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Game Design and Homemade PowerPoint Games: An Examination of the Justifications and a Review of the Research

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Research on educational games often focuses on the benefits that playing games has on student achievement. However, there is a growing body of research examining the benefits of having students design games rather than play them. Problems with game design as an instructional tool include the additional instruction on the programming language itself as well as the potential costs associated with new software. One way to mitigate these problems is to use *Microsoft PowerPoint* as game design software. While not intended for this purpose, *MS PowerPoint* is ubiquitous in schools and requires little additional instruction before students can design games. In this literature review, we introduce homemade PowerPoint games, examine the three pedagogical justifications for their use (i.e., constructionism, narrative writing, and question writing), and review research studies involving homemade PowerPoint games. When we compared the recommendations from the literature for the justifications with how the homemade PowerPoint games were implemented, we found that the recommendations were not followed. Future research examining the use of homemade PowerPoint games should look to better align the implementation of a game design project with recommendations based on the research examining the individual justifications.

Aldrich (2005) defined an educational game as a simulation that has elements of entertainment. While their purpose is to educate, games themselves, "…do not support learning objectives directly" (p. 85). Games have built-in inefficiencies. For example, Aldrich stated that there are numerous ways of putting a ball in a hole that are better than using a golf club that make obtaining the objective more time consuming yet more enjoyable at the same time. At a deeper level, games provide learners with opportunities to collaborate, problem-solve, and to develop a sense of place in a simulated world through self-discovery (Kafai, 2006). Games can help contribute rich experiences that are often not found in a traditional classroom setting, and those experiences can provide skills that students need in the twenty-first century (Kebritchi & Hirumi, 2008).

Research has shown that games been found to increase motivation, teach complex understanding, provide opportunities for reflective learning, and give feedback and points for self-regulation (Betrus & Botturi, 2010). However, games are not a panacea for all that ails education (Prensky, 2008); for all of their benefits as a tool for maintaining motivation and interest (Gee, 2003), empirical research has not made a convincing case for their use in classrooms (Hays, 2010). The research has often shown neither an advantage nor disadvantage over traditional instructional methods, and given the complexity of tying instruction to games, one could question the extra use of time and other resources for little or no additional benefit.

While research has often focused on how students learn by playing games, a separate line of research has examined the effects of students acting as designers of educational games. The idea of students learning by building an artifact, such as a game, has been called constructionism (Papert, 1991). Kafai (2006) contrasted the instructivist method of using games as a way to sweeten learning, where through game design students construct knowledge while building technological fluency through their design decisions.

One of the problems associated with game design as an instructional strategy is the time commitment involved; in addition to the content, students must learn a programming language as well (Barbour, Thomas, Rauscher, & Rieber, 2008). The teacher may not have the requisite skill to program, let alone teach how to program in a computer language. Therefore, researchers have looked at "low-tech" ways to have students create games while still using computers, getting the benefits believed to be associated with constructionist teaching without the time and resource allocation. One way teachers can use game design to teach is by using *Microsoft PowerPoint* as a game design tool. *MS PowerPoint* is ubiquitous in schools, and while it does not have the capabilities of many programming languages such as *Scratch* or *Alice*, it requires little additional instruction before students can begin designing games.

Proponents of homemade PowerPoint games have provided three philosophical justifications to support their use as an instructional tool (Barbour, Thomas, Rauscher, & Rieber, 2010). First, the games are consistent with constructionist pedagogy. Second, the students gain a deeper understanding of the material by writing concise narratives for the games. Third, the students must write quality questions for the game, which further enhances their understanding of the material. However, despite these justifications, studies involving the use of *MS PowerPoint* as a game design tool have, for the most part, shown no benefits to student performance over traditional methods (Siko, Barbour, & Toker, 2011; Barbour, Clesson, & Adams, 2011; Barbour, Kinsella, & Rieber, 2011; Parker, 2004). Current research is being conducted to examine why instruction using homemade PowerPoint games have not shown additional benefits over traditional methods of instruction. The purpose of this literature review is to examine whether prior research and implementation of homemade PowerPoint game projects were congruent with the justifications for their use. In other words, was there evidence of the three justifications in each of the previous studies involving homemade PowerPoint games?

In this literature review, we will first describe homemade PowerPoint games in detail. We will then review the research on homemade PowerPoint games to date. We will then examine research on the three philosophical justifications for using homemade PowerPoint games in the classroom: 1) constructionism (as it relates to games and game design), 2) the use of narratives as an instructional tool, and 3) student generated questions. In the results section, we will discuss how the studies examining homemade PowerPoint games demonstrate the three justifications. Finally, we will identify future directions for research involving homemade PowerPoint games.

METHODOLOGY

In order to conduct the literature review, the authors researched the literature using two methods. With respect to studies on homemade PowerPoint games, the literature was collected based on the authors' personal knowledge and participation in previous studies. Additional searches using Google Scholar yielded no additional results.

For the literature review on the justifications for the use of homemade PowerPoint games, we began by reviewing the supporting literature in the aforementioned studies using homemade PowerPoint games. Further, we utilized the Education Resources Information Center, ProQuest, and Academic Onefile databases, along with Google Scholar. First, we used the "cited by" feature on Google Scholar to find more recent articles which cited the seminal works noted in the original research for the games. Second, we conducted our own searches for literature on the three justifications.

We used a variety of search terms, including constructionism, game design, narratives, microtheme, writing across the curriculum, student generated questions, and student questioning. Our search was limited by the electronic databases available at Wayne State University, the Michigan e-Library and Catalog Resource System, and open access services.

WHAT IS A HOMEMADE POWERPOINT GAME?

A homemade PowerPoint game is one of several low-tech games built from the *MS Office* suite (for another example of games using *MS Office*, see the game project at http://www.excelgames.org). Homemade PowerPoint games can be created from scratch or by using an existing template (n.b., for the research discussed in this literature review, games were created from a template which can be found at http://it.coe.uga.edu/wwild/pptgames). A screenshot of a title screen created from a template is shown in Figure 1.

