Homemade PowerPoint Games:
A Constructionist Alternative to WebQuests

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An ever-growing body of scholarly work has supported the assertion that the act of designing and building projects leads children to learn in powerful ways in ways that they perceive to be authentic and meaningful (Blumenfeld et al., 1991). One well-developed and well-articulated philosophy and approach is known as constructionism (Harel & Papert, 1991). As the name implies, constructionism involves learning by building. While this includes building with sand, clay, papier maché, and other arts and crafts-like materials, technology affords unique opportunities to extend a learner's conceptual understanding in subject area domains by building digital artifacts. Examples from the literature include computer programming with languages specifically designed for learning, such as Logo and Boxer (diSessa, 2000; Harel & Papert, 1990), and using modeling, simulation, and microworld tools in content domains such as physics (White & Frederiksen, 2000), mathematics (Roschelle, Kaput, & Stroup, 2000), and biology (Horwitz, 1999). Among the outcomes of these projects are innovative software tools that reconceptualize what it means to learn and teach. However, a problem that all of these projects have yet to surmount is that of scaling—the widespread implementation of the project in schools without special outside assistance or resources.

One approach to integrating technology in education that has overcome the scalability problem is Bernie Dodge's WebQuests (*http://edweb.sdsu.edu/webquest/*), a creative instructional use of the Internet. Teachers have adopted WebQuests for many reasons, not the least of which is an extensive set of resources and support created and maintained by Dodge and his colleagues at San Diego State University. We speculate that another reason is that teachers find WebQuests a comfortable addition to their instructional repertoire—they already design instruction for their students and WebQuests build on those skills. Another persuasive benefit is that WebQuests are seen by a teacher's colleagues and administrators as an innovative way to make good use of Internet resources while also using students' time well. Teachers who design WebQuests find satisfaction in integrating Internet-based resources in ways that are consistent with their training and daily school responsibilities.

Although WebQuests can be creative and useful resources for teachers, they are, by and large, instructivist examples of technology integration—they are web-enhanced forms of direct instruction. For die-hard advocates of WebQuests, this is not meant as a criticism, only as an observation. Like other forms of direct instruction, WebQuests range from fact-oriented "retelling" tasks to inquiry-based learning activities. Although the literature is full of enthusiasm for the potential of WebQuests in education (e.g. Vidoni & Maddux, 2002; Wang & Hannafin, 2008), the current empirical evidence for their effectiveness is not well established or convincing (Allan & Street, 2007; Gaskill, McNulty, & Brooks, 2006; Strickland & Nazzal, 2005). WebQuests have not been found to increase student achievement when compared to similar forms of directed instructional activities (Abbitt & Ophus, 2008). Educators interested in constructivist forms of learning yearn for activities that are more student-centered and student-directed than WebQuests. So, inspired by Dodge's work and our own research at the University of Georgia focusing on children's design of educational computer projects, we propose a constructionist alternative, not replacement, to WebQuests—homemade PowerPoint games.

In this article, we introduce and describe the concept of homemade PowerPoint games and

the project infrastructure that has been developed. Then, we discuss the technological pedagogical content knowledge (TPCK) framework, each of the three types of knowledge, and how they interact with each other through the homemade PowerPoint game project. We conclude with some thoughts on homemade PowerPoint games as an example of TPCK and the potential for this project to become a scalable example of technology integration, similar to the WebQuest initiative.

Introducing the Homemade PowerPoint Game Project

The use of games in education is obviously not new (Gredler, 2003). Typically, games are given to children to play either as a reward for doing other work or as a way to sugarcoat content. That is, most educational games have a weak or nonexistent link between the game's context (or narrative) and the educational content of the game. Classic examples come from mathematics, such as Math Blasters, in which the rehearsal of math facts are embedded in a game that otherwise has nothing to do with math. A major criticism of this approach is that it conveys to students the message that no one would want to do mathematics because it is interesting, useful, or even beautiful in its own right, but only if it is first made more palatable by wrapping a game around it. Research on learning from playing games is mixed and few differences between games and traditional classroom instruction have been reported (Dempsey, Lucassen, Gilley, & Rasmussen, 1993-1994; Gredler, 2003; Kirriemuir & McFarlane, 2004).

