LEARNING WITHOUT BOUNDARIES: DEVELOPING MOBILE LEARNING SCENARIOS FOR ELEMENTARY AND MIDDLE SCHOOL LANGUAGE ARTS & MATHEMATICS

By

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ABSTRACT

*This article provides an overview to a collaborative knowledge building project using iPod Touches in elementary and secondary language arts and mathematics classrooms, working with 4 teachers and over 80 students. The interactive technologies for embodied Learning in Reading and Mathematics (iteL*RM) project intends to facilitate student exploration of standards-based topics using wireless mobile technologies with instructional multimedia and communication software. Learning opportunities incorporate the same technologies and learning strategies popularized by video games, personal broadcasting, and Web 2.0. The goal of the initiative is to help children develop appropriate thinking strategies and sufficient practice to improve fundamental knowledge in target areas and increase problem-solving skills using a range of emerging technologies for communication and computing.*

INTRODUCTION

In the modern elementary and secondary classroom, it is highly probable that students have used technology during a lesson or at least heard about the types of technologies available for learning. A more likely scenario is that children have had wider experiences and are more adept users of technology *outside* the classroom, where they use mobile phones and portable gaming devices to initiate, expand, and sustain social relationships (Evans, 2008; Schuler, 2007). In their work constructing ethnographies of youth and new media, Mimi Ito and colleagues (2008) make a distinction between "friendship-driven" and "interest-driven" practices and networks. The former are the loosely collected groups of peers who leverage mobile, wireless technologies such as mobile phones to maintain social relationships where these networks are merely extensions of already existing connections. On the contrary, *interest-driven networks* are strongly connected to technology and most noticeably arise when one or more members of a loosely coupled community begin to demonstrate expertise and direction that formalizes knowledge and relationships. A good example is the interest-driven networks that emerge around popular online massive multiplayer games such as World of Warcraft and the Sims (Salen, 2007). Technology, then, becomes both the focus and medium for forming and sustaining interest groups with an agenda to generate useful knowledge valuable to members of the community. It is this phenomenon of collaborative knowledge building that we wish to leverage with the Learning Without Boundaries project, engaging teachers and, especially, students in domain-specific activities in language arts and mathematics to spur interest-driven networks of learning.

Collaborative Knowledge Building and Learning Technologies

As cited in a recently released white paper, The Power of Pow! Wam! Children, Digital Media and Our Nation's Future (Shore, 2008), "Electronically-enabled experiences fill daily life at home, at work, and in our communities. This trend is likely to accelerate…" as the sophistication and availability of such devices increases" (p. 4). Adding to this discussion is another prominent scholar in the field James Paul Gee who notes in a second timely report, Getting Over the Slump: Innovation Strategies to Promote Children's Learning (2008), media use by kids ages 8-10 is

already a part of their daily activities: "On average per day, children spend 37 minutes using computers, 65 minutes playing video games, 59 minutes listening to music, and 197 minutes watching TV" (p. 14). The challenge here is twofold. On one hand, children and youth spend only a small portion of their waking lives in formal learning environments (Bransford et al, 2000). Consequently, educators are hard pressed to find meaningful learning experiences for the students that also abide by state and national standards of learning (specifically in the United States). On the other hand, as hinted above, the type and uses of technology in the formal classroom is often inferior compared to the situations children encounter at home. Although a digital divide may still exist when it comes to higher-end desktop and laptop computers, the saturation of mobile phones, portable game consoles, and personal media devices provide ample exposure to sophisticated computational and communication devices. Again, citing the work of Gee: "Many elementary [and secondary] school children are gamers and emerging tech-savvy digital natives. They crave engaging experiences with new technologies, and today they want to learn socially and collaboratively, using digital tools that allow them to participate in learning communities and to produce media and knowledge" (2008, p. 29).

