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Multimedia Technologies and Familiar Spaces: 21st-Century Teaching for 21st-Century Learners

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Abstract

This article explores 21st century skills, nonlinear thinking skills, and the need for student reflection—which, taken together, serve as an essential foundation for digital-age teaching of today's hypertext learners. The authors discuss why preservice teachers need to use multimedia technologies within the context of students' familiar, technology-rich living spaces to develop their own teaching skills and the technology skills of their students. Exemplary multimedia samples are offered as demonstrations of ways to develop essential technology-related skills in the next generation of teachers.

Today's students are immersed in a variety of technologies from a young age. As such, they have been described as "wired" or "digitized," but even these tags are outdated almost upon arrival. Prensky (2001a) called this first generation to grow up in a society immersed in technology "digital natives"—the generation that has spoken the language of technology from birth. Ironically, such familiarity and comfort with all things digital present challenges for educators who struggle to keep up with an ever-changing technology context and students who no longer process information primarily in a sequential manner.

Equally important in this fast-paced, digital world is the lack of time or opportunity for students to reflect on their learning. Reflection and critical thinking enable students to learn from their experiences; therefore, time must be built into classroom instruction for both processes to occur (Henniger, 2003). Not only are reflection and critical thinking skills undervalued in today's standards-driven classrooms, but policies continue to emphasize views of technology as primarily a means to assist with writing and organizing information.

Although such technology use can facilitate communication, today's students must learn how to think deeply about their learning so they can realize their place in a rapidly changing, global society. They must learn to *apply* technology tools appropriately in order to process multiple perspectives on real-world problems and formulate solutions to these problems (Partnership for 21st Century Skills, 2002). With new demands for meaningful and contextual application of technology in classrooms, teacher preparation becomes both increasingly important and increasingly challenging as teacher educators seek new ways to integrate 21st- century skills, nonlinear thinking skills, and digital-age reflections into coursework.

Essential Skills for Digital Teaching and Learning

Although the claim that students inhabit a much different world than in times past has been made throughout history, it is particularly true in this century. From a young age, today's children are exposed to computers, the Internet, instant messaging, social networking sites, and cell phones that provide instant communication locally and globally. Not surprisingly, research shows that today's digital students learn more when engaged in meaningful, relevant, and intellectually stimulating schoolwork and that the use of technology can increase the frequency for this type of learning (North Central Regional Educational Laboratory [NCREL] & the Metiri Group, 2003). Using technology, teachers can tap into the knowledge of experts; visualize and analyze data with their students; link learning to authentic contexts; and take advantage of opportunities for electronic, shared reflection (Bransford, Brown, & Cocking, 1999).

All of these pedagogical opportunities need to be part of current teacher education programs. Preparation of tomorrow's teachers, however, does not depend solely on how well emerging technologies are incorporated into college coursework; instead, it rests on how well incoming teachers are taught to *leverage* the technologies to help their students develop these same skills. Twenty-first-century skills fall into six distinct categories, each of which can be readily engaged through careful use of multimedia technologies in the classroom setting: critical thinking, information and media literacy, creativity, communication skills, collaboration, and contextual learning (Partnership for 21st Century Skills, 2002.).

Critical thinking involves in-depth examination of topics from a variety of perspectives and calls for cognitive skills such as comparison, classification, sequencing, patterning, webbing, and planning. Bloom's early taxonomy of cognition included six graduated levels of thinking that move from knowledge to comprehension, application, analysis, synthesis, and finally, evaluation (Bloom, 1956).The higher levels of thinking—analysis, synthesis and evaluation—are key to critical thinking and form the basis for developing all other 21st-century skills (Levy & Murnane, 2004).

Information and media literacy involves the ability to critically analyze and evaluate information; determine what information is needed; and locate, synthesize, evaluate, and use information effectively (Gunter, 2007; NCREL & the Metiri Group, 2003). Since so much of today's media is in visual form, students need visual literacy skills to understand

information that integrates images, video, sequences, design, form, symbols, color, 3D, and graphic representations. They need to know how to interpret visual messages and look beyond the surface to determine deeper meaning in what they see.

