Beetle Bug Fire Safety Adventure Game

Barbara Freedman

University of North Texas

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Dr. Jones

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Abstract

The interactive multimedia adventure game *Beetle Bug Fire Safety Adventure Game* was developed as a tool for parents to use with children ages 2 – 5. The game aims to help parents teach children the importance of developing a fire safety plan for the home and training children on the concept of leaving the home in the event of a fire. In the game, children are asked to imagine they are in their home and are given basic choices they might encounter in the event of a fire. All choices eventually lead to the ultimate goal of leaving the home safely and convening at a location outside the home with other family members. Developers envision the game to possibly be used in a research project by preschool educators on the efficacy of a multimedia tool to teach concepts of safety to preschool children. Details on the possible research parameters are included here.

Keywords: adventure game, multimedia, fire safety, early childhood

Beetle Bug Fire Safety Adventure Game

The interactive multimedia adventure game *Beetle Bug Fire Safety Adventure Game* was developed by a team of researchers and developers formed in a course on multimedia systems design and theory that is part of the requirements for the fulfillment of a Ph.D. in Learning Technologies from the University of North Texas. The team is made of University of North Texas Department of Learning Technologies students Barbara Freedman, Jaimie (Jim) Reborn, Ron Steiner, and Jessica Wagner. The resulting game can be found at the website http://ltec6210adventuregame.com.

The course designers discussed ideas for the required adventure game. One of the course designers had access to an artist who had previously designed a series of lessons on fire safety for young children. Artist Rodney Talley gave permission to use his art and materials for this project (personal communication, October 4, 2016). The details of the agreement can be found in Appendix A. The lessons were available in an existing mobile device application called "Beetle Bug" (Talley, 2013). According to Talley (personal communication, November 18, 2016), the original lessons were developed in conjunction with the Professional Firefighters Group of Charlotte, NC as a tool for parents to use with children ages 2 – 5 to help develop a home safety plan with the purpose of training children what to do in the event of a home fire.

Game Design

The *Beetle Bug Fire Safety Adventure Game* addresses several fire safety protocols that reinforce the concept of following a fire exit plan to leave the home in case of a fire. The target learner is expected to use the website with an adult participant. Ideally, this is a family endeavor as the game is intended to be an aid in fire safety protocol specific to a family's living environment.

The game is housed on a website using a Wordpress template. Participants choose options and pages of the site using a mouse. Participants are asked a question and they can choose from two options and use the mouse to click on the option chosen. Each option brings the participant to a new page with a multimedia display of the fire safety protocol to be learned and other options for play. There are no wrong answers but a redirection of choices that do not follow the protocol. Participants will be guided through the limited choices presented to eventually land on the game's "safe" page that indicates they have safely exited the home. A prize of a sing-a-long song will load and play automatically when the participant lands on the safe page.

Learning Theory

The epistemological position for the design of this course is based on a combination and of cognitivism and constructivism. Lev Vygotsky's Social Development Theory is considered when determining the depth of elaboration appropriate to the target learner for this educational adventure game and the impact the participation of the adult guide has on the students' learning (Vygotsky, 1962, 1978). Additionally, this game calls for an adult or older participant to assist the target learner through the game. The more knowledgeable other (MKO) (Vygotsky, 1978) assists the target learner through using the technology to play the game also through the game itself. The MKO scaffolds learning (Wood, Bruner, & Ross, 1976) to assist the target learning in playing and completing the game. In this game, there are no wrong answers but redirection toward the ultimate goal (Cooper, 1993), get to safety.

Experiential learning theory grounds the design approach adopted from Inter*PLAY*. Clark (2004) created a "new" design theory based on experiential learning developed over the years by Dewey, Kolb, Merrill, and others with a focus on Merrill's first principles to develop guided learning theory (GEL). According to Clark (2004), GEL contains the following elements: the

goal of the lesson, reasons and activation, demonstration of first principles of experiential instruction, application, integration, and assessment. Hirumi (2014b) used GEL as an option for Level III interactions, learner-instructor interactions, the "meta-level that transcends and is used to guide the design and sequencing of Level II interactions" (p. 50).