Figure 1. An introductory screen from a typical homemade PowerPoint game.

The game can be contained completely within the *MS PowerPoint* file or the game can require additional materials (e.g., a game board or dice). In the case of the former, digital photographs or scans can be taken of a hand-drawn game board and inserted into the file, or the materials can be created in *MS PowerPoint*. An example of an external game board can be seen in Figure 2.

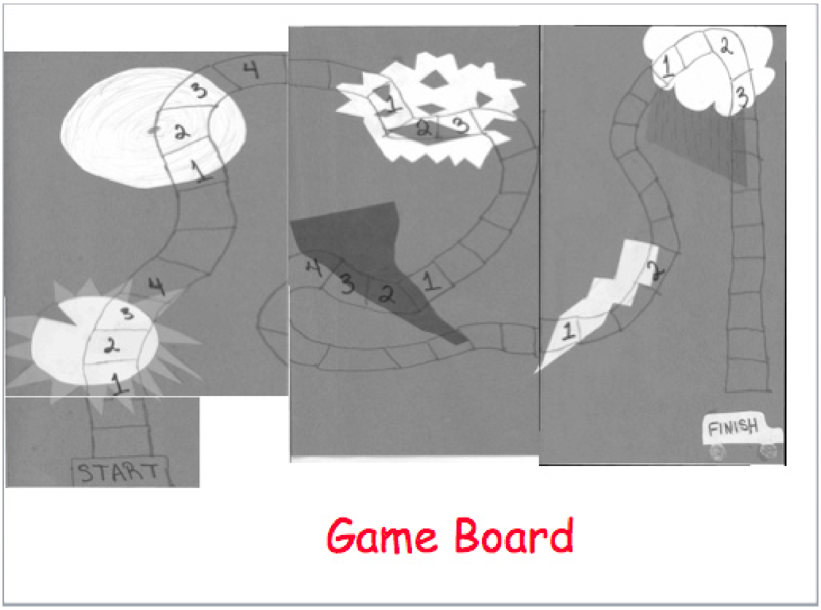

Figure 2. An example of a slide containing a game board that must be printed before playing.

In the directions the players were instructed to print off said slides in order to play the game. Students create a game narrative, which is presented at the beginning of the game and should be limited to one slide. An example of a narrative is presented in Figure 3.

Figure 3. A narrative from a homemade PowerPoint game.

Players are given directions on how to play and win the game on a single slide separate from the narrative. An example of a direction slide is shown in Figure 4.

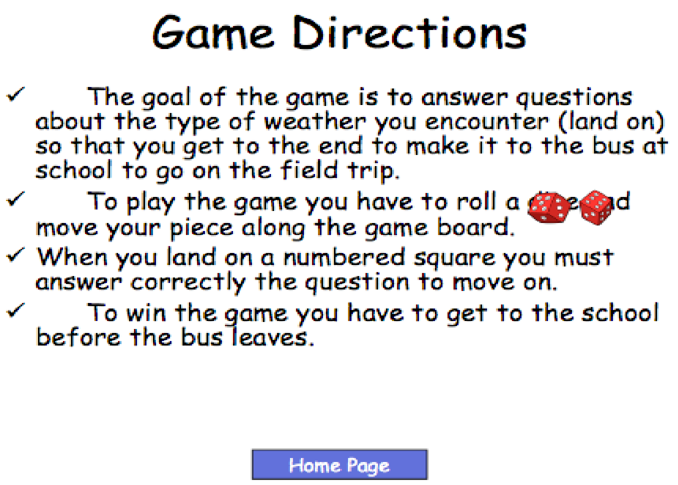

Figure 4. A slide containing the directions for a homemade PowerPoint game.

In this particular game, which was created by elementary students for a unit on weather, the players are presented with the scenario of needing to answer questions about weather in order to safely make their way to the school bus to attend a field trip.

Players navigate through the game by answering multiple choice questions correctly to eventually achieve the goal stated in the narrative (see Figure 5).

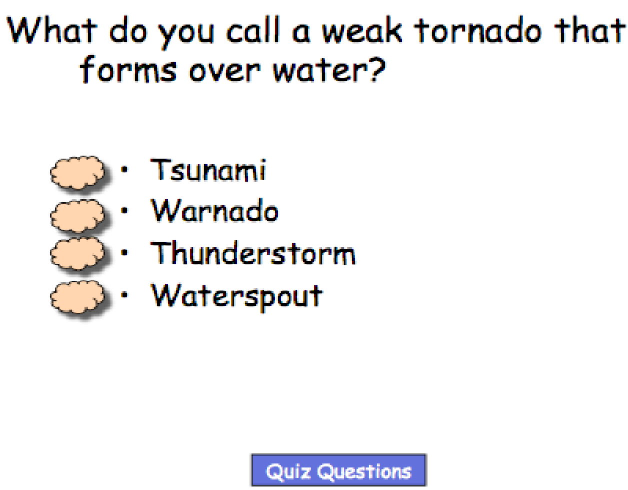

Figure 5. A screenshot of a typical multiple choice question.

For this game, students answered questions on various weather phenomena. For this question, a waterspout is a weak tornado that forms over water. Clicking on that button will take a student to a slide acknowledging that the answer was correct, and the player would continue.

Homemade PowerPoint games can be "won" in a variety of ways. Games with external game boards and dice would have a goal of making it to the end of the board. Games with no external parts would include penalties for incorrect answers. Some game would send a player back to the beginning of the game. Other games would incorporate "checkpoints" where players would return if they answered a question incorrectly after reaching a checkpoint. Some games included a scorecard where two players kept track of correct answers or points earned for answering questions correctly. Finally, some games have clues distributed throughout the game and a final challenge in order to reach the end.