"Creativity is the act of bringing something into existence that is genuinely new, original, and of value" (NCREL & the Metiri Group, 2003, p. 33). The amount of acquired knowledge no longer defines intelligence; rather, today's measure of intelligence involves the capacity to create, produce, and apply technology in complex and sustained situations (Committee on Workforce Needs in Information Technology, 2001). This skill is essential to teaching today's children effectively. They are a generation of learners who have continuing technology-enhanced opportunities to create and share new, original, and valuable information with others.

Communication centers on the ability to impart one's thoughts effectively to others. Using current technologies, communication is not only far easier than it was in times past, it is also constantly available in a wide variety of forms.The International Society for Technology in Education (ISTE, 2007) recently developed an updated version of *National Educational Technology Standards (NETS) for Students* that focuses more on skills and expertise and less on technology tools. This update is a significant step forward in meeting the demands of 21st-century learning, as students are increasingly expected to use digital media to interact, communicate, collaborate, and publish with peers, experts, and others using a variety of digital media.

Along with its update for *NETS for Students*, ISTE is refreshing its *NETS for Teachers*, as preservice teachers must also hone their communication skills in ways that make use of all technologies available. They must help their students hone these skills as well—determining, as they go, the appropriate discourse rules in each setting (Partnership for 21st Century Skills, 2006).

Contextual learning ensures that new concepts are presented in the context of their intended use or in the context of what students already know. Ideally, students gather and analyze their own data as teachers guide them in the discovery of concepts. Sharing, communicating, and responding to concepts allows students to improve their communication and critical thinking skills. All of these skills help students (a) process new information into their prior knowledge so it makes sense to them; (b) discover meaningful relationships between abstract ideas and practical applications; and (c) internalize concepts by relating, experiencing, applying, and transferring them in context *(*Texas Collaborative for Teaching Excellence, 2007*)*.

Multimedia uses multiple forms of text, audio, graphics, animation, or video to convey information. As such, multimedia technologies offer today's classroom teachers the opportunity to move from a largely linear learning environment to an increasingly nonlinear environment. Such technologies also allow students a strong degree of choice as they pursue learning with multimedia texts. Although multimedia classroom tools offer classroom teachers multiple ways of engaging students in the learning process, they also present challenges for teachers. One of the challenges lies in the fact that certain multimedia tools promote far more active learning and student decision-making than others (Jacobson & Archodidou, 2000; Spiro & Jehng, 1990).

There are two categories of multimedia—linear and nonlinear. Linear multimedia tools generally progress from one screen to the next and are commonly used by instructors as a supplementary teaching aid. This form of multimedia tends to limit learning potential because it does not require active participation. On the other hand, nonlinear multimedia

tools (those that include hyperlinks) offer viewers interactivity, control of progress, and choice in their construction of knowledge.

When used as active learning tools, nonlinear multimedia engages students in using 21st-century skills and provides a variety of creative, digital-age reflection opportunities. These honor Dewey's (1938) constructivist teaching and learning strategies and support cognitive flexibility in learning. According to cognitive flexibility theory (Spiro & Jehng, 1990), learners benefit from retrieving information in the nonlinear fashion that hypertext allows, as it helps them develop complex and rich schemata and enables them to use their knowledge in a flexible manner (Jacobson & Archodidou, 2000; Jacobson, Maouri, Mishra, & Kolar, 1996). Hypertext learning environments are particularly beneficial for learners who prefer active, problem-based, and self-directed learning (Bajraktarevic, Hall, & Fullick, 2003; Rabe & Cadorna-Carlow, 2007). These environments also show potential to foster higher order, complex reasoning skills in students (Lima, Koehler, & Spiro, 2004).

The concepts *reflection and reflective practice* are entrenched in teacher education literature (Ottesen, 2007) with good reason. Reflection is a vehicle for critical analysis and problem solving and is at the heart of purposeful learning. Reflective observation focuses on the knowledge being learned (i.e., curriculum) as well as the experiential practice (i.e., pedagogy); both are important aspects of the learning process (Kolb, 1984). Through metacognitive examination of their own experiences, preservice teachers are encouraged to take a closer look at what they are learning and to explore their own growth in greater depth. Experiencing the power of reflection in their own learning, they are more likely to encourage similar reflection on the part of their students.