Although learning from playing games is perfectly legitimate and there are games that effectively bridge the game play with the content, we have chosen to focus on *learning by designing games*. The idea that children can handle the task of designing games to enhance their own learning is supported by the work of Project KID DESIGNER (Rieber, Luke, & Smith, 1998), a project begun over a decade ago. One important outcome of Project KID DESIGNER is that it demonstrated that elementary and middle school students were capable and interested in designing their own games that integrate and make use of the content they were studying in school. But, like many other technology-based projects, Project KID DESIGNER was not scalable because it relied on university researchers to act as the children's programmers.

In contrast, the homemade PowerPoint game project began explicitly with the goal of tackling the scalability problem while remaining true to the constructionist principles of learning by designing games (see Rieber, Barbour, Thomas, & Rauscher, 2008, for an overview of the project). While we are not advocating for Microsoft products, the fact is that PowerPoint is a nearly ubiquitous software tool in K-12 schools. PowerPoint games are also already a familiar part of many classrooms, though not used in a way that we embrace: already existing game templates (such as *Jeopardy* or *Who Wants to be a Millionaire*) that a teacher modifies for instruction, usually just by adding content. The homemade PowerPoint game project is different in that it contends that a better use of class time for learning is to turn over the act of designing the game to the children themselves. Of course, it is also only an instructivist use of homemade PowerPoint games if teachers merely download and have their students play an existing game. But this instructivist result of a constructionist project likewise confronts the problem of scalability because we believe that these teachers will become a likely group to adopt the constructionist activity of game design.

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This project is in its first of several phases. We are starting with building an infrastructure and support system for teachers while also conducting several pilot projects with school children. Again, inspired by Dodge's WebQuest project, we have built a web site that provides teachers with an array of training materials, homemade PowerPoint game templates for use in the classroom, and a database of existing games they can download, use as is, or adapt. Many of the templates include the idea of using other ubiquitous technologies such as paper, cardboard, glue, and paper clips as part of the game design in order to mitigate the programming limitations of using PowerPoint. For example, a monopoly-like game template includes a PowerPoint slide that is meant to be printed for use as a game board while playing the game. Other games include directions and cut-out templates for making spinners to provide randomization as part of the game. (Of course, PowerPoint allows users to program their own scripts, known as macros; however, we are designing our resources to be usable as quickly as possible without special skills by teachers in their classroom.)

In addition to the use of a ubiquitous tool such as PowerPoint, another advantage of using PowerPoint for game design is that the games can be small or large. Games based on question and answer templates can quickly be adapted for classroom use just by having students write their own questions. However, homemade PowerPoint games can also be designed over a long period of time, similar to math and science fair projects. Indeed, we have long envisioned the advantages of schools using design activities as the focus of an interdisciplinary, thematic curriculum (Rieber, 2001). Our plan anticipates the desire of children to take and modify existing homemade PowerPoint games. In our previous work, we noticed that the playing of game prototypes was one of the most valuable ways to induce other creative ideas and revisions to the design. Therefore, our project embraces the "open source" concept: Children who design homemade PowerPoint games agree to give other children permission to adapt and modify the games they create.

As part of the homemade PowerPoint game infrastructure, this project takes advantage of the World Wide Interactive Learning Design (WWILD) Team web site. Its searchable database includes homemade PowerPoint games as a software category. Teachers can have their students' best homemade PowerPoint games added to the WWILD Team database if they and their students agree to the following stipulations:

- Free-to-copy: Anyone is allowed to download, copy, and use the games.
- Open-source: All users are allowed to adapt, modify, or extend the game.

Games that are modified in interesting ways can be added to the database as a new submission, however, credit must be given to the original designer(s). For these reasons, all game templates provided to teachers include an "open source" copyright slide and a "credit slide" that shows the names and school of the children designers. This page must remain as game adaptations are created—the new designer(s) add their name(s) to the credit slide. In this way, the history of the game's design along with appropriate credit to the past designer(s) is maintained. It should also be noted that the WWILD Team site already provides a means for members (including students) to review materials in the database. This should prove to be an attractive and useful feature among teachers and students selecting homemade PowerPoint games for playing or adapting. (It may even lead to healthy competition among designers—we envision a yearly competition to determine the best homemade PowerPoint games based on student votes.)

> ***"We believe that the near ubiquitous technology of PowerPoint offers widespread means of realizing the power of game design for K-12 education."***

This project proposes the use of homemade PowerPoint games as a practical and scalable approach to implementing a constructionist learning philosophy within K-12 schools. Building on the work of Project KID DESIGNER, which provides a model for teachers supporting game design teams, coupled with research showing that children other than those who designed the games find the games motivating and enjoyable (Rieber, Davis, Matzko, & Grant, 2009), we believe that the near ubiquitous technology of PowerPoint offers widespread means of realizing the power of game design for K-12 education.