The typical process for implementing a game design project consisted of five consecutive days in the computer lab (Barbour, Rieber, Thomas, & Rauscher, 2009). On the first day, students play various styles of homemade PowerPoint games (i.e., self-contained games and games that required additional materials). After playing the games, the teacher will lead a discussion on what makes a game good and interesting. Generally, students work in groups of two or three for the project. For homework, students begin creating questions for their games and brainstorm ideas for a game narrative. A typical game consists of ten questions per group member, so most games generally have 20-30 questions. On the second day, students usually receive instructions on how to download the template as well as how to create action buttons in *MS PowerPoint*. While students are often very familiar with viewing and creating presentations using *MS PowerPoint*, action buttons are often a feature students have never used. For the rest of the second day and continuing into the third and fourth days, students have time during class to construct their games. When students complete their games, they play their own games to look for errors. On the last day any students still not finished complete their games, while the groups that are finished played each other's games. Shortly after the game project is completed, an assessment of the content is taken.

RESEARCH INVOLVING HOMEMADE POWERPOINT GAMES

To date, many studies using homemade PowerPoint games as a review tool have not shown statistically significant differences in student performance between control and treatment groups. For example, in a study using homemade PowerPoint games to teach grammar to middle school students, Parker (2004) did show that students who created games showed increases in their scores between the pre-test and post-test, but the control group showed greater gains. By simply examining the scores without the context of previous student performance, one would have considered the games as a detriment. However, Parker noted that the control group, who normally outperformed the treatment group, actually scored lower on the pre-test compared to their previous performance in the class. Thus, their gains appeared greater than the group who created the games. As for the merits of creating the games, Parker stated the students in the treatment group scored higher on the post-test than their class average or scores on previous assessments would have predicted. The average for the treatment group as a whole was a near failing grade on previous assessments yet achieved a passing grade on the post-test. Parker concluded that the games improved student motivation for the students.

There have been several studies about the use of homemade PowerPoint games conducted at the secondary level. Barbour, Clesson, and Adams (2011) conducted a study in a British literature class comparing the performance of students who created games as a review exercise versus those who completed a more traditional review. The study showed no statistically significant difference in performance between the groups. However, the authors noted the small sample size (i.e., 15 students in the control group and 20 in the treatment group) as a possible reason for those results. Barbour, Kinsella, and Rieber (2011) conducted a similar study in a U.S. history course that was taught in a blended (i.e., instruction occurred in both face-to-face and through a course management system), where students created a homemade PowerPoint game to review one chapter, but completed a traditional review for the other chapters. Again, the researchers found no statistically significant difference in student performance on content for which they created games, although the students who did create the games performed slightly better than the control group.

Since one of the justifications for using homemade PowerPoint games as an instructional tool is the premise that students will write higher-order questions, the researchers suggested a lack of higher-order questions as a possible explanation for the no significant difference findings. Barbour et al. (2009) examined the data from the Barbour, Kinsella, et al. (2011) study to see if students were indeed writing higher-order questions. They analyzed over 1,900 student questions, and a large majority of them (i.e., 94%) were determined to be "Knowledge" level, with an inter-rater reliability of 97%. Furthermore, none of the questions analyzed were above the "Application" level on Bloom's Taxonomy.

The largest study involving homemade PowerPoint games to date involved approximately 150 students enrolled in an environmental chemistry course (Siko et al., 2011). In the first iteration of this study, the researchers replicated the protocol from the previous studies to obtain baseline data, since they were examining the effects of the games in a different content area. Student performance was compared on two separate unit tests. On both unit tests, there was no statistically significant difference in performance. Due to the nature of scheduling at the school where the study occurred, it was also possible see if those who created games twice performed better than those who only created games once for the second assessment. While the group who created games for both units in the study performed better than those who created games for only the second unit, it was still not statistically significant.

Similar to the Barbour et al. (2009) study, Siko (in press) analyzed the student-generated questions from the Siko et al. (2011) study. Two researchers independently coded 625 questions for the first unit test and 661 questions for the second unit, with an inter-rater reliability of 86% and 96%, respectively. The coding revealed that approximately 61% of the questions from the first unit and approximately 67% of the questions from the second unit were "Knowledge" level questions. While these numbers indicate that students are wrote more higher-order questions than in the Barbour et al. (2009) study, student performance in both studies were the same (i.e., no statistically significant difference between control and treatment). Siko et al. (2011) also posited that the inherent nature of a high school science course versus a social studies course would contain more problem-solving content, and thus students should write more higher-order questions.

Siko and Barbour (2012), in the second iteration of the Siko et al. (2011) study, examined the effectiveness of more structure to the game design assignment. The implementation of the project was different that previous protocols, where the questions, narratives, and games were constructed in the days leading up to the test as a review. Instead, the project was spread out over the entire unit. Fewer days were spent in the computer lab, and most of the work was completed prior to going into the computer lab. These changes were made due to the observations made by Siko et al. (2011) that students spent time writing questions in the computer lab (i.e., when they were assigned as homework), and students showed became more easily distracted after four consecutive days in the lab. Further, Siko et al. (2011) questioned whether a review exercise could be considered a constructionist activity. For the first unit, students were given guidelines for the number of knowledge, comprehension, and application questions the game could contain (i.e., for a group of two writing a total of 20 questions, ten, five, and five questions, respectively). For the first unit, the control group performed better than the group that created the games, and it was determined to be statistically significant ($p < .05$).

For the second unit, even more structure was provided. Students were given the project at the beginning of the unit. Due dates for drafts of both the narratives and questions were given and, unlike previous iterations, feedback was given to the students. In the protocols for prior studies (i.e., four or five consecutive days in the computer lab), there was little opportunity for the teacher to review and provide feedback for the students. The addition of feedback and revisions was supported by the research of Lotherington and Ronda (2010), along with Rickards and DiVesta (1974). For this unit, the students who created games performed statistically significantly better than the treatment group ($p < .01$). This was the first statistically significant difference in student performance in favor of students creating the homemade PowerPoint games that has been reported. Siko and Barbour (2012) suggested that future research should continue to examine how the implementation of the game design project with respect to structure affects student performance.

