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Game Design as an Educational Pedagogy

Michael K. Barbour
Sacred Heart University

Kathy Clesson

Meghan Adams

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Michael Barbour
Assistant Professor – Instructional Technology
365 Education
Wayne State University
Detroit, MI 48202
313-577-8349
mkbarbour@gmail.com

Michael Barbour is an Assistant Professor at Wayne State University in Detroit, Michigan. He completed his Ph.D. in Instructional Technology from the University of Georgia. Michael's research interests focus on the effective use of online learning to provide curricular opportunities for rural K-12 students.

Kathy Clesson
University High School
500 W. Gregory St.
Normal, IL 61790-7100
kmcless@ilstu.edu

Kathy Clesson is a teacher and English Department Coordinator at University High School in Normal, Illinois. Kathy was the 2008 winner of the National Laboratory School Association's TeachTech Award. Her winning entry was an Arthurian Legend Web page/podcasting unit, developed for her English Literature class at U-High. Her inspiration for the unit came from her participation in the Illinois State University Center for Teaching, Learning & Technology's podcasting grant award program.

Meghan Adams
Yorkville Middle School
702 Game Farm Road
Yorkville, IL 60560
mmadams84@gmail.com

At the time of this study, Meghan Adams was an undergraduate education student at Illinois State University. She completed her student teaching at University High School with Kathy Clesson. Currently, Meghan is a teacher at Yorkville Middle School.

Title: Game Design as an Educational Pedagogy

Abstract: In this paper, the researchers explored the use of homemade PowerPoint games as a pedagogy strategy. This quasi-experimental study examined whether there were performance differences between students in a class that utilized the teachers' traditional methods of reviewing for a unit exam and students in a second class that utilized homemade PowerPoint games. The analysis of variance indicated that there was no statistically significant difference in the performance or the level of improvement between the two classes, which may have been due to the small sample size. These results are consistent with other studies of homemade PowerPoint games.

Keywords: constructionism, game design, MS PowerPoint, project-based learning

Over the past two decades there is increased evidence that the act of constructing their own projects can provide meaningful student learning (Blumenfeld, Soloway, Marx, Krajcik, Guzdial and Palinscar 1991; Harel and Papert 1991; Horwitz and Christie 2000; Roschelle, Kaput and Stroup 2000; White and Schwarz 1999). Even with the potential of projects described in these studies, one of the main obstacles continues to be the problem of how to achieve widespread implementation of these projects in schools without special assistance or additional resources. One project that has overcome the scalability problem is WebQuests (<http://webquest.org/>). One reason for this is that the steps involved in creating a WebQuest are consistent with what teachers normally do when they are designing instruction: selecting and evaluating resources, and creating standardized assessments. Rieber, Barbour, Thomas and Rauscher (2008) propose an alternative to WebQuest that are also designed to overcome the scalability issue – homemade PowerPoint games (see <http://it.coe.uga.edu/wwild/pptgames/>).

Homemade PowerPoint games are already familiar to and used by many teachers as they download *Jeopardy* or *Who Wants to be a Millionaire* templates where they are able to add their own questions. Teachers' comfort with and access to *Microsoft PowerPoint* make these examples a common illustration of technology integration in the classrooms. Barbour, Rieber, Thomas and Rauscher (2009) argued that homemade PowerPoint games are a more meaningful

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project, as it requires students to design, and not simply play the game. In this article, the researchers examine the effectiveness of homemade PowerPoint games as a design activity. Using a quasi-experimental design, student performance was compared to determine if the act of designing a homemade PowerPoint game had any effect.

Literature Review

Three decades ago Seymour Papert began experimenting with the use of motorized turtles and computer programming as a way to teach students mathematics (see Papert 1980). A student of Piaget, Papert used this form of computer-aided instruction to develop an approach to education known as constructionism or learning by constructing or building. Simply put, constructionists believe that learning occurs “in a context where the learner is engaged in constructing a public entity, whether it's a sand castle on the beach or a theory of the universe" (Papert 1991 1). The initial work conducted by Papert and his colleagues led to additional research into and use of design activities (Harel and Papert 1990).