Homemade PowerPoint Games: An Example of TPCK

Along with providing a constructivist alternative to WebQuests, homemade PowerPoint games are also an example of an instructional strategy that is consistent with the TPCK framework. Mishra and Koehler (2006) described TPCK as:

> The basis of good teaching with technology and requir[ing] an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to built on existing knowledge and to develop new epistemologies or strengthen old ones (p. 1029).

With the TPCK framework, Mishra and Koehler described how teachers need to consider the three knowledge areas (technology, pedagogy, and content), how these knowledge domains interact with each other (pedagogical content knowledge, technology content knowledge, and technological pedagogical knowledge), and how all three interact together (TPCK). We believe that homemade PowerPoint games are an instructional strategy that is consistent with the TPCK framework. In the following sections, we describe these knowledge areas and how they interact through the use of homemade PowerPoint games.

Technological Knowledge

One of the reasons the WebQuest initiative has become scalable and popular is because it does not require teachers to have a high level of technological knowledge. Homemade PowerPoint games are similar in that they use a technology that is familiar and comfortable for most teachers and students and is available in most schools. In fact, the only technological knowledge required to create a homemade PowerPoint game that teachers and students may not already pos-

sess is the ability to create action buttons, which is required to link slides together in a non-sequential manner. To provide assistance in obtaining this technological knowledge, we have created a game template and variety of other resources (e.g., handouts and help videos) to teachers and students to overcome this missing technological knowledge (see the "Template" and "Teacher Resources" links at *http://it.coe.uga.edu/wwild/pptgames/).*

The majority of schools that we have worked with continue to use the 2004 version of MS PowerPoint; therefore the help items that are currently available are based upon that version. As schools begin to upgrade to the latest version of MS PowerPoint, and as resources become available, the help items that are provided on the homemade PowerPoint game website will be updated.

Pedagogical Knowledge

Pedagogical knowledge focuses upon how instruction can be designed and delivered in an effective and efficient manner. Homemade PowerPoint games are based on three instructional strategies: constructionism, subject area writing, and question generation. As described earlier, constructionism is a set of learning strategies based on the act of learning by building, and researchers have found that children learn better and are more motivated to learn when they construct projects (Blumenfeld et al., 1991; Harel & Papert, 1991; Kafai & Resnick, 1996). In addition to constructionism, there has been a movement focused on student writing in the United States for several decades.

Advocates of "writing-across-the-curriculum," as it has become known, argue that the act of writing about a subject allows students to create meaning, and thus students learn that subject (Berthoff, 1982; Griffin, 1983; Raimes, 1980). Finally, researchers have found that having students write higher-order questions about the content enhances their processing of that content (Rickards & DiVesta, 1974; Wong, 1985). These three instructional strategies form the pedagogical knowledge on which homemade PowerPoint games are based (see Barbour, Thomas, Rauscher & Rieber [in press] for a more developed discussion of how each of these pedagogies influence the design of the homemade PowerPoint game project).

Content Knowledge

One of the main benefits of homemade PowerPoint games is they are not content-specific. By this we mean that they can be used in a variety of subject areas as the individual who designs the game provides the content. For example, Rieber, Barbour, Thomas, and Rauscher (2008) described a game called "The Traveling Georgia Artist," in which Chris, a teenager living in rural Georgia who wants to attend college so she can become an artist, has to travel around the state of Georgia selling her art. The game requires students to have content knowledge from the Georgia social studies curriculum in order to answer the questions correctly. After each turn, players draw an "Expenses" card and, if they answered the question correctly, they also draw a "Sell Art" card. Mathematical content knowledge is then required, as the players add the amount of their sales to a bank account and subtract their expenses. The first player to reach $2000 is the winner of the game.

"Researchers found that building their own multimedia projects increased students' motivation and learning."

Barbour et al. (in press) described a second game entitled "By the Light of the Moon." In this game for fourth grade science students, players must have content knowledge from the astronomy unit in order to answer questions to move around the game board, avoiding the spells of the evil wizard, until they reach the end. In both examples, the designer was responsible for generating the content knowledge.