To date, research involving homemade PowerPoint games has shown no statistical difference in performance when the games were used as a review tool prior to an assessment. In these instances the games were created at the end of a unit where students spent four or five consecutive days in the computer lab learning about the games, receiving instruction on the technical aspects of the games, and then constructing the games. However, when the games were part of a longer unit-long project rather than a review, a statistically significant difference in student performance was found. Research has also examined one of the justifications for the use of the games: student-generated questions. In two separate studies, it was found that students primarily wrote "Knowledge"-level questions.

JUSTIFICATIONS FOR HOMEMADE POWERPOINT GAMES

Published research on homemade PowerPoint games (Barbour, Clesson, et al., 2011; Barbour, Kinsella, et al., 2011; Parker, 2004) have listed three pedagogical justifications for their use in classrooms. The first justification was that the creation of the games is consistent with constructionist pedagogy, first championed by Seymour Papert (1980). The second justification was the games' reliance on writing a narrative, which encompasses ideas such as microtheme writing and writing across the curriculum (Ambron, 1987; Garner, 1994). Finally, homemade PowerPoint games involved student-generated question writing (Wong, 1985). The following section describes each of the justifications in detail and provides an overview of the literature.

Constructivism and Constructionism

Constructivism, as a learning theory, stresses learning by building knowledge structures (Papert, 1991). Smith and Ragan (2005) defined three key tenets for constructivist design. First, knowledge is built on experience. Second, learning results from personal interpretation of knowledge. Third, learning is an active process. Good constructivist design principles include opportunities for students to express their opinions, create their own meaning, and share control of the classroom (Richey, Klein, & Tracey, 2011). Further, the role of the instructor in a constructivist learning environment is to act as a guide to help students form connections between previous experiences and new ones. The activities in the environment are relevant and meaningful to the student, and promoter higher-order thinking.

Constructivist learning environments contain principles of discovery learning and active learning, the former involving minimal guidance with no predetermined outcome, and the latter emphasizing higher level interactions with old and new knowledge through higher-order processes (Richey, et al., 2011). Constructivist learning environments are often contextualized in real-life situations to increase student motivation, and often contain ill-structured problems that students must define the problem, collaborate with one another, and reflect on their own values in order to solve the problem.

Constructionism is an extension of constructivist pedagogy. Seymour Papert, a student of Piaget, coined the term in his work with students using the *Logo* programming language. The simplest definition of constructionism is "learning by making" (Papert, 1991). As Kafai (2001) noted, young children are inherently good at making games anywhere they are at play, both by modifying existing games and inventing their own. Paraphrasing Piaget, Kafai felt that this construction of games was an effort by children to master their environment and make sense of the world. At the core of constructionism is a student-generated artifact (Rieber, 2004). The artifact is created as a result of a set of driving questions or activities, and acts as a representation of student cognition that can be shared and critiqued. Questions are ill-structured, and the artifact should represent how the student's thought processes changed over time.

Papert's seminal work about constructionism and the programming language *Logo* was *Mindstorms*. The main purpose of *Logo* was to control a small box on the screen (called a "turtle") through commands in the program to create geometric shapes. In *Mindstorms*, Papert (1980) was weary of the computer being used to teach the child, which was the dominant use of computers in education at the time in the form of computer-assisted instruction. Papert felt that it should be the other way around, where the child teaches the computer through programming. In this process, the student was building their knowledge through debugging the program. Papert equated this process as being similar to how a child learns their native language with relative ease, yet struggles through the traditional process of learning additional languages later in life. Papert (1987) went on to illustrate how computer programming through *Logo* helped to teach mathematical problem-solving and geometry, particularly with students who struggled in a traditional math classroom.

Constructionism in Game Design

Kafai, Ching, and Marshall (1997) examined student learning by building astronomy resources for younger children. Fifth and sixth-grade students created astronomy games for younger students using *Logo*. The 26 students worked in groups of three or four to design a game that was to be played by students in the fourth grade revolving around answering a question about an astronomy topic (e.g., "What is the Big Bang?"). The students who designed the games showed statistically significant gains between the pre-test and post-test in both astronomy and *Logo*. However, *Logo*, with its simplistic layout, is unfortunately no longer flashy enough to compete with today's games (Overmars, 2004). Teaching with *Logo* still persists, and there are annual practitioner conferences around the world, and recent publications on *Logo* tend to be more for practitioner-focused.

Efforts in game design research have tried to create programming languages that are advanced enough to appeal to today's media consumers but still at a level that students can understand (Resnick, 2009). One example of this is the programming platform entitled *Scratch* (http://scratch.mit.edu/). Developed at the Massachusetts Institute of Technology, *Scratch* is an open-source programming language geared toward students age 8-16 that allows them to create stories, games, and art. It is combined with a community of learners that teach and borrow from one another (Resnick, 2009). The purpose of *Scratch* is not to create computer programmers; rather, it is meant to foster twenty-first century skills, such as collaboration, problem solving, and creativity. Resnick noted that students can consume media but are often not proficient at creating media, and thus by teaching students to create media they can increase their digital fluency as well as their computational thinking skills.

Peppler and Kafai (2007) discussed in detail the effects *Scratch* had on students in urban settings with respect to informal learning. They noted that in their research they had seen students drawn toward games and projects that had sufficient demands but were still accessible. Further, users of media were discriminating readers but had trouble verbalizing those characteristics. In other words, young consumers of media know what is good but cannot put those traits into words. Peppler and Kafai found that creating media helps learners to better verbalize (i.e., be vocally critical of) their discrimination of media. With *Scratch*'s online community, there are opportunities for informal learning as well. Their research in urban settings provided examples of art and games that became teachable moments for topics such as American urban culture and the analysis of media.