When reflection has been included in instruction, it allows preservice teachers to address uncertainties in their own learning, develop new approaches to learning, and document their growth as reflective practitioners (Capobianco, 2007; Moran, 2007; Ray, Powell, & Strickland, 2006). Reflective activities have long included journal entries or narrative writing, but technology can facilitate and enhance the skills of reflection as electronic reflections can be readily archived, revisited, updated, and shared in exciting and creative ways.

The following examples of multimedia technologies, taken from our own classroom practice, offer productive ways in which teacher educators have invited technology application into their coursework with preservice teachers (whom we refer to as teacher "candidates" in this portion of the article) in field settings. These exemplary student products illustrate how today's multimedia technologies directly promote 21st-century skills, nonlinear thinking, and reflective practice described in this article.

Nonlinear Multimedia Technologies

Thought processing software such as Inspiration and Kidspiration can be used as both a teaching and a learning tool, as presented in Figure 1 and Figure 2. As a teaching tool, our candidates used *Inspiration* as a scaffold for concept mapping when planning article summaries. Quick, electronic organization of key ideas taken from their readings helped candidates organize their research before writing papers. In one summary, candidates defined a particular constructivist principle, described a type of software, and then explained how using the technology in the classroom could support the constructivist principle.

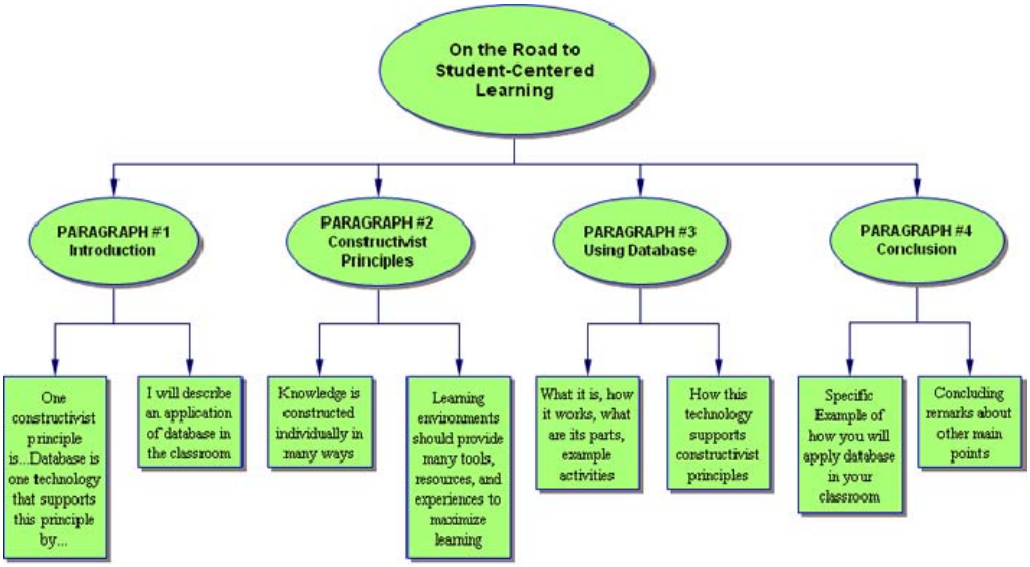

Figure 1. *Example of Inspiration as a teaching tool. (Click to view larger image.)*