One example of design activity research is that of Kafai (1994 1995) and her colleagues (Kafai and Harel 1991). They conducted a number of projects where the researchers had fifth and sixth grade students design multimedia projects for younger students. Kafai, Ching and Marshall (1997) found that students used the design activity as an opportunity to engage in content-related discussions and that there was increased learning of astronomy concepts by students through the use of these design activities. The researchers also concluded that while many of these elementary students were not prepared for the long-term, less structured design activity, “the potential benefits [made] it a worthwhile learning experience” (125). In reflecting on the differences between instructionist and constructionist learning, Kafai (2001) suggested having students make games for learning might be the next step in taking advantage of the recent popularity and focus on video

games in education.

Another example of the use of design activities as a learning activity is the work of Rieber (2001) and his colleagues (Rieber, Luke and Smith 1998; Rieber and Matzko 2001) on *Project KID DESIGNER*. *Project KID DESIGNER* involved four different classes of elementary students over a three-year period that worked in teams to design games. Each team of elementary students was matched with graduate students who were responsible for taking the elementary students game ideas and objects (e.g., graphics, directions, rules) to develop the game using *Macromedia Authorware*. Using a rapid prototyping model of development, the elementary students would provide the graduate students with guidance in terms of what changes were required to the prototype until the elementary students were satisfied with the game. While the researchers did not investigate whether students learned more about the subject areas of their games, Rieber et al (1998) concluded, “the project has demonstrated that game design gives children an authentic, meaningful context to apply ideas from school subjects” (Conclusions, ¶ 5). However, the authors also acknowledged one of the main limitations of this initiative was the reliance on *Macromedia Authorware*, which necessitated the involvement of adults to program the games.

Taking the lessons of *Project KID DESIGNER*, Rieber (n.d.) concluded that “Project KID DESIGNER was not scalable because it relied on university researchers to act as the children’s programmers” (¶ 3), but because homemade PowerPoint games made use of a more ubiquitous tool this issue could be overcome. Rieber et al (2008) described homemade PowerPoint games as having a “game world, story or context; game play or goals and strategies within the game; and game rules.” Parker (2004) described the homemade PowerPoint games that his students created as having “game pieces, virtual or real game boards, and questions with correct and incorrect answers.” Essentially Parker’s students created board games that used PowerPoint as a way to ask students the required

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questions, which is a fairly accurate description of most of the homemade PowerPoint games created to date – electronic board games that use the interactive, non-linear aspects of PowerPoint to provide a way to house and deliver questions or problems.

Barbour, Thomas, Rauscher and Rieber (2010) argued that homemade PowerPoint games have the potential to increase students' level of understanding. The authors make this argument based upon the process that students undertake in the writing of their game narrative or story and in the creation of their game questions. To many, it may seem odd to explore the value of writing to an audience of those in the field of language arts. However, three decades after writing-across-the-curriculum programs became popular it is still often a struggle to incorporate writing into the other subject areas – even if we have come to understand that writing about a subject allows students to create meaning, and thus students learn that subject (Berthoff 1982; Griffin 1983; Raimes 1980). The writing involved in the students' construction of their game narratives is a specific form of concise writing that is quite similar to a microtheme. Work (1979) described microthemes as an essay that could fit on a five by eight inch index card. Originally intended for a language arts audience, microthemes have been used extensively in the sciences where researchers have found that students who write in the short, highly structure format perform better on assessments than students who do not use microthemes (e.g., Ambron 1987; Collins 2000; Kirkpatrick and Pittendrigh 1984; Moore 1993 1994). In constructing a homemade PowerPoint game, students have to write a narrative that provides a player with background to the game, the basic context for the game, and motivational elements that entice the player to play the game... all on a single PowerPoint slide.