In a similar retrospective study, Kafai, Peppler, and Chiu (2007) looked at how programming became part of the culture of their research site – an urban community center called the Clubhouse Design Studio – over time. They noted that while *Logo* was available to the students and teachers, it was rarely used. With the addition of *Scratch* to the Clubhouse Design Studio, the number of programming projects increased overall and the majority of them were created using *Scratch*. The authors listed several reasons for the shift. First, since the mentors at the community center (i.e., undergraduate students) were novices at *Scratch* as well, it generated a learning environment where the mentors and students learned from one another. Second, *Scratch* allowed for media-rich programming where students could manipulate high quality digital images as objects in the *Scratch* environment.

Another study involving the urban community center analyzed the programming acumen of the students over the course of the study (Maloney, Peppler, Kafai, Resnick, & Rusk, 2008). The researchers collected 536 projects and analyzed the programming content for use of concepts such as user interaction, loops, conditional statements, random numbers, variables, communication and synchronization, and Boolean logic. Of the seven categories of programming content, five showed statistically significant gains between projects collected during the first and second years of the project, indicating a growth in the ability of students to design more advanced projects. Moreover, the students did not relate their actions to computer programming, with some actually giving the researchers a quizzical look when asked what computer programming was. The researchers indicated that the students used terms such as "cool" or "fun," not realizing that what they were doing was indeed computer science. However, some students did see the career potential if they continued to excel in game and media design.

Another programming language, *Alice* (http://www.alice.org/), is a 3-D environment that also allows students to create games and digital stories. As their website notes, it features a drag-and-drop interface that creates "a more engaging, less frustrating first programming experience" (Carnegie Mellon University, 2011, ¶ 1). Sung, Shirley, and Rosenberg (2007) discussed the enhancement of a college computer graphics course with *Alice*. While the original intent of the course was computer graphics, many students mistook the class for a game design course; and as a result the course was modified to meet all of the computer graphics objectives while students designed games for the course. The researchers noted that despite an increased workload and little time dedicated to the programming aspects of the course, student attitudes regarding the workload remained unchanged, and the projects created by the students contained richer graphical environments than in previous semesters of the course that did not use *Alice*.

Alice has also been used to increase the knowledge of computer programming concepts among non-computer science majors. Bishop-Clark, Courte, Evans, and Howard (2007) examined three areas (i.e., knowledge, enjoyment, and confidence levels) with students who were not computer science majors using *Alice* in a university setting. In a survey of 154 students, which also include pretest and posttest data, students showed significant gains in all three categories after completing a series of tutorials about *Alice* and two programming exercises. *Alice* has also been used at the K-12 level. For example, Rodger et al. (2010), while teaching *Alice* at the university level for years, have begun efforts to infuse *Alice* into elementary school curriculum. The authors detailed efforts to provide training to elementary teachers by providing summer workshops, tutorials, quiz templates and technical support to hundreds of teachers. These efforts have been similar to the original *Logo* trainings with summer workshops for teachers (Logo Foundation, 2000).

A key component to constructivist and constructionist techniques is finding the appropriate level of structure to the lessons. On one hand, several studies have shown that constructivist teaching methods are not superior to guided methods of instruction. Kirschner, Sweller, and Clark's (2006) review of constructivist and project-based learning concluded that guided instruction is overwhelmingly superior to methods that provide minimal guidance. In addition, according to what was then current knowledge of cognition and information processing, it was detrimental to take novices through a process of application without a solid base of knowledge. Mayer (2004) also pointed out the lack of successes with instruction using minimal guidance methods, specifically citing studies using *Logo*, in his review of constructivist literature. Kurland and Pea (1985) found that students who learned *Logo* under pure discovery conditions could write simple programs, but were never able to write complex programs built of simple, fundamental concepts. Interviews showed that the students had many incorrect assumptions about programming in *Logo*. In a separate study, Pea and Kurland (1984) also found that students with extensive experience in *Logo* were no better on tests of planning than control groups. This was contrary to Papert's assumption that *Logo* taught students how to problem solve. However, these studies were conducted in situations where *Logo* was taught in a pure discovery format. Mayer (2004) did find that students who were given extensive training in *Logo* were able to outperform students who learned *Logo* under pure discovery conditions, but failed to mention any results that compared those students to a control group who received no training in *Logo*. Mayer concluded by saying that guided instruction in *Logo* is a prerequisite for transfer, and that Papert was often misunderstood as being a sole proponent of pure discovery learning.

With respect to the actual construction of a homemade PowerPoint game, constructionism can be seen on three levels: the actual *MS PowerPoint* file into a coherent game, the creation of a storyline or narrative for the game, and the construction of the questions themselves. As stated earlier, the purpose for using *MS PowerPoint* as the vehicle to construct the game is to limit the amount of technical acumen needed to implement constructionism. Both teachers and students have a working knowledge of how to use the program. Similarly, the second philosophical justification for creating games, the writing of the narrative or storyline, relies on simplicity as well.

Narratives

The second justification for the use of homemade PowerPoint games in the classroom is the aspect of writing a narrative for the game. Many games have a story that is embedded in the rules and objectives of the game. For example, the game of *Monopoly*® employs the narrative of competing real estate barons whose goal is to own as much property as possible and to force the others into bankruptcy. Narratives are written in everyday language, unlike the unfamiliar language of scientific texts or edu-speak (Avraamidou & Osborne, 2009). This mysterious language is believed to alienate students; therefore, it is believed that science education should make a move toward writing in the everyday language contained in books, movies, and television (Prain & Hand, 1996). By extension, this also could include designing games around a science fiction storyline.