Given these trends, the interactive technologies for embodied Learning in Reading and Mathematics (telL*RM) project is designed to guide students to explore language arts and mathematics using wireless mobile technologies with instructional multimedia and communication software. Within these grades we focus on context clues, synonyms, and antonyms for language arts instruction, and division of decimals and the relative magnitude of two decimal numbers for mathematics. We are starting with a small set of standards-based "lesson plan instances" of difficult to teach subjects in elementary and secondary classrooms to both gain administrator buy-in and to demonstrate the efficacy of proposed interventions. The learning scenarios being developed incorporate the same technologies and learning strategies popularized by video games, personal broadcasting, and Web 2.0 technologies, the latter two being hosted on an open-source, community-based course management system called Moodle. The goal of Learning Without Boundaries initiative is to help elementary and secondary students develop appropriate strategies and sufficient practice to improve fundamental knowledge in target areas and increase problem-solving skills using a range of emerging technologies for communication and computing. The authors also provide teachers the support and tools to continue developing lesson plans and requirements for custom-built software applications that serve their needs. Table 1 illustrates planned professional development

What is Inquiry-based Learning and Why Use it in the Classroom?
▪ Instruction starts with a driving question, a problem to be solved
▪ Students explore the driving question by participating in authentic, situated-inquiry. As students explore the question, they develop an understanding of the discipline and also how to apply their understanding
▪ Students, teachers, and community members engage in collaborative activities to find answers to the question
▪ During the inquiry process, students are scaffolded with learning technologies that allow them to perform activities normally beyond their individual ability
▪ Students create a set of products to address the needs of the question. These products are shared artifacts that represent the learning of the class Defining Electronic Portfolios and Techniques for Helping Students Develop Them
Moodle: Student-Centered Dialogue, Collaboration, and Support
▪ This workshop is focused on the instructor looking to engage students in the ownership of their learning. This workshop provides instructional strategies and activities using tools within [Moodle] to help you engage and to encourage student discussion and dialog. Examples will be demonstrated and we will have the opportunity to discuss other possible ways to provide students with "ownership" in their learning.
Moodle: Reflective Learning Activities
▪ This workshop is focused on the instructor wishing to create outside-of-classroom reflection through projects, peer-critique and peer-review, reflective journaling, or self-assessment via personal portfolio review. Instructional strategies will be suggested and examples of how to do this will be demonstrated. We will have the opportunity to discuss how this approach can help support good practices in education and meet the higher order task of critical thinking as found in Bloom's Taxonomy.
Moodle: Planning Lessons and Using Assignments
▪ This workshop is focused on the instructor wishing to create online, module lesson plans and assignments to free up time in the classroom for other activities (e.g., discussion). This workshop provides hands-on opportunities to restructure your course content for use and reuse for years to come. It will also cover how to use the Assignments tools to post problem solving or skills practice online. Examples will be demonstrated and we will have the opportunity to discuss how this approach can support best practices in education.
Moodle: Connecting Students with Content
▪ This workshop is focused on the instructor looking to engage students in learning. This workshop provides instructional strategies and activities using tools within [Moodle] to help you connect and engage your students in learning. Examples will be demonstrated and we will have the opportunity to discuss other possible ways to make course content available to (and resonate with) your students.
Using Games to Enrich Instruction in the Classroom

Table 1. Professional development workshop plan for using Moodle.

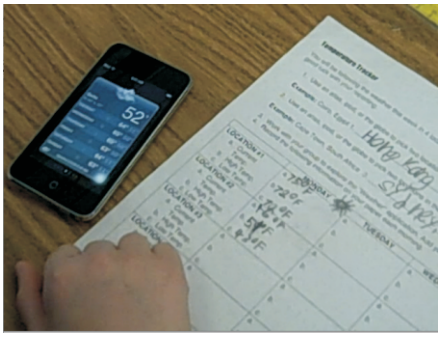
activities for teachers in the use of Moodle for inquiry-based learning.

The working principle at play is that the more familiar children are with advanced educational software and learning technologies, in our case open-source software delivered via Moodle and educational applications served by the iPod Touch, iTunes U, and the Apple App Store, the more teachers will incorporate them into planned and spontaneous instructional situations. The iPod Touch (along with earlier generations) is becoming one of the most popular devices for communicating and accessing information. As Pasnik (2007) indicates: "In addition to providing students with opportunities to personalize their use of media, teachers can use iPod to get students interacting, which requires them to confront one another's strengths, ideas, opinions, and content understanding" (p. 7). Our analysis of information and communication technologies available to classrooms indicates the high potential for successful use for educational settings (Table 2).