The other aspect of homemade PowerPoint games that has the potential to enhance deeper understanding is the students' creation of their game questions (Barbour et al 2010). As the questions provide the skill or challenge component to homemade PowerPoint games, writing good questions is

critical to creating an engaging game. For example, if the questions are too difficult to answer the player is unable to progress in the game. If the questions are too easy there is no sense of challenge for the player and the game becomes routine and boring. Both of these situations would cause players to stop playing the game, so students must construct questions that begin easy and get progressively more difficult to provide an appropriate level of challenge. One of the ways to achieve this range of challenge is to have students write questions from a variety of level on Bloom's taxonomy, particularly the higher levels (Bloom 1956). Rickards and DiVesta (1974) argued that students who were able to write higher-order questions were able to process the original information better because the skill demanded better comprehension. The benefits of student-generated questions have a long research history, for example, in her review of 27 studies from 1965 to 1982 Wong (1985) concluded that the majority of research indicated that students generating questions "enhanced students' processing of prose" (250). Those studies reviewed that did not reach this conclusion had insufficient training or lacked instruction on question development, or did not provide enough time for students to internalize the content before asking them to construct their questions.

To date there has been little research that has investigated the claims made by proponents of homemade PowerPoint games. Parker (2004) explored the effectiveness of homemade PowerPoint games as a project-based learning activity with middle school students in two language arts classes. Unfortunately, there were no measures taken to ensure that the two groups were similar in ability or in access to technology outside of school (something Parker himself discusses). The results stemming from the use of the homemade PowerPoint games in his study are illustrated in Table 1.

[INSERT TABLE 1 ABOUT HERE]

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The data illustrated that the control group was an academically stronger group of students than the treatment group based upon their prior performance. It also indicates that the control group had a greater improvement between the pre-test and the first post-test, which might be expected of an academically stronger group of students. It wasn't until the second post-test, taken only by the treatment group after they had additional time to play each other's PowerPoint games, did the treatment group's improvement become comparative to that of the control group. Apparently the first post-test was completed after the treatment group had created their own homemade PowerPoint games, but before they played the games of other's. Their improvement from the first post-test to the second post-test could have been the result of them playing each other's PowerPoint games, but it could also have been the result of the additional time spent on the topics or having already taken a post-test that was similar in content.

Barbour and his colleagues (Barbour, Kinsella and Rieber 2007; Barbour, Kinsella and Toker 2009) examined the performance of students in a social studies course delivered by a mid-western high school. These researchers had students design homemade PowerPoint games as a way to review for a portion of their mid-term and final exams. They compared the students' performance on the multiple-choice questions focused on their game topics against their performance on the remaining topics to see if the students performed better on the topics they constructed their game on. The authors found there to be "no statistically significant differences in the students' scores on portions of the exam where they did create PowerPoint games and portions of the exam where they did not create games" (Barbour et al 2009 1378). Upon further analysis, Barbour, Kromei, McLaren, Toker, Mani and Wilson (2009) found that 93.7% of the questions written by the students for their homemade PowerPoint games were level one questions based on Bloom's taxonomy, and speculated this was likely the reason why the use of this design activity was no more effective than traditional

forms of review for these students.

Research to date has shown the value of design activities as a tool for student learning. However, seven years after the introduction of the use of homemade PowerPoint games as a design activity the research into their effectiveness as a design activity is questionable. Clearly, more systematic investigations of the use and effectiveness of this design activity are required.

Methodology

The purpose of this study was to investigate differences in student performance based upon the use of homemade PowerPoint games as a design activity. The researchers adopted a quasi-experimental approach where students in a treatment group created homemade PowerPoint games as a review activity and their scores were compared to a control group. Students from two sections of a course in British Literature at a mid-Western high school were selected. This course was recommended for college-bound juniors and seniors, and it combined the study of British literature from Beowulf to Bono, with composition based on the literature. Among the authors studied were Malory, Chaucer, Shakespeare, Milton & Bunyan, Shelley, Tolkien, and Heaney. Epic and lyric poetry, novels, essays, short stories, and plays were also examined. Students participated in discussions, wrote short timed essays after specific readings, crafted longer essays or multi-media pieces as a culminating activity in each unit, and completed comprehensive semester exams.