Gough (1993) believed that science fiction could serve as an avenue for helping students grasp the social context of science. Science fiction is often set in the future, and the stories told provide a way of describing how the characters arrived at that point in time. Working backwards to the present, students can begin to grasp how the events of today shape tomorrow, providing meaning to the content by showing how it will directly influence their future. Jang (2009) examined how technology and writing affected student motivation in a seventh-grade science class. The students were allowed to foster real-life examples of content being covered (e.g., dieting and weight management during a nutrition unit). Using qualitative methods, the researcher found the ability for students to create their own meaningful context for content increased motivation, problem-solving skills, and creativity. The study also concluded that creativity did not occur on its own; the environment needed to be highly structured to achieve optimal creativity. Pickens and Eick (2009) also noted increased interest in more inquiry-based assignments for lower achieving students.

Further, Glynn and Muth (1994) discussed the importance of writing as an instructional tool in science. Metacognitive processes involving retrieval, organization, and writing skills force students to work with new knowledge and existing schema. When given a writing assignment, students must consider all of these in addition to the audience for which the writing assignment is intended. However, studies involving writing across the curriculum have not been overwhelmingly convincing. In a meta-analysis of 48 writing across the curriculum studies, Bangert-Drowns, Hurley, and Wilkinson (2004) found only a small but positive impact in achievement from the implementation of such strategies. They found that using the strategies in the appropriate context was beneficial, and that strategies using metacognitive prompts showed enhanced effects. The authors also found the length of the writing assignment reduced the effects of the strategy. The last finding was applicable to games, as the narratives for games are not lengthy (Dickey, 2006). Game designers do not want players to spend inordinate amounts of time reading; they simply want you to get the gist of the game and start playing as quickly as possible. In the example given above for *Monopoly®*, the narrative can either be found on the box itself or in a small handout. This style of condensed writing assignments, where ideas are written as concisely as possible, is consistent with the type of writing required by microthemes (Stewart, Myers, & Culley, 2010).

Ambron (1987) stated that the difference between note-taking and various narrative-based writing assignments (i.e., journals and microthemes) was that the latter involved an active engagement in the content. Collins (2000) compared the performance of biology students who either completed a series of microtheme assignments or a longer term paper, and found that students who completed more microtheme assignments (i.e., 9-11 assignments) scored 13.2% higher on test scores than those who completed the term paper assignments. Furthermore, Kirpatrick (1984) examined the effects of the use of microthemes in a physics course and also found increased student achievement on tests. Finally, Stanley (1991) and her colleagues noted increased motivation and participation with the use of microthemes in technology courses offered at community colleges. A theme consistent in all three studies was the notion of dispelling myths that writing strategies are solely for English courses.

Garner (1994) examined the use of microthemes in a college accounting class. He noted that writing across the curriculum was useful to help in the active engagement of students, and believed microthemes helped students create a structured and focused argument due to the microtheme's limited space. Anecdotal evidence indicated assignment grades rose from almost all low grades to very few low grades. Teacher evaluation scores also rose, and 80% of the students voted that the use of microthemes should remain as part of the curriculum. Stewart, Myers, and Culley (2010) conducted a study using a microtheme writing strategy in a women's psychology course. Throughout the semester the treatment group was given several short, unannounced microtheme writing assignments during class time, while the control group did not. Near the end of the semester both groups were given an assessment consisting of multiple-choice questions and an essay that was similar to the microtheme assignments given to the treatment group. The group who wrote microthemes scored statistically significantly higher on both portions of the test than the control group.

In summary, the use of short writing exercises in subject areas other than English language arts has been shown to be an effective tool for increasing both student performance and motivation. Proponents of homemade PowerPoint games stated that the storyline of the game is an example of a microtheme narrative, since it is limited to the space on a single *MS PowerPoint* slide. The final philosophical justification, constructing questions for the game, requires students to consider many variables. Yet, similar to microthemes, questions need to be revised and reworded to be as clear as possible. In the next section, we look at research involving the use of student-generated questions as an instructional strategy.

Question Writing

The final philosophical justification for using homemade PowerPoint games as an instructional strategy is the act of providing challenge to the game by writing relevant questions based on the material (Barbour, Kromrei, et al., 2009). In addition, the students must come up with several choices. The students must obviously have the correct option, but they must also create plausible yet incorrect options as distracters. The students are learning what is incorrect as well as reinforcing the correct answer. The process of developing questions, choosing a correct answer, and developing plausible incorrect alternatives forces the students to analyze the content, even addressing their own misconceptions about the material. Chin and Osborne (2008) stated that there were four reasons for students to write questions in science:

- "direct their learning and drive knowledge constructions;
- foster discussion and debate, thereby enhancing the quality of discourse and classroom talk;
- help them to self-evaluate and monitor their understanding; and
- increase their motivation and interest in a topic by arousing their epistemic curiosity" (p. 3).

Wong (1985), in reviewing 27 studies using self-questioning techniques, gave three theoretical justifications for using self-generated questions as an instructional strategy. First, self-questioning was a form of active processing, which helped learners guide their thinking. Second, self-questioning was supported by metacognitive principles, where students became self-aware of their current level of understanding. Third, schema theory supported the use of self-questioning, since questioning was a way to integrate new information with current schema. Wong found the majority of these studies did enhance learning. However, the results were not overwhelmingly convincing, since there were studies that showed no difference in performance and a few that showed negative results. Upon further examination, Wong determined the level of direct instruction on how to write questions, goals involving more higher-order questions, and the amount of processing time given were all key factors in more successful studies. Wong's findings were also supported by Rosenshine, Meister, and Chapman (1996), who found that reading comprehension generally increased when question writing was used as a comprehension strategy.