The iteL*RM project partners with two fourth grade, one sixth, and one eighth grade classroom totaling over 80 students using iPod Touches for classroom activities, project-based communication, enrichment, and remediation. Figure 1 provides an overview of how the ipod is being adopted in an elementary classroom teaching kids how to combine mobile, wireless devices, web applications, and standard lesson plans for personalized learning.

	Formal ←						→ Informal
	Desktops	*Laptops*	*Tables*	*UMPC*	*PDA*	*Media Device*	*ipod Touch*
Asynchronous	High	High	High	High	High	n/a	High
Synchronous	High	High	High	High	Medium	n/a	High
1 to Many	High	High	High	High	High	Low	High
Many to Many	High	High	High	High	Low	Low	High
Availability	High	High	High	High	High	High	High
Affordability	Low	Low	Low	Medium	Medium	Medium	High
Functionality	High	High	High	High	Low	Low	High
Portability	Low	Medium	High	High	High	High	High
Customibility	High	High	Medium	Medium	Low	Low	Medium
Ubliquitus	Low	Low	Medium	Medium	Medium	Medium	High

Table 2. Comparison matrix of ICTs used for education.



At a little past 8:00 o'clock in the morning, students in Ms. Robert's fourth grade class are working independently at their desks on a mathematical task. To get students to explore number ranges and averages, she has asked them to track the temperatures of five countries around the world over a five-day period. By using a weather application on the iPod Touch, downloaded from the Apple Apps Store, the students are able to access a wealth of information at their fingertips. In the case shown in the photo to the left, Jason is tracking temperature changes in Hong Kong from his desktop in southwest Virginia, USA. With the aid of a wireless access point in the classroom, Jason is able to leverage the features provided by mobile wireless technologies to make this particular learning episode customizable (he gets to choose the five cities) and meaningful (numbers are not mere abstractions but represent real conditions in the cities he is tracking).

Figure 1. Incorporating emerging technologies into existing classroom practice.

Mobile, Wireless Devices & Web 2.0: Platforms for Collaborative Knowledge Building

We place emphasis on a participatory culture, one that incorporates multimedia production and networking technologies as integral to learning activities (Jenkins et al., 2006). As a sociotechnical unit, *social software* provides a platform to conduct the proposed activities identified by iteL*RM values, goals, and objectives. Social software refers to software that allows individuals to connect or collaborate through computer-mediated tools (Boyd, 2007). This type of software has existed for several years in the form of listservs, forums, newsgroups, and other online systems. Recently, however, blogs, RSS feeds, tagging systems, and collaborative filters have made social software popular (Tepper 2003), particularly among young computer users. A recent Pew Internet & American Life Project (Lenhart et al., 2007) found that 55% of all American youth (ages 12-17) use some form of social networking site. Some of the most popular websites today are excellent examples of social software systems, including: multimedia content-sharing systems like YouTube (www.youtube.com) and Flickr (www.flickr.com); and product recommendation systems like reviews on Amazon (www.amazon.com), and Netflix (www.netfic.com.)

Key to the iteL*RM model is that many social software

systems provide some form of syndication. Most of the sites permit users to "subscribe" to a particular stream of information. This allows users to see information, in which they are interested, in one place by aggregating multiple sources of information. They read a brief portion of the information and decide to visit the site of the source of the information only when appropriate. Social software systems, in addition, contribute to creating systems that provide many new benefits to users, such as the idea of a "mashup." A mashup is a website that provides some service making use of data from two or more sites together, in an integrated fashion. One of the first mashups created showed an online map (e.g., Google map) showing real estate prices. The data for the mashup came from two different and independent sites (real estate prices and online maps). The result was a new service that mixed related information to provide new functionality or information. Today, mashups are an integral part of Web 2.0 systems. In iteL*RM, students' multimedia productions are shared through online social networks hosted on Moodle. This system invites and supports tagging and exchange of information to develop, collaborate, and comment on each other's work. Teachers and students learn how to create RSS feeds promoting their work and asking for advice and opinions, and they aggregate feeds from the work produced by their peers to create mashups of topics and productions related to their topics of interest. Together this establishes and sustains an online collaborative environment to complement the on-site activities of young participants.