Two teachers team-taught both sections of this course. One was a senior teacher who has taught for over 25 years, had been at the school for sixteen years and had taught the course twenty-eight previous times. The other was an undergraduate student who was completing her teaching internship during the semester when this project occurred. Students in both sections completed a two-week unit and exam on one Shakespearian novel (i.e., *McBeth*). This exam

served as the pre-test. The students then began another two-week unit on a second Shakespearean novel (i.e., *Hamlet*). At the end of this two-week period students began a one-week review to prepare for their unit exam.

The control class worked in small groups to review *Hamlet* by writing a newspaper or magazine article, a literary review, a diary of one of the main characters; by creating a PowerPoint presentation on the production history; performing a scene from the novel; creating a montage with information about three of the characters; staging a modern-day talk show that drew from the characters and plot of *Hamlet*; or drawing a graphic novel version of one of the scenes or acts (see Appendix A for the complete guidelines for the review activities). These were all activities that the senior teacher had used in this course for reviewing *Hamlet* in the past (and would have been the same kinds of activities all students completed for the *Macbeth* unit).

The treatment class worked in groups to create a homemade PowerPoint games to review *Hamlet*. Each group of students were assigned one of the five acts from *Hamlet* on which to base their game, with one group assigned the characters and another group assigned the dramatic terms in *Hamlet*. Once each group had created their game, the students were given time in class in which to play each other's games (as well as having access to these games for review purposes for their exam).

Treatment

The teachers used a five-day model for the design of the homemade PowerPoint games, as described by Rieber et al (2008). During the first class students were introduced to the concept of game design, what makes a good game (and a bad game), and provided time to play some existing homemade PowerPoint games. Students were organized into groups, assigned a topic and asked to generate a story idea and premise for their potential games for homework. This first

class was a combination of stage one and two outlined by Rieber and his colleagues.

The second class saw students develop and refine their ideas, and add them to the homemade PowerPoint game template. The teachers introduced the students to Bloom's taxonomy and how it can be used as a guide to developing questions for their game, and how most good games (including homemade PowerPoint games) begin with an easier level of challenge and get progressively more difficult. Students then began the process of generating potential questions for their game. Their homework from this second class was to write five potential questions.

During the third class students reviewed each other's questions and refined them based on this peer editing process. Then they began to add the questions to their game template. As this is a time consuming process, most of the third class and even some of the fourth class was spent on this activity. While one student was inputting their questions into the template, other students in the group were writing additional questions and reviewing them through their peer editing process. The first half of the fourth class saw students continue inputting questions into their game. The second half of this class allowed each group to play each other's game for the purpose of usability testing (i.e., to make sure that it worked, to get feedback to improve upon the game. Students' homework after the fourth class was to use that feedback to finalize their game. During the fifth and final class the students played each other's completed games.

Instruments

Students completed an exam on *Macbeth*, as a pre-test, to determine if there were statistical differences in the performance of students in the two sections. This exam included fill in the blank questions (28%), multiple-choice questions (42%), and short answer questions (30%). Both teachers, using a rubric for the short answer questions, graded it independently and

their scores were averaged into a single measure. The rubric was developed by the senior teacher, who used responses from previous years to train the junior teacher in the standard application of the rubric.

Students in the control group (n=21) received an average score of 76.61%, while students in the treatment group (n=14) received an average score of 78.83%. These student scores were tested for the equality of regression slopes to ensure that any potential performance differences were due to the treatment and were found to be statistically insignificant ($F(1, 32) = .160, p > .05$). The short answer questions on the pre-test were worth 86 point, the two teachers were consistent in their application of the rubric for 71% of the students. They differed by one point on seven students' exams, and two points on three students' exams.

The *Hamlet* or post-test was also a combination of fill in the blank questions (20%), multiple-choice questions (20%), short answer questions (40%), and long answer questions (20%). Like the pre-test, both teachers independently using an established rubric for the short and long answers questions graded this exam. The scores assigned by both teachers were averaged to give the students a final score. The short answer and long answer questions on the post-test were worth 86 point, the two teachers were consistent in their application of the rubric for 97% of the students. They differed by one half point on only one student's exam.

