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Creating a Ripple Effect: Incorporating Multimedia-Assisted Project-Based Learning in Teacher Education

This article explores the effects of multimedia-assisted, project-based learning in teacher education. We conducted pre- and post-surveys to investigate how the experience of developing multimedia projects influenced preservice teachers' knowledge and self-efficacy in (a) technology, (b) subject matter, and (c) teaching. Forty-two preservice teachers enrolled in an educational technology course participated in this study. They learned to design and develop 8 multimedia projects related to their subject content areas over the period of one semester. The results showed that the approach contributed to their increased knowledge base and professional growth with respect to multimedia technology skills. Additionally, outcomes significantly supported their reflection on the teaching/learning process and helped them establish a more concrete, insightful teaching philosophy.

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PAUL SAETTLER (1968), a renowned historian of instructional technology, noted that the word *technology* stemmed from the Latin form *texere,* meaning to weave or construct. This fact implies that technology should be seamlessly integrated into the teaching/learning process, thus fostering an effective, constructive environment.

A powerful approach to make this happen is multimedia-assisted, project-based learning. This method is designed to lead students to accomplish their learning goals in the course of creating multimedia projects. Multimedia-assisted, project-based learning is one of the most innovative instructional methods in the 21st century. According to the National Council of Teachers of English (2004), viewing and visually representing literature are important vehicles for sharing information today, and people need to extend their ways of communicating through technology by learning how to visually construct meaning, to join a global society.

Multimedia-assisted, project-based learning provides educational benefits that a nonmultimedia mode of instruction cannot offer. This method promotes a learner-centered constructivist model, helps students develop skills for retrieving information from multiple resources, and motivates students intrinsically by providing a sense of ownership and accomplishment (Moursund, 1999; Sandholtz, Ringstaff, & Dwyer, 1997). When used in teacher education courses, multimedia-assisted, project-based learning can create a more powerful effect because teachers learn not only how to use technology to communicate with their students but also how to teach their students to communicate with others through alternative media. Plus, as new teachers understand how to use multimedia authoring software, they also learn how to teach more effectively and show students how to explore ideas beyond the limitations of print. For example, creating a collage of images from the past can bring history to life in ways that transcend traditional textbook teaching. Using hypermedia to connect Web sites can help students connect science concepts with real-life examples. These multisensory examples demonstrate how multimedia can be used to enhance understanding of new concepts.

In this research project, we investigated how multimedia-assisted, project-based learning influenced and/or changed preservice teachers' knowledge and self-efficacy in the following three areas: (a) technology, (b) subject matter, and (c) teaching. We conducted pre- and post-surveys to explore the power of multimedia-assisted, project-based learning through the eyes of preservice teachers. Forty-two graduate students enrolled in an educational technology course participated in this study. The class consisted of 30 women (71%) and 12 men (29%). A majority of the participants were in their 20s; 52% were in the 21–25 age range, and 31% in the 26–30 age range. There were also a small number of nontraditional students (10% in their 30s and 7% in their 40s). In the following section, we highlight the multimedia projects completed by the preservice teachers.

The Projects

As society enters the 21st century, there is an urgent need to teach students how to demonstrate what they are learning by creating their own multimedia presentations. K–12 students can take pictures of their own science experiments and write captions that describe their hypotheses and their observations. Students can integrate photos into their history reports that make the past come alive. They can create slideshows with images and music to portray concepts in literature and the humanities. Multimedia productions provide opportunities for students to demonstrate their learning in more authentic ways.

This need to teach students multimedia skills is well reflected in many sets of instructional technology-related national standards. For example, the International Society for Technology in Education (ISTE)'s National Educational Technology Standards contain the following expectations for students at various grade levels.

> PreK–2: Use developmentally appropriate multimedia resources (e.g., interactive books, educational software, elementary multimedia encyclopedias) to support learning
>
> Grades 3–5: Use technology tools (e.g., multimedia authoring, presentation, Web tools, digital cameras, and scanners) for individual and collaborative writing, communication, and publishing articles to create knowledge products for audiences inside and outside the classroom

> Grades 6–8: Design, develop, publish, and present products (e.g., Web pages, videotapes) using technology resources that demonstrate and communicate curriculum concepts to audiences inside and outside the classroom (ISTE, 2000, Standards section, ¶ 2).