Lotherington and Ronda (2010) conducted a study involving fourth-grade students creating online board games for geography content. They found that students wrote better questions over time when given the opportunity to not only revise their questions, but to help edit the questions of other classmates as well. Based on classroom observations, the authors found the children to be excited and engaged throughout the project. Harper, Etkina, and Lin (2003) examined question-generating interventions in an introductory physics course. Over a period of eight weeks, students generated questions based on the physics content, and these questions were rated based on the level of difficulty. Roughly half of the questions written by students were rated as low difficulty, while the other half of the questions were rated as being of medium or high difficulty. Test scores showed no relationship between student performance and the number of questions written. However, a significant relationship was found between student learning and the number of conceptually difficult questions written.

Conversely, a similar study by Berry and Chew (2008) examined student performance in an introductory psychology course over three exams and found no relationship between question difficulty and performance. When these authors compared the groups who wrote questions versus those who did not, they found the group writing questions made significant gains in performance over the course of the three exams. In other words, the students writing questions were performing at a lower level earlier in the semester but had erased those differences by the end of the semester. The authors noted a potential reason for the differences in findings between their study and the Harper et al. (2003) study with respect to question difficulty could be the content in the introductory courses. In other words, an introductory physics course may require more higher-order thinking skills than an introductory psychology course. An introductory psychology course may require more factual knowledge than analytical skills. Thus, students who wrote more difficult questions were better prepared for the assessments in the physics course, whereas analytical skills were not emphasized in the introductory psychology course.

Chin and Osborne (2008), in their literature review of question generation in science, found several common themes. They stated that the nature of the questioning in classrooms has evolved over time from factual exercises to socio-cultural and inquiry-based questions. In addition, the skill needed to be explicitly taught to the students, through scaffolds, prompts, and modeling. While they stated the strategy could lead to positive outcomes, it was ultimately the responsibility of the teacher to foster an environment of inquiry. Herring (2010) provided support for the latter from his qualitative study of question generation at three Australian secondary schools. Further, Herring found a generally favorable attitude toward the technique; however, small pockets of students did not find question generation helpful. With respect to transferring the technique to other courses and for future use, transferring the technique was more of a function of school culture rather than the techniques themselves.

Question writing has been shown to be an effective instructional strategy. There are differing views on whether the quality (i.e., level of difficulty), the quantity of questions written, or both have a greater effect on student performance (Berry & Chew, 2008; Harper, et al., 2003). However, there is general agreement that the effectiveness of the strategy can be enhanced through practice, feedback, and scaffolding. The primary challenge in a homemade PowerPoint game is to answer questions created by the designer. The designer must pay attention not only to the construction of the question and the correct answer, but also the alternative choices (Barbour, Rieber, et al., 2009). This process should be supported by teacher through modeling and feedback (Lotherington & Ronda, 2010).

In this section we have reviewed the three justifications for the use of homemade PowerPoint games in the classroom. Constructionist philosophy promotes learning through the building of the homemade PowerPoint game. Writing the narrative or game story gives students an opportunity to demonstrate their knowledge in short, concise writing exercises. Question generation to provide the appropriate level of challenge to their games allows students to develop their understanding through the demonstrating their knowledge of what is correct as well as what is incorrect. The support for these justifications was generally positive but not overwhelmingly so. In the next section we will look specifically at how these findings related the justifications for using homemade PowerPoint games are reflected in the studies examining the games themselves.

DISCUSSION

Given the research involving the justifications for the use of homemade PowerPoint games in the classroom, it would seem that researchers would have little difficulty seeing significant findings in studies examining the implementation of a game project in the classroom. Therefore, we need to question how well the justifications align in practice in the studies examining homemade PowerPoint games.

With respect to constructionism, Siko et al. (2011) first suggested that the game projects, used as a review exercise, did not constitute constructionism. On one hand, the students did create an artifact representing their knowledge. In theory, however, the students would have already learned all of the content through other instructional methods; the game was solely a reinforcement tool applied immediately before the students were given an assessment. Siko and Barbour (2012), in the second iteration of the study, altered the implementation of the game project away from a review tool to a project that extended through the entire unit. This change, along with others (i.e., corrective feedback, revisions, requirements on question difficulty), may have led to the only statistically significant finding in any of the research examining homemade PowerPoint games.

In the studies examining narratives, researchers found that writing about science could affect motivation (Jang, 2009), and these motivating effects could be seen in lower achieving students (Pickens & Eick, 2009). Parker (2004) suggested that these effects could be seen in lower performing students who created homemade PowerPoint games. However, researchers have yet to examine the effects of homemade PowerPoint games on lower achieving students.

In terms of student performance, the review conducted by Bangert-Drowns et al. (2004) only found a small, positive change in achievement from writing across the curriculum strategies. And while studies examining microthemes have shown increased achievement when the technique is used (Collins, 2000; Kirkpatrick & Pittendrigh, 1984; Stewart, et al., 2010), these microtheme assignments dealt with writing about the content. There is a difference between writing a narrative for a game (i.e., fiction) and writing a concise answer to a question posed by an instructor about the content. If a homemade PowerPoint game contained a narrative extrinsic to the content, the justification does not stand. However, Siko and Barbour (2012) addressed this issue by requiring students to relate their story to a content-specific narrative so that the story fostered questions related to scientific processes and inquiry. Even if the game had a narrative that was somewhat related to the content being covered in the course, rewriting and revising the narrative was not the same as answering a specific question related to the course objectives within a defined word limit. Further, when the games were used as a review tool over the course of several days in the computer lab, one could question how many times the narrative was revised. Finally, Collins (2000), Stewart et al. (2010), and Garner (1994) all examined the effects of microthemes when they were used multiple times throughout a course. Thus, the effects of one short writing assignment (i.e., the narrative), which may be related to the content, on student test performance should be scrutinized.