Researchers were interested in the difference in student performance between the pre-test and post-test based upon their group assignment. Using an analysis of variance (ANOVA) the researchers tested the hypothesis:

$$H_0: \bar{x} \text{ control post-test} - \bar{x} \text{ control pre-test} = \bar{x} \text{ treatment post-test} - \bar{x} \text{ treatment pre-test}$$

$$H_1: \bar{x} \text{ control post-test} - \bar{x} \text{ control pre-test} \leq \bar{x} \text{ treatment post-test} - \bar{x} \text{ treatment pre-test}$$

Statistical analysis was conducted using SPSS.

Results and Discussion

Along with the ANOVA, descriptive statistics were also calculated to allow the researchers to compare the means of the students' performance between the control and treatment groups. Table 2 provides the descriptive statistics or summary of student performance for both the pre-test and post-test by the control and treatment groups.

[INSERT TABLE 2 ABOUT HERE]

As the data illustrated, the students in the control group performed on average better than the students in the treatment group on both examinations. However, there was a small increase in the level of improvement on the pre-test and the post-test in the treatment group compared to the control group.

The ANOVA comparing the difference between the students pre-test and the post-test scores indicated that this small positive difference was statistically insignificant ($F(1, 36) = .192$, $p > .05$), and the researchers failed to reject the null hypothesis. In quasi-experimental studies there are a variety of reasons that could cause the researchers to fail to reject the null hypothesis. It could be due to poor instrumentation (i.e., the pre-test and/post-test), a lack of randomization, an insufficient sample size (i.e., $n = 35$), or the lack of effectiveness of the treatment. It is impossible for the researchers to determine what factors may have contributed to the results of this study.

These results were consistent with the findings presented by Barbour et al (2009), who found no statistically significant difference between the two groups, but did report an increase of 0.5% greater in the students knowledge for topics they used homemade PowerPoint games to review compared to other topics. In Barbour et al (2007), the authors speculated that the small sample size (i.e., $n=49$) might have been the reason for this result. The further speculated that if

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the same difference were found in a sample of 800 students (i.e., approximately eight times the sample size they actually had) the results would be statistically significant. While this speculation has no validity from a methodological standpoint, it does speak to the need for research studies on the effectiveness of homemade PowerPoint games to look beyond single class or single teacher projects in an attempt to achieve those larger sample sizes.

Parker (2004) also arrived at similar conclusions. Ignoring the methodological problems of Parker, the overall results were quite similar to those presented here. Students in the control group ($n=19$) in Parker's study improved 49% between the pre-test and the post-test, while students in the treatment group ($n=18$) improved 40% between the pre-test and their final post-test. These results represented a statistically insignificant difference.

In all three of these studies (i.e., this study, Barbour et al, and Parker), the act of designing games using PowerPoint caused students in the treatment groups to improve at the same level as the students in the control groups. These results indicate that having students design a homemade PowerPoint game was at least as effective as other methods the teachers' used to review the content. This supports Kafai et al's (1997) belief that student use the design activities were "a worthwhile learning experience" (125). If the proponents of homemade PowerPoint games desired their project to be seen as a pedagogical strategy that was as effective as other strategies that teachers currently utilize than the results of these three studies achieve that goal. The results of this study indicate that using homemade PowerPoint games as a review tool was as effective as the other methods that the teachers had historically employed.

Conclusions and Implications

Recently, the proponents of homemade PowerPoint games have indicated that they are trying to achieve a greater level of use for this design activity among K-12 teachers (Barbour et

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al 2009; Rieber et al 2008). Barbour et al. (2010) indicated:

While there are isolated examples of homemade PowerPoint games being used in other universities and educational contexts (often due to the efforts of University of Georgia graduates), we are hoping that with increased exposure of homemade PowerPoint games that we will begin to achieve greater ubiquity throughout North America. (13)

These results did suggest the use of homemade PowerPoint games was as effective a pedagogical strategy as the other learning activities commonly utilized by these two teachers, and the researchers recommend that teachers who may be searching for an example of technology integration that requires a low level of technical ability consider this form of design activity.

