information concerning what is going on or what quest to follow from these non-playable characters.

Both the dialogue and the inventory systems were created by third parties. These systems were purchased to streamline and decrease the development time of Tesla's Revenge. The dialogue system, created by the Pixel Crushers team, is especially powerful and includes the save system currently implemented in the game as well as the dialogue system.

PILOT STUDY

The entire game consists of three acts. To evaluate the first act of the newly developed game, a pilot study has been conducted by using a set of pre and post-test questions. For the pilot testing, seven individuals including library student workers and staffs were recruited. As a pre-test, student workers and librarians were asked three questions: one open-ended question and two multiple-choice questions for keyword search. The following questions were asked as a pre-test.

1. *You are assigned to write a research paper on the topic of your choice. You pick depression and bullying among teenagers. In 3-5 sentences, describe how you would go about doing your research.*

2. *What would be an appropriate set of keywords to use in a search for information about Dr. Martin Luther King?*
    a. *Martin Luther AND Church*
    b. *Civil Rights movement AND figures*
    c. *Atlanta AND 1960s*
    d. *Dr. Martin Luther King, Jr. AND biography*

3. *What pieces of information would you need to take note of in order to cite an article from a scholarly journal for an assignment?*
    a. *Web URL AND sponsoring organization*
    b. *Title of the website AND date it was last updated*
    c. *Author of the article AND Journal title*

These questions were designed to assess an individual's ability to develop a manageable topic and research question, and to demonstrate a familiarity with keyword usage and basic citation information. Game activities in the first act were designed to provide an interactive platform upon which individuals can learn and practice using keyword searches, citations documentation, and proper quotation usage in research papers. Although the completion rate of the demo varied, the initial results from the testing demonstrated a knowledge regarding formulating a research topic, executing keyword searches, and citing documents.

Average game completion time was about 17 mins. After playing the game, three questions including one open-ended question and two multiple-choice questions about keyword search were asked to the game testers as post-test questions. The following questions were asked as post-test questions.

1. *You must write a paper on poverty in the United States. In 3-5 sentences, describe your research process.*

2. *What would be the appropriate set of keywords to find information about the effect of social media on personality?*
    a. *Social media AND psychological effects*
    b. *Facebook AND money*
    c. *Twitter AND small business*
    d. *Marketing AND social media*

3. *Which of the pieces of information would you need in order to properly cite an article from a scholarly journal for an assignment?*
    a. *Title of the website AND date it was last updated*
    b. *Author of the article AND journal title*
    c. *Web URL AND sponsoring organization*
    d. *Volume Number AND Date Accessed*

According to the data we obtained from the pre and post-tests, we were able to see that the majority of the participants already knew what they were doing in regards to keyword searches. All test participants already possessed vast knowledge on how to utilize research mechanics effectively. We attribute their knowledge to being obtained from working in library. As a result, our beta testing data was not as fruitful as we had hoped. The knowledge that our test subjects already possessed made it impossible to determine whether the game improved their understanding of the material presented. However, our pilot test results revealed a slight increase in precision with regard to selecting search keywords and describing research process. Fortunately, from our first testers we were able to derive valuable suggestions to enhance our game. Such suggestions included commentary on gaming mechanics, the difficulty of the presented content, and the inclusion of more detailed instructions. These enhancements will be present during the next wave of testing. We have determined that further testing would be most beneficial with a less experienced group of researchers, and that testing involving faculty will serve as a means to verify content.

In our next wave of testing, the test subjects will mostly be classrooms of freshmen. Through them we will obtain more useful results regarding the benefits the game produces in student engagement and understanding.

CONCLUSION AND FUTURE WORK

The development of educational video games is a vital tool for the school industry for such games provide students with alternate methods to learn and understand a particular subject. The 2D educational adventure game introduced in this paper is still currently under development. Upon its completion, the game will offer instructors an innovative and engaging way to promote student interest and comprehension. The development team composed of students, librarians, and faculty at Middle Georgia State University predict that the game will be completed in the next few months. A demonstration of the first act has been completed and the second act is the primary focus of the team now. The script of the entire game is finished, barring a few minor adjustments for gameplay. The team is currently focusing on the essential core gameplay functionality and developing mini-games of the second and third acts.

As we develop the remaining two acts, we plan to further enhance the first act by referring to the pilot test results. Furthermore we will fully evaluate the finished game using newly developed evaluation questions. The test subjects of the final evaluation will be freshmen since they are the intended audience for the game. From the final evaluation, we will be able to obtain more useful implications regarding the benefits of the educational adventure game in student engagement and understanding.

REFERENCES

Casper, D., Talmage, C., Hollifield, S., Nylund, C., & Kwak, M. (2015). Chasing the Truth: An Educational Game for Information Literacy and Student Engagement. *18th of Southern Association for Information Systems Conference (SAIS).* Hilton Head, South Carolina.

Gee, J. (2007). *Good Video Games and Good Learning: Collected Essays on Video Games, Learning and Literacy* (1st ed.). New York: Peter Lang International Academic Publishers.

Gee, J. P. (2005). Good video games and good learning. *Phi Kappa Phi Forum*, 33-37.

Gumulak, S., & Webber, S. (2011). Playing video games: learning and information literacy. *Aslib Proceedings, 63*(2/3), 241-255.

Morrison, B. B., & Preston, J. A. (2009, March). Engagement: gaming throughout the curriculum. *ACM SIGCSE Bulletin, 41*(1), pp. 342-346 .

Prenski, M. (2006). *Digital game-based learning.* New York: McGraw-Hill.

Riterfield, U., Cody, M., & Vorderer, P. (2010). *Serious games: mechanisms and effects.* New York: Routledge.

Schiller, N. (2008). A portal to student learning: what instruction librarians can learn from video game design. *Reference Services Review*, 351-365.

Smale, M. A. (2012). Get in the Game: Developing an Information Literacy Classroom Game. *Journal of Library Innovation, 3*(1), 126-147.

Soloway, E., Guzdial, M., & Hay, K. E. (2004). Learner-centered design: The challenge for HCI in the 21st century. *interactions, 1*(2), pp. 36-48.

VanLeer, L. (2006). Interactive Gaming Vs. Library Tutorials for Information Literacy: A Resource Guide. *Journal of the Indiana Library Federation, 25*(4).

Winn, B., & Heeter, C. (2007). Resolving conflicts in educational game design through playtesting. *Innovate: Journal of Online Education, 3*(2).