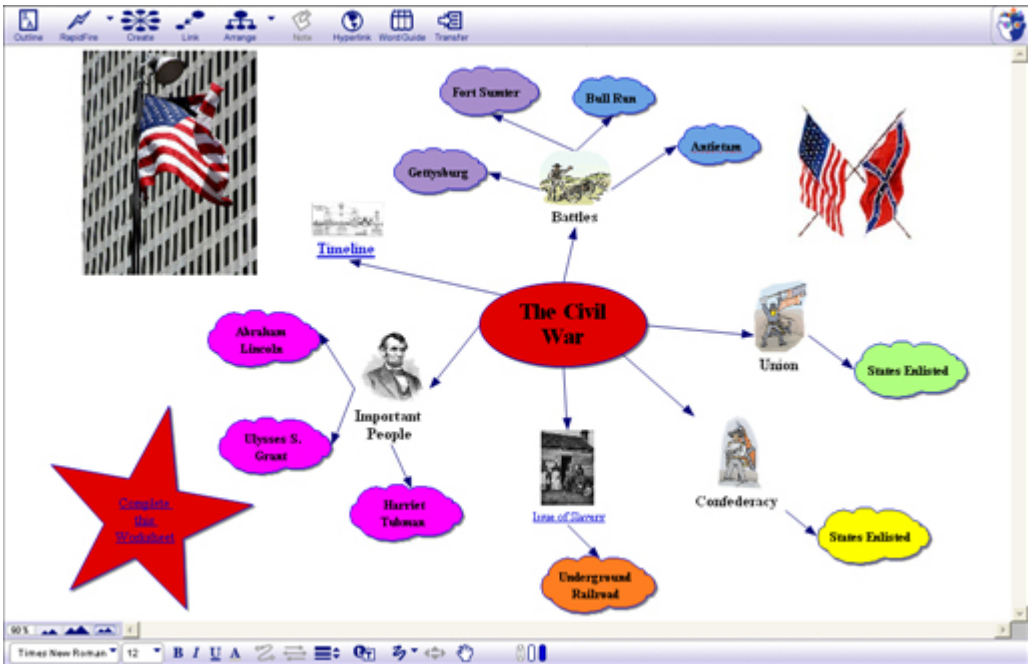

Figure 2. *Example of Inspiration as a learning tool. (Click for larger image.)*

One candidate wrote, “In my own classroom, I would have groups of students build a database on weather patterns then look for ways these patterns contribute to global warming. Students could work cooperatively and construct their own knowledge using critical thinking skills.”

Using concept maps as writing aids enabled students to map ideas visually, separate key concepts from supporting ideas, and understand how concepts were connected. Candidates learned the value of using concept maps as teaching aids, as evidenced in comments such as the following:

> I don't like writing but Inspiration helped me organize my thoughts so writing summaries was easier. Inspiration will be valuable to both my students and me because it lets me map out my thoughts and brainstorm activities. It provides great visuals so we can grasp concepts better and get a better understanding of what is being taught.

To further contextualize the value of thought processing software and nonlinear thinking to classroom applications, our candidates were required to design classroom learning activities for use with their future students. To create grade-level, content-specific concept maps, candidates considered their intended content learning outcomes, the developmental levels of students, and the need to differentiate to accommodate all learners. Candidates determined the substance and organization of concepts to be included in maps and gathered and hyperlinked individual concepts to age-appropriate Internet sites, sounds, and graphics that might be of high interest to the targeted age group.

Student appreciation for using thought processing software was evidenced in reflections such as, "I will definitely use *Kidspiration* in my kindergarten classroom because the program would be a great tool to let them see what they have learned and will help them be creative." Another student wrote,

> The students will use critical thinking skills when using technologies such as Inspiration. It allows students to create their own knowledge and organize their concepts into ways they understand. I see it as a very valuable tool in the classroom because creating knowledge is vital to the learning process.

The development of nonlinear thinking was also embedded in PowerPoint projects related to candidates' intended curricular areas. To create these nonlinear projects, candidates designed a menu slide with several options for viewer selection (see example at http://homepages.utoledo.edu/jlamber4/CITE/australia.swf). On each menu item, hyperlinks were inserted to move a viewer to a specific location in the project (Figure 3). The automatic mouse click was removed from the entire slide show, and hyperlinks were placed on all slides to provide viewer navigation to and from the menu.

Figure 3. *Slide with PowerPoint navigational buttons*

To show candidates how their students could create simple Web pages as part of classroom assignments, they were required to save their PowerPoint projects as HTML files viewable as Web pages. One student reflected,

I knew how to use PowerPoint but the way I was using it was boring. It was the same way that all my teachers have used PowerPoint and I thought it was the only way it could be used. Now I know there are so many other things you can do with the program and I am excited about using it with students in the classroom. They can learn so much more about organizing and presenting information and making it really come alive by putting in pictures, sounds, and movies. I would much rather give students a project like this than ask them to write a research paper!