Although this project ultimately answered few of the researchers' initial questions, it formed the basis of understanding for future, larger scale research endeavors into the effectiveness of homemade PowerPoint games as a pedagogical strategy. The small sample sizes found in these single class or single teacher studies will never yield statistically significant results. It is recommended that further examination of the effectiveness of homemade PowerPoint games utilize multiple teachers, multiple courses sections, and even multiple grades to provide a more adequate sample size. In these expanded investigations, the training of students to write appropriate questions must be more carefully controlled to overcome deficiencies that have been found in other homemade PowerPoint game studies.

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Appendix A

Culminating Project Options

All projects call for an oral explanation/presentation

1. As an individual or in a group of two to four, create a newspaper or magazine featuring journalistic accounts of the events in the play. You may include the full range of print media genre (news, sports, editorial, feature, cartoon, advertising, letters to the editor, etc.). If this is a group project, editorial credits and bylines are a must.
2. Draw a condensed, serial (a.k.a., graphic novel) version of one of the acts or scenes from HAMLET. The cartoon must remain true to the original story, although the captions may be in modern English.
3. Assume the persona of one of the characters from the play. Write a diary (with at least five, one-page entries) chronicling the events of an act or a number of acts. Include the character's thoughts and feelings regarding events in HAMLET.
4. Investigate the genre of literary criticism. Choose any 8+ page article of literary criticism on Hamlet (from a reputable journal) to read and summarize for the class. In your 5-8 minute oral presentation, cover the following things: source of the article, a summary of its content, your response to the ideas presented by the critic, and what you learned about the genre in general. (Submit a copy of the article on the day of presentation.)
5. Investigate the genre of film reviews. Locate and copy at least three substantive reviews of the Academy Award winning production starring Kenneth Branagh. Outline each review to determine a deep structure of the genre, then write your own review of a version of the film. Provide an oral summary of the three print reviews, then share your evaluation of the film. Include in your class presentation some sense of what you learned about the genre.
6. With a partner, use the information you would garner in the suggested option above (plus some research into the film careers of both the director and key actors) to script and perform a 5-10 minute Siskel (rest his soul) and Ebert segment reviewing a Hamlet film version of your choice. The presentation may be live or videotaped. (The production script should be available to your teacher on the day of performance.)
7. Research the production history of the play. Using PowerPoint, share the fruits of your findings. The presentation should contain imported pictures of stars, sets, costumes, and clips of reviews from selected productions chosen for their artistic variety. Print out a paper (slide) version of the presentation.
8. As an individual or in a group of two or three, create and perform a 5-10 minute newscast or radio broadcast reporting the events in one or more acts of Hamlet. Focus on the major events in the play, and adhere to the format of your chosen medium (radio or TV). Commercials may be included. Performance may be live or taped. Hardcopy of the broadcast must be turned in on the day of presentation.

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8. Create a triptych montage (poster-size) symbolically depicting three characters of your choice. The names of the characters must be worked into their respective portions of the montage. Include a written explanation for your visual symbols.

9. In a group of 3-5, create an Oprah/Sally Jesse Raphael/Jerry Springer style talk show segment featuring the characters from Hamlet as guests. The performance may be live or on tape, but a production script is due the day you go “on air.”

10. Come up with your own artistic, research, written or performance-based project to wrap up your study of the play. (Clear your idea with your instructor.)

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Table 1 – Results from Parker (2004)

	Control Group	Treatment Group
Sample Size	19	18
Class Average Prior to Study	84%	62%
Pre-Test	31%	47%
First Post-Test	80%	73%
Second Post-Test	-	87%
Average Difference (from first post-test)	+49%	+ 14%
Overall Difference	+49%	+ 40%

Table 2 – Summary of Student Performance Data

	Control Group	Treatment Group
Pre-Test	78.83%	76.61%
Post-Test	85.14%	84.36%
Average Difference	+ 6.32%	+ 7.75%