Pedagogical Content Knowledge

Pedagogical content knowledge was described by Shulman (1986) as the belief that certain teaching strategies (i.e., pedagogy) were specifically suited or had specific applications in specific disciplines (i.e., content). An example of pedagogical content knowledge (PCK) from the homemade PowerPoint game project is the use of the writing as a way for students to learn. By itself, this instructional strategy is simply an example of pedagogical knowledge. However, if you examine a specific example of this strategy, such as the use of microthemes in science, it is an example of PCK. A microtheme is an essay that can fit on a five by eight inch index card (Work, 1979). Research on the use of microthemes in the sciences has consistently found that students who are able to write in the concise, highly structured way required by microthemes perform better in course assessments than students who didn't complete such writing assignments (Ambron, 1987; Kirkpatrick & Pittendrigh, 1984; Moore, 1993, 1994). While microthemes have been used in other disciplines such as English language arts and mathematics, researchers have primarily focused on their use in the sciences. The concise writing required by microthemes is consistent with the kind of writing required of students to write their game narrative on the "Story" slide of a homemade PowerPoint game.

While microthemes are one example of the pedagogical content knowledge inherent within homemade PowerPoint games, as discussed earlier there is no specific content (or pedagogy) that must be utilized by this design activity. For example, a mathematics teacher could have students create homemade PowerPoint games designed to work on the students' problem solving skills. A science teacher could have students design games that reinforce geospatial reasoning. Students in an English class could create games that test their reading comprehension. A social studies teacher could have students design games that measure the historical thinking. Bell, Schrum, Thompson, and Bull (2008) described all of these skills as examples of pedagogical content knowledge.

Technological Content Knowledge

The literature on the use of games in education seems to focus on the social studies discipline, likely due to the fact that many simulation-style games like *SimCity* and *Civilization* allow players "to explore relationships among geography and politics, economics and history, or politics and economics—interdependencies that can be difficult to discern through more conventional means" (Squire, 2004, p. 22). For example, in discussing the use of *SimCity* with a seventh grade social studies class, Teague and Teague (1995) concluded that students were "able to identify with and related to [these] projects that [had] a significant bearing on their everyday lives" and that students seemed "to be motivated by 'gaming'" (p. 32). In his dissertation study with social studies students using *Civilization III,* Charsky (2004) found that students seemed to understand the complexity of historical development as "more than a sequential series of cause and effects events" (p. 134).

McDivitt (2006), who used the World War II game *Making History* with 64 sophomores and also taught a control group using standard history textbooks, conventional lectures, and assignments, reported that students who were taught using the video game "scored as well or better on every single question…[and] were noticeably better at identifying the geography of Europe, explaining the significance of the 1938 Munich Conference, and listing the reasons for the start of the war" (p. 15). These are all examples of teachers using technology-based games with natural ties to the curriculum. Homemade PowerPoint games offer teachers the same opportunities regardless of content area.

Technological Pedagogical Knowledge

An alternative instructional strategy to students playing electronic games in class is to have students design their own games. For example, in the Project KID DESIGNER described earlier, Rieber, Davis, Matzko, and Grant (2009) found that children enjoyed and benefited from playing games designed by other children. Similarly, Kafai and her colleagues completed a series of studies for which older elementary students designed educational games for younger students in their school. These researchers found that building their own multimedia projects increased students' motivation and learning (Kafai, 1994, 1995; Kafai & Ching, 2001; Kafai & Harel, 1991). Based on this research, the process of having students design games has been an effective technology-based instructional strategy.

Conclusion

Students are required to use PowerPoint to construct home made content-based games. To construct these games, students write a game narrative or story (i.e., a short overview or context for the game that must fit on a single PowerPoint slide) and develop questions to provide the appropriate level of challenge to their games. These three pedagogical skills are required of students as they use a technology-based tool to construct games in a specific content area, and form the intersection envisioned by Mishra and Koehler with their TPCK framework. This combination of technological, pedagogical, and content knowledge provides a scalable example of good teaching with technology.

Over the past half decade there have been literally thousands of preservice teachers each year who have experienced the design of homemade PowerPoint games through the introductory technology integration course at the University of Georgia. In addition, we have been active in bringing this project to in-service teachers throughout Georgia by partnering with local teachers and making presentations at statewide practitioner-focused conferences. However, the use of PowerPoint games has not reached the scalability of a project like WebQuests. 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 hope that with increased exposure of homemade PowerPoint games we will begin to achieve greater recognition throughout North America.

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