Similar to other nonlinear projects, candidates used the web authoring software, Dreamweaver to create classroom Web pages (e.g., see http://homepages.utoledo.edu/jlamber4/CITE/class_web_site.htm). Web pages included candidates' personal bios, philosophy of teaching and learning with technology, reading lists, classroom rules, and hyperlinks to content-related Web sites, and activities and lesson plans created during teacher preparation. Reflecting on Web page authoring, a student noted,

I loved creating the classroom web page and I think it will be a great way to communicate with parents and students. I also think it will be a creative assignment I can give my students so that they can post their work on the Internet for anyone around the world to see.

Blogging (see example at http://julieschmitt3.blogspot.com) offers an online world of journaling where people share their thoughts, experiences, and sometimes pictures and audio files. Blogs are structured with postings in chronological order with the latest posting at the top. Readers can make comments on each posting and can post thoughts instantly to a worldwide audience. Postings are archived monthly for later retrieval. Our candidates created blogs at the beginning of the semester and were periodically required to post reflections related to the benefits of classroom uses of technology. The instructor provided feedback online and whenever needed, both the candidate and faculty member could communicate using the blog. Communication was layered over time in an electronic conversation format that included peer comments and responses. Candidates could personalize their blogs by choosing different designs and formats.

As seen in the following comments, students' reflections on blogging as a teaching tool clearly demonstrated their enthusiasm.

> I believe that I will definitely use blogging in my future classroom. After viewing several classroom blogs, I have found that it is very beneficial to students, parents, and even the teachers themselves. The students and parents can be in touch with what is going on inside the classroom and can stay up-to-date on assignments and projects. This could be especially beneficial to those who are absent from class. I believe I will use blogs not only to post information for parents and students, but I will also use posts for a collaborative discussion. This will be a different way to test students on their abilities and knowledge, rather than simply testing them or asking them to write strictly-guided papers.
>
> I want to use blogs so my students have a means of expressing themselves as well as becoming more familiar with emerging technology.
>
> I think I will use blogging in my classroom because it gets rid of some paper work that you have to deal with; it gets the students more involved; and, most importantly, it helps out with communication.

Podcasting is a Web-based broadcasting medium where audio files are available for download. Podcasts can be incorporated into classroom instruction by creating talk shows, recording lectures, interviewing experts, studying a foreign language, or telling stories. No special equipment is needed to create basic podcasts other than a microphone, a computer, and software that will allow recording. After carefully reflecting on new concepts and their experiences using various technologies, students created podcasts to communicate what they believed were important reasons for integrating technology as a teaching and learning tool. Students recorded their typewritten scripts and searched for digital music clips on the Internet to add interest to the podcasts. Podcasts were then uploaded and linked to Web pages and blogs.

The following samples illustrate how this new technology can be used as a creative means of reflecting on the benefits of using technology in the classroom:

Podcast 1. Visual literacy and critical thinking

Podcast 2. Hands-on learning, organizing information, use in foreign language

Podcast 3. Constructivist learning and interacting with peers in health

As in podcasting, digital video was used as a creative outlet for student reflection. Using the same design process as podcasts, candidates recorded reasons their nonlinear multimedia projects would be useful for students and supportive of constructivist teaching and learning. Video-based reflections required each candidate to write scripts, record video, cut unnecessary footage, insert titles and transitions, and save the product as a movie file. The movie was then inserted into the first PowerPoint slide on final projects.

Regularly, students were asked to reflect on what they were learning about the benefits of using hypertext applications. Rich metacognitive comments recorded in blogs, podcasts, and written reflections demonstrated candidate understanding of the benefits of using hypertext for learning, as well as their motivation for using these types of technologies in their future classrooms. Some final semester comments included the following:

> I knew PowerPoint but didn't know how to actually do anything with it. After this class, however, I can actually do things on this program that I never thought possible or even considered - like making it interactive and including sounds, pictures, and movies. It would be a fun program for learning about social studies. Using technology has opened my eyes to a new world and a new way of teaching. I now understand how children learn better and have a deeper understanding of topics when they learn in an interactive way. It makes the learning more student-centered rather than teacher-centered.

The most beneficial thing I will take from this class is the variety of programs that I worked with such as Inspiration and PowerPoint. I learned that it is important to make students think at higher levels and to challenge them. I want to make students work actively and reflectively on every project they undertake. Technology gives me the tools to make this happen!