The educational technology course used in this study was designed to prepare the preservice teachers to use technology effectively in their future classrooms and to assist their future students in meeting multimedia expectations. The participants were required to design and develop eight multimedia products in their subject content areas:

- Project 1—Slideshow: Using MovieMaker, create a 1–3 min slideshow organized around a topic in his or her subject content area.
- Project 2—PowerPoint presentation: Using PowerPoint, teach a 10-min minilesson in his or her subject content area.
- Project 3—Online lesson: Using Mozilla, develop an online lesson to reinforce student learning.
- Project 4—Concept map: Using Inspiration, create a clear, focused concept map to teach a complicated concept in his or her subject content area.
- Project 5—Virtual field trip: Using Word graphic tools, structure a virtual field trip connecting four quality Web sites about a topic in his or her subject content area.
- Project 6—WebQuest: Using PowerPoint, create a student-centered WebQuest about a topic in his or her subject content area.
- Project 7—Teacher Web site: Using FrontPage, create a teacher Web site to effectively communicate with students and their parents.
- Project 8—Newsletter: Using Publisher, create a newsletter to promote his or her ideal learning environment supported by instructional technology.

This course was structured around project-based learning (PBL). PBL has been defined in simple terms as "a model that organizes learning around projects" (Thomas, 2000, p. 1). Sidman-Taveau and Milner-Bolotin (2001) explained that "project-based learning is a comprehensive, constructivist-based approach that engages students in the investigation of authentic problems" (p. 64). Likewise, a similar definition of PBL is noted as "an inquiry method of teaching and learning," where the process starts with a question (Furger & Shaffner, 2004, ¶ 4). In PBL environments, students handle real-world situations, which allow opportunities for gaining permanent knowledge and skills (Gulbahar & Tinmaz, 2006). These skills include an ability to sustain work over time, collaborate with others, problem solve and think critically through complex activities, and attend to the process along with the product (Seidel, Aryeh, & Adria, 2002). Another benefit of using PBL is that it motivates and invites those students who struggle with boredom from traditional school assignments (Chen & McGrath, 2004). With PBL, students become engaged, self-motivated, and persistent in discovering answers to their questions. An additional advantage of implementing PBL is the unique opportunities that it provides for teachers to build successful relationships with students (Furger & Shaffner, 2004). As the role of the student and his or her learning change to PBL, the teacher has to change to become a facilitator who helps students build their own knowledge base (Gulbahar & Tinmaz, 2006).

The ISTE (2000) indicated that "multimedia brings a two-for-the-price-of-one dimension to project-based learning" (Multimedia PBL section, ¶ 1). Students can learn "both the instructional technology and the disciplines being focused on in the project-based learning lesson" (ISTE, 2000, Multimedia PBL section, ¶ 1). Multimedia is defined as "computer-mediated information that is presented concurrently in more than one medium" (Kahn, n.d., ¶ 2) and can include text, graphics, animations, video, and audio. A key concept in multimedia learning is cognitive load. Solso (2001) suggested that working memory places a severe limitation on the amount of information that can be absorbed at any given time. Therefore, learners need both verbal and visual content to retain information longer and comprehend it more deeply.

Because multimedia instruction uses the learner's capacity of both visual and verbal memory systems, this approach can enhance the learning experience. According to Gardner (1993), meaningful learning takes place in various modalities. Yellin, Blake, and Devries (2004) suggested that students need to not only read books, but also explore the World Wide Web. For example, students would benefit from the opportunity to create PowerPoint presentations to share with others, as well as composing their own videos and computer images. Especially, multimedia embedded in literacy instruction can significantly improve reading outcomes for children (see Chambers, Cheung, Madden, Slavin, & Gifford, 2006). Chambers et al. suggested that the use of embedded multimedia can enhance the effectiveness of beginning reading instruction for disadvantaged children.