Instructional Design

The instructional design chosen for this project is grounded design for online and hybrid learning using Inter*PLAY* concepts adapted from Atsusi Hirumi based on guided experiential learning theory. According to Hannafin, Hannafin, Land, and Oliver (1997), "grounded-learning systems design is defined as the systematic implementation of processes and procedures that are rooted in established theory and research in human learning" (p. 102). Hirumi (2014a) explained grounded design further by explaining grounded design "articulates and aligns theory with practice to optimize learning" (p. 2).

Hirumi (2014b) offered a solution for "sequencing e-learning interactions to engage learners and facilitate student achievement" (p. 45) that involves a three-level framework. In this framework, Level I is internal learner interaction, Level II is human and nonhuman interactions, and Level III is learner-instruction interactions. These interactions are all connected and eventually circle back on one another. Level III interactions, associated with a lesson, define a strategy to guide the design of Level II interactions between the learner and human and nonhuman resources, which stimulate Level I interactions within the learner's mind (Hirumi, 2014b).

Stapleton and Hirumi (2014) developed a "learner-centered approach for fostering innovative thinking and creative problem solving" (p. 159) called Inter*PLAY*. Inter*PLAY* builds on existing experiential theories by integrating story, play, and game with the basic elements of

instruction to "evoke emotions, spark imagination, and foster creativity and innovative thinking" (Stapleton & Hirumi, 2014, p. 160). The Inter*PLAY* strategy utilizes conventions found in interactive entertainment to facilitate learning. It is suggested a learning environment utilizing Inter*PLAY* include six instructional events: expose, inquire, discover, create, experiment, and share (Stapleton & Hirumi, 2014). These events are the basis for the design of the *Beetle Bug Fire Safety Adventure Game.* A learner assessment alignment table with the learning objectives for the project based on Hirumi's (2014) design was developed and can be found in Appendix B.

Calendar and Roles

A timeline was to be included and submitted to the professor as part of the original proposal for the project in the course for which the game was designed and can be found in Appendix C. Team member roles were also to be included and submitted to the professor of the course as part of the original proposal for the project in the course for which it was designed and can be found in Appendix D.

Multimedia

This game was designed specifically for a course in multimedia systems design and theory. Multimedia can be defined as the use of more than one form of communication is presented simultaneously (Mayer, 1997; Mayer, Moreno, Boire, & Vagge, 1999). In the case of *Beetle Bug Fire Safety Adventure Game,* the developers constructed an online environment via a website using text, fixed full-color images, animation, and sound. Target learners view a page with information and choose a path of action by using the mouse to click one of two options. The choice made takes the target learner to a new site page that provides information on that path or redirects to another path via visual content. Each screen is a multimedia instructional message (Mayer & Moreno, 2002) containing text, fixed and animated pictures, and sound narration. The

multiplicity of tools on a single site page, visual and auditory, builds in differentiation based a variety of possible learners intelligence (Gardner, 1993). However, although there is text on the screen, the content to be learned is delivered using graphics and narration alone. This is in keeping with Mayer's (2014) multimedia design principals of modality and redundancy. Modality, as Mayer states, is when ''people learn better from a multimedia lesson when words are spoken rather than printed'' (Mayer 2014, p. 393). Redundancy is ''that people learn better from graphics with spoken words than from graphics with redundant spoken and printed words'' (Mayer 2014, p. 392).

Proposed Research Questions

1. Does implementing multimedia adventure gameplay assist families with creating a fire safety plan for their home and family?
2. Does implementing multimedia adventure gameplay have an impact on children's knowledge of fire safety protocols specific to leaving the home in the event of a fire?

Methodology of Proposed Research

Research Design

This proposed research is aimed at understanding the efficacy of the interactive multimedia adventure game *Beetle Bug Fire Safety Adventure Game* as a specific tool for knowledge transfer and retention. The current model of the game does not include a way to collect data on user interaction with the game nor does it include a survey for the MKO to complete. It does not currently have an assessment tool constructed in the game other than the target learner's ability to navigate successfully toward the "safe" page. The game could be designed in a different delivery model to track the number of clicks it takes for the participant to complete the game successfully to reach the "safe" page. A formative assessment could track the

number of clicks it takes for the participants to reach the website "safe" page. The data collected could compare formative and summative assessments. If participants use fewer clicks in the summative assessment rather than the formative, the assertion might be that content knowledge was gained.