Programs like these not only make learning more fun for students, but more effective as well. It is an interesting way of learning, and something outside of the "normal" classroom setting. Not only does it make it more enjoyable for the teacher, but it makes it more interesting for the students as well.

Conclusion

The current generation of digital students is both familiar with and motivated to use multimedia tools. Teacher educators must, therefore, harness their power as teaching and learning opportunities for the next generation of classroom teachers. In the most positive sense, multimedia technologies can be as tantalizingly random as these digital natives' "new" brains. By making use of multimedia tools in teacher education instruction, faculty can meet digital natives where they stand, showing them how to make better sense of what initially appear to be random patterns of thinking. Fortunately, and in almost every instance, nonlinear multimedia technologies by necessity involve the use of 21st-century thinking skills that provide students with the flexibility to be active decision makers in their own learning (Bajraktarevic et al., 2003; Spiro & Jehng, 1990).

Certainly, critical thinking and information literacy skills are needed to choose pertinent information that has been sufficiently evaluated for accuracy and appropriateness. Using

an electronic storyboard or concept map as a precursor to writing or creating multimedia products can help students readily classify individual topics and then organize or synthesize them into a coherent whole. Media literacy is called upon when selecting images, sounds, designs, messages, and layouts for multimedia projects. Finally, creativity is needed when putting these elements together for presentation to others.

The nonlinear thinking called upon by most multimedia products helps students see and form meaningful relationships between concepts— a critical practice if knowledge is to be fully internalized (Texas Collaborative for Teaching Excellence, 2007). Connecting concepts with prior knowledge increases the likelihood that students will not only internalize but transfer their learning into their future classroom settings. Nonlinear thinking also focuses students' attention on what is of key importance in the material they are examining and enables them to better decipher and communicate vital information from complex texts.

Equally important in helping students make sense of the barrage of information available to them is providing time and opportunities to reflect on knowledge and experiences during the learning process (Kolb, 1984). Reflection on their nonlinear thinking provided our candidates avenues for expressing the cognitive dissonance experienced while learning new skills. It also provided time to consider the benefits of this kind of thinking and learning. Reflective exercises thus increased their understanding of the learning process and increased their likelihood of integrating 21st-century thinking into their own future classrooms. As students are challenged to reflect and communicate while using familiar technologies, they can creatively explore and convey new concepts and have the time and space to critically analyze and share what they have learned.

We cannot assume that learners learn the same way they always have and that the same methods we used years ago will work today. Based on recent research in neurobiology, digital natives are indeed different (Prensky, 2001b). The ongoing stimulation that is part of their electronically rich lives visibly changes their brain structures and affects the way they think. As a result of the fast-paced, random-access, graphics-intensive world afforded by today's technologies, students' ability to reflect has been significantly affected. According to Prensky, today's students have short attention spans for old ways of learning but not for games or anything that really interests them. They crave interactivity and an immediate response for every action.

Because of these changes, teacher educators are challenged to invent ways to include reflection and critical thinking into their learning but still maintain digital native language and tools. Faculty members need to understand the mental changes in today's students and find new methods and ways to speak their new language in and outside of traditional classroom settings. Multimedia technologies such as those illustrated in this article offer practical ways that faculty members can speak a new digital language and at the same time promote 21st-century skills, appeal to students' nonrandom way of thinking, and provide valuable opportunities for reflection. More training will be needed to help faculty members understand the differences in today's students and ways to integrate these technologies across programs. Furthermore, as these technologies are integrated into teacher preparation, it will be critical to research the influence of hypertext on teacher candidates to verify if it does, in fact, foster the higher order and complex reasoning skills some have suggested (Bajraktarevic et al., 2003; Lima et al., 2004; Rabe & Cadorna-Carlow, 2007; Spiro & Jehng, 1990).

While it is still not entirely apparent how the thinking of digital natives is changing, new technologies, when presented to teacher candidates in the context of their intended use, which is to enhance the teaching and learning processes, seem to motivate, engage, and

offer more opportunities for self-directed learning and reflection. Such technologies provide avenues for creativity and foster inclusion of 21st-century skills in teacher education curricula. When the technology is already familiar and we employ these tools to challenge students to use critical skills, we reap the benefits of teaching today's students in their familiar spaces.

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