As evident in the research previously discussed, using multimedia-assisted PBL in teacher education programs has potential to open new territory for preservice teachers in the college classroom, and subsequently for their future students in elementary, middle, and high school classrooms. We observed how designing and developing these multimedia projects influenced the preservice teachers' knowledge and self-efficacy. The effects of the approach are reported in detail in the following sections.

Impact on Technology

First, we investigated how the experience of producing the multimedia projects influenced the preservice teachers' knowledge and confidence in using technology. At the beginning of the course, all the participants indicated that they were using a computer on a daily basis for their school assignments or job-related work. In terms of their level of proficiency with the software programs used for the projects (FrontPage, Inspiration, MovieMaker, Mozilla, PowerPoint, Publisher, and Word), there was a significant improvement after the completion of the projects. Prior to the development of the projects, they were most familiar with Word and PowerPoint. On a 1 to 5 scale, with 5 indicating excellent, the preservice teachers rated their level of proficiency with Word an average of 4.29 and PowerPoint 4.13. After the completion of the projects, their ratings increased from 4.29 to 4.85 for Word and from 4.13 to 4.47 for PowerPoint. More important, in terms of the programs they were less confident about (Mozilla, Inspiration, and MovieMaker), their level of proficiency greatly improved after the projects; from 1.24 to 3.91 for Mozilla, from 1.35 to 3.95 for Inspiration, and from 1.53 to 3.91 for MovieMaker.

The participants found all the projects quite useful; in terms of the usefulness of the projects, they rated all the projects above 4 on average. Among the projects, the participants rated the PowerPoint presentation project the highest (4.88). They indicated that the PowerPoint project was "a great way to show visuals while lecturing" and "an effective way to organize the content." On the other hand, they rated the Mozilla online lesson project the lowest (4.01). Their perception of the usefulness of a project was closely related to their familiarity with the software program used for the project. Although the participants viewed PowerPoint as "a fast and easy way to provide information in a structured manner," they noted that "I had never used Mozilla before, so everything from class I learned for the first time" and "It took a long time for me to learn how to use Mozilla."

In addition, these projects positively influenced their comfort level and preparedness for using technology. Prior to the development of the projects, only 42% of the students were comfortable using technology for teaching, and only 36% felt prepared to utilize technology. However, after the multimedia experience, 91% became comfortable, and 94% were ready to use technology in their classrooms. According to the students, developing the projects "broke the idea that creating multimedia products would be complicated." They indicated that, "Once I finish a project, I was proud and I gained confidence using the technologies," and, "Even if I make mistakes with technology, it is better to attempt

the programs instead of fear of doing things incorrectly." The results also showed that after the projects, all the participants (100%) agreed or strongly agreed that technology would enhance their future students' learning by increasing student interest in the topic being taught. This is a significant change when considering that only 59% had the notion prior to the projects.

Impact on Subject Matter

We found that multimedia-assisted PBL also increased the students' knowledge and self-efficacy in their subject matter. According to Kennedy (1990), there are three core aspects of subject matter knowledge: (a) the content of the subject including facts, concepts, principles, or laws; (b) the organization and structure of the content, referring to the network of relationships among facts and concepts; and (c) the methods of inquiry including rules of evidence or forms of argument. Based on this model, we investigated how the preservice teachers' perceptions of their subject knowledge changed in terms of these three aspects in the course of developing the projects.

The results showed that the students perceived that their knowledge on how to structure the patterns and relationships among the facts and concepts of their subject matter had improved most significantly; prior to the projects, only 56% of the participants agreed or strongly agreed with the notion, but after the projects, 97% acknowledged their knowledge improvement in this aspect. They commented that, "I was able to make connections between the topics in my content area and better realize how technology can be combined with them for possibly better lessons." In addition, they felt that the experience of developing the projects greatly helped them extend their knowledge on how to challenge existing theories and produce new ideas in their subject content areas; the percentage of the participants who agreed or strongly agreed with this statement increased from 59% to 82% after the completion of the projects. They also felt that they possessed a high level of knowledge on the important facts, concepts, or principles related to their subject matter; prior to the projects, 88% agreed or strongly agreed with the statement, but after the projects, all the participants (100%) agreed or strongly agreed.