The task of writing questions for homemade PowerPoint games also contained gaps in the relationship between the research involving the strategy and how it was implemented in the research examining the effects of games. Once again, literature reviews on this strategy showed small, albeit positive effects (Rosenshine, et al., 1996; Wong, 1985). Studies involving question writing included opportunities for revisions and review (Lotherington & Ronda, 2010); however, when the games were used as a review tool, there was no time for teacher feedback on the questions. Similarly, the review by Chin and Osborne (2008) found that question writing skills needed explicit instruction, scaffolds, prompts, and modeling in order to be effective, and this was simply not possible over the course of several consecutive days in the lab to start and finish the game design project. Once the game design project shifted from a review exercise to a unit project, which allowed for significant instruction on question writing, test scores revealed a statistically significant finding (Author, 2011a).

Finally, one could begin to question whether the homemade PowerPoint games are indeed games. As stated in the introduction, Aldrich (2005) noted that games have challenges and built-in inefficiencies that are both motivating and entertaining. Both Siko et al. (2011) and Siko and Barbour (2012) lamented that the games created in their studies often had narratives that were extrinsic to the content, and that the games rarely referred back to the narrative once the players began to answer questions. Therefore, it could be said that games with extrinsic narratives could not be considered games, as the challenge of answering multiple-choice questions without a theme, narrative, challenge, or any built-in inefficiencies was nothing more than a digital worksheet with feedback tacked on to a short story.

In summary, based on the justifications set forth by researchers examining homemade PowerPoint games should yield small, positive effects on student learning. However, the justifications as implemented in the research examining the effects of homemade PowerPoint games on student performance were suspect. It was questionable whether the games actually constituted constructionism because the games were often created as a review tool. The narrative research and research examining microthemes dealt with actually writing about the content. If the game's narrative was not intrinsically and explicitly linked to the content, then the justification should not be warranted. The research involving question writing as an instructional strategy showed only minimal gains in student performance which could be enhanced through such practices as opportunities for student revisions, peer review and feedback, and the quality of instruction on how to write good questions. These enhancements were difficult to accomplish when the game project was conducted as a review where students spent consecutive days in the computer lab constructing the games from scratch. Finally, if a homemade PowerPoint game lacked any linkage between the narrative and the questions themselves, it would be difficult to classify the artifact as a game by most definitions.

FUTURE DIRECTIONS

In this article we have reviewed research involving game design as an instructional strategy, introduced the concept of a homemade PowerPoint game, and examined the justifications for their use in the classroom. We have also reviewed the current literature on the justifications as well as the research that has been conducted on the use of homemade PowerPoint games as an instructional tool. Many of the findings have shown no statistical difference in performance, and a comparison of the research involving homemade PowerPoint games and the justifications proponents have given for their use has shown two things. First, the literature has shown minimal but positive support for each of the justifications. Second, the recommendations for enhancing the effects of these individual strategies were not present in many of the studies examining the use of homemade PowerPoint games. These two findings may explain the lack of statistically significant findings when comparing test performance between students who created homemade PowerPoint games and those who did not.

Recent changes to how a game design project was implemented, namely an increase in the amount of structure and their implementation as a unit project rather than a unit review, has shown statistical significance (Author, 2012). Therefore, future research should look into whether those changes are responsible for the change in results, and what further changes could be made to further enhance those results. The reason for this finding was attributed to a change in the implementation of the game project (i.e., from a review activity to a unit project and the addition of corrective feedback). Future directions for research using homemade PowerPoint games should look to extend those results by examining reasons why students performed better in those cases.

Siko et al. (2011) first questioned whether the games, as implemented, truly constituted constructionism. The authors wondered whether a review for a test equated to learning by building, as the content had already been presented in a traditional manner. However, in a more structured setting, where the game design project was actually part of the curriculum, the benefits of constructionist learning might be seen. The aforementioned studies that criticized constructionist practices focused their critique on studies which involved unstructured discovery learning (Kirschner, et al., 2006; Kurland & Pea, 1985; Mayer, 2004; Pea & Kurland, 1984), with Mayer (2004) finding that heavily structured constructionist environments outperformed less structured constructionist environments. While the answer may lie with increased structure, researchers should also pay attention to see if the pendulum can swing too far in terms of structure – as one of the motivating aspects of games in education involves the correct level of structure (Hirumi & Stapleton, 2008).

Second, more time needs to be built in for feedback and revision. Students were given assignments to write questions as homework, but they were immediately tasked with constructing the games. Siko et al. (2011) provided anecdotal comments that the students were writing many of their questions in class; therefore, no feedback could be given to the students. Research studies involving student-generated questions mentioned practice and feedback mechanisms for improvement (Lotherington & Ronda, 2010; Rickards & DiVesta, 1974; Rosenshine, et al., 1996). In the second iteration of the study (Author, 2012), a structured timeline was provided that included due dates for written questions for which the instructor had time and was able to provide feedback. Also, more instruction and structure was provided to the students with respect to the difficulty level of the questions. Students were given more examples of how to write more difficult questions, such as how to take a “Knowledge”-level question and turn it into a “Comprehension”-level question. One drawback of this approach is that would not allow comparisons to the studies involving the analysis of questions such as the Barbour, et al. (2009) and Siko (in press) studies, where questions were written without difficulty requirements. However, performance on assessments between unstructured and structured groups could be compared.

If logistically possible, students should be given more opportunities to create games. While Siko et al. (2011) and Siko and Barbour (2012) did not see a statistical difference in performance between groups who created games on multiple occasions versus those who only did once or not at all, the group who did create games twice did have a slightly higher score. The authors suggested the difference, albeit not statistically significant, may have been due to an initial discomfort with the new style of instruction. Given a more structured environment, or perhaps more opportunities to create games, is a potential avenue for future research.

Finally, a future direction for research could also be to test the use of narratives as a justification. Student performance could be compared between groups who create their own games versus those that simply write questions that are added to a game with a predetermined narrative, since some studies involving student-generated questions provide benefits without the context of placing the questions within a game or similar artifact (Berry & Chew, 2008; Harper, et al., 2003; Rosenshine, et al., 1996; Wong, 1985). Taking this one step further, performance between groups who only write questions could be compared to groups who create games, testing the constructionist justification altogether.

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