A survey for the MKO could also be included as part of the study. Once the game is reviewed by the MKO, the participant could play the game again as a summative assessment. Data collected from each assessment could be compared to determine the efficacy of the tool in knowledge acquisition. Additionally, a survey could be created for the MKO to complete pre-assessment and post-assessment that would give demographic information about the participant and the impressions of the MKO on the game that would include the MKO's assessment of the efficacy of the use of the game in transferring knowledge about fire safety and to what degree did the game assist in helping the family design and teach a fire safety plan for their home. This survey could be in the form of a questionnaire that would use a Likert-type scale for each question such that the data collected would be quantitative. Open-ended question or opportunities for comment could be included in the questionnaire.

Research could compare participant's knowledge gained or not within demographics. Demographics to be compared may include ages groups, income demographics, the location of participants, and gender of participants. This study might concur with recent research that has found game-based learning should produce consistent results across genders (Lester, Spires, Nietfeld, Minogue, Mott, & Lobene, 2014).

Location of the Proposed Study

This research can take place in a school with a teacher as a guide or at home with a parent as the original game was intended by the creator/artist. Gaining access to children can only be

made ultimately through the parent. It is important for researchers to be mindful of protocols when involving children. In addition to child's safety and well-being, the value of the research is increased when utilizing ethically sound techniques when working with children (Thomas & O'Kane, 1998). Establishing a good rapport with children's gatekeepers can have positive effects on access to children for research (Thomas & O'Kane, 1998). Careful consideration should be made that all children are studied in the same environment as where they participate in the research may have an effect on their participation (Morrow & Richards, 1996). Given these considerations, using the parent in the conducting the research study in the child's home with the parent as the MKO may be the better option for the environment of the proposed research study.

Problems

Although he formative and summative assessments are based on quantitative data collected through gameplay, the process of the gameplay is not immune to flaws in data collection. Performing the assessments in the child's home with the parent may be easier for the child and parent as the MKO but makes it difficult for the researchers to observe the process of the game-play during the formative and summative assessments. The parent must then deliver the formative and summative assessments in isolation from researchers observations thus becoming an active participant in the research; in essence, they become a research assistant. Given the parent as MKO helps the child participant clicking through the game, they might inadvertently or deliberately help the child choose the "correct" answers. This leads to researcher bias on the part of the parent as a research assistant.

The use of a multimedia tool may be more engaging for the target learner but may not have any direct effect on learning (Dousay, 2016). It will be difficult to assess if the participant completes the summative assessment with fewer clicks than the formative assessment, ostensibly

indicating a concept learned, because they have actually learned the concept or if they are just remembering "correct" choices. Participants may recall the correct choice on the screen, the left or right, or by the picture, rather than making a choice based on a concept learned.

Implications For Future Research

This topic, fire safety, is a serious issue. The development of materials to assist parents and teachers in teaching this specific aspect of fire safety, exiting the house safely in the event of a fire, can be constructive. As Lester, et al note, "Empirical studies have demonstrated that students achieve significant learning gains from interacting with educational games in a range of subjects." (p. 4). However, care should be used when implementing this tool as the successful use of the tool may not be an indicator of successful knowledge acquisition or the practical application of this knowledge is a real-life emergency situation. Successful use of a multimedia instructional aide does not automatically translate to impacting behavior (Schwebel & McClure, 2014). This game provides materials for knowledge-based learning process but does not bridge the gap toward practical application by providing real-life procedural knowledge or materials (Gobet & Wood, 1999). It does not provide an opportunity for synchronous application in the home. Construction of additional materials for parents or teachers to use to help design a practical application of the concepts learned is encouraged and application of these materials in further research to determine their efficacy is warranted.