The preservice teachers attributed these improvements to the fact that producing the projects required that they research and learn more about the topics that they presented. They noted that, "Designing these projects helped to make me think in greater detail about topics in my content area and served me in that it made me delve more in depth to each specific topic" and "I had to thoroughly prepare; winging it was not an option."

Impact on Teaching

To identify any change in their teaching styles, we asked the participants in which manner they preferred to teach, selecting from case study analysis, demonstrations, discussions, field work, group/paired learning, lectures, student production of multimedia, or use of multimedia. At the beginning of the course, the preservice teachers selected lectures and demonstrations as their favorite teaching styles; they put 23 check marks on lectures and 22 on demonstrations (multiple checking was allowed). However, their preference shifted to the use of multimedia and student production of multimedia after the projects (from 15 to 31 checks on the use of multimedia; from 9 to 32 checks on student production of multimedia). The number of checks on the lecture mode dramatically decreased to 4 after their multimedia experience.

Their perceptions of the teacher's role changed accordingly. Prior to the projects, they viewed the teacher as an authority setting standards and defining acceptable manners in the classroom (22 checks) or a model teaching by examples (26 checks). After the completion of the projects, they considered the teacher as a facilitator guiding students by asking probing

questions (30 checks) or helping students develop their ability to make their own decisions (21 checks).

Obviously, multimedia-assisted PBL led the preservice teachers to change their views of the teacher's role from teacher-centered to more dynamic student-centered approaches. Their comments showed that they became more interested in and more concerned about the student learning process after the projects. They noted, "I learned more effective ways of engaging the student regarding coursework," "Exploring different media to connect with students and finding the most effective media were what helped the most," and "I feel that I can now know many means of motivation to help encourage my students to learn subject material."

In addition, multimedia-assisted PBL enhanced their sense of efficacy. After the projects, 94% of the participants came to believe that they could teach their future students to take initiative and responsibility for their learning (56% believed so prior to the multimedia experience.) Furthermore, 100% felt that they could help their students develop problem-solving skills (38% were confident doing so prior to the experience). After the projects, 97% of the participants felt confident to use effective instructional strategies for their future students (59% prior to the projects), and 94% believed that they could truly make a difference in their classes (68% prior to the projects).

Conclusion

This study found that multimedia-assisted PBL positively influenced the preservice teachers' knowledge and self-efficacy in (a) technology, (b) subject matter, and (c) teaching. This powerful instructional method is truly meaningful in teacher education. Multimedia-assisted, project-based learning can create a profound ripple effect in the teaching/learning process. When teachers engage with students in creating multimedia presentations, they have an opportunity to personalize the curriculum to reflect learning from the viewpoints of learners. When students learn that they can generate and publish images, sounds, and language in ways that demonstrate their learning, they are set free from traditional forms of testing. Multimedia productions provide opportunities for constructing authentic demonstrations of learning. Changing the medium of presentation for what is learned can change classroom dynamics in very important ways. By working together to generate productions of knowledge, the students and the teacher become both learners and creators of new knowledge.

However, it is important to be aware of some possible barriers to multimedia projects. Steelman (2005) identified technical difficulties with software, hardware, and networks, and lack of teachers having uniformed tools, as main hindrances. Time restraints, teacher training, and keeping up with permission slips were other difficulties cited. Such stumbling blocks occurred in this research project. In the course of developing their multimedia projects, the students encountered software glitches and computer malfunctions that led to a great deal of frustration for them. And it caused more anxiety when there was no prompt technical support. In addition, it was challenging for the instructor to address the needs of all students because they had different levels of computer skills and interests. For example, those who were not familiar with Web site design needed more time and more teacher guidance to complete their Web site projects, and some experienced students could finish their assignments much faster with less assistance. Obviously, multimedia segments by themselves are insufficient. Students still need practice in working with the teacher and their peers and practice in other formats to solidify cognitive learning. In addition, the teacher needs to able to customize instruction in such a way as to fit the target students' knowledge levels and learning goals. As in the original meaning of the word *technology*, the efforts and creativity of both the teacher and students should be seamlessly woven into the implementation of technology to bring out the best outcome of multimedia-assisted, project-based learning.

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