It is cautioned that *Beetle Bug Fire Safety Adventure Game* does not attempt to include enough options nor is it designed in a framework for it to be a tool to encourage problem-solving in a real-life situation (Kim, & Hannafin, 2011). Although the construction of this game is intended to provide a tool for parents or teachers to use to introduce one specific aspect of fire safety, it does not provide a plethora of options for the target learner. There is only one scenario

given, a multi-level house or apartment building with fire escapes. This may not be the actual home scenario encountered by the target learner. In this regard, this game addresses cursory issues and concepts of escaping a house on fire. A more in-depth tool could be developed that can have options for the parent or teachers to design a house more like the target learner's actual home environment. This might be a better foundation upon which to test for practical application of knowledge. More research would be needed with the new tool.

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Appendix A

Artist and Designers' Agreement

As part of our Ph.D. studies in Learning Technologies at the University of North Texas, Department of Learning Technologies, students in the course 6210: Interactive Multimedia Theory and Design, fall 2016, have been tasked with a project to create an educational multimedia adventure game that can be accessed online. The team of students, Barbara Freedman, Jaime Reborn, Ron Steiner, and Jessyca Wagner (further referred to as "Team"), will be using the basic concept of fire safety instruction as the educational foundation. The instructional design, generally speaking, will be aimed at teaching, reinforcing, and checking for understanding of the concepts. Since the Team is hopeful to use a 2D design rather than just a text-based product, the Team will be using artwork. Rodney Talley, principal and artist of http://www.childsafetyapps.com, has agreed to allow us to use his Beetle Bug characters and other art as needed for this design. Mr. Talley has been gracious to volunteer to create new material if needed. The Team and Mr. Talley understand that the design, use of the artwork, and implementation of the game is for a course requirement as part of the Team's Ph.D. program and will be limited to the Ph.D. program including the dissemination of the website URL once the game has been completed. In other words, all of the Team's work, instructional design, game design, programming, sound design, art, and all other work, tangible or time, related to this product design, production, and implementation for the course work requirement, is protected under the US Copyright Agreement and Fair Use for limited educational purposes of the Team as part of the Ph.D. program (not the educational product and use of the product with others outside the Team and this course!). If there is any interest in the product on a commercial level, all parties will have to reevaluate and discuss in a separate agreement.

Appendix B

Learner Assessment Alignment

Skill/Standard	**Learning Objective**	**Classification of Objective**	**Assessment Method**
Recognize what's hot	Given graphic representations of common household objects, identify hot, unsafe items you should stay away from. (EO1)	Understand	Product Checklist / Rubric
Recognize a hazardous situation	Make a list of all items seen in a video that represent a hazardous situation. (EO2)	Understand	Product Checklist / Rubric
Call for help	Demonstrate ability to properly call for help, including what information to provide to the dispatcher. (EO3)	Apply	Performance Checklist / Rubric
Home fire escape	Generate a home fire escape checklist. (EO4)	Create	Product Checklist / Rubric
Know what to do if trapped in your home	Exhibit proper technique for exiting your home if there is a fire and smoke already in the house. (EO5)	Apply	Performance Checklist / Rubric
Know ways to prevent a fire in your home	Given a graphic representation of a home, identify fire safety items and list any items missing. (EO6)	Evaluate	Product Checklist / Rubric
Exhibit ability to react properly to a fire situation in your home	Navigate through a simulation of a fire in the home performing all tasks learned in the course correctly and in the proper order. (TO)	Apply	Performance Checklist / Rubric

Appendix C

Proposed Timeline

9/26/2016	Proposal draft including ID plan, timelines, and responsibilities of each member
10/3/2016	Storyboard done
10/10/2016	Status update #1
10/17/2016	Work on project
10/24/2016	Work on project
10/31/2016	Work on project and prepare status update
11/7/2016	Status update #2
11/14/2016	Finalize project for draft submission
11/21/2016	Draft due
11/28/2016	Peer review
12/5/2016	Presentation
12/12/2016	Project and Final Paper Due

Appendix D

Team Member Roles

Roles	**Team Member**
Instructional Design	Ron Steiner & Jessyca Wagner
Artist liaison	Barb Freedman
Programmer	Jim Reborn
Story designers	Barb Freedman & Jessyca Wagner
Rubrics	Ron Steiner
Sound engineer	Barb Freedman & Jim Reborn
Artist	Rodney Talley
Graphic User Interface (GUI) Designer	Jim Reborn
Project Manager	Ron Steiner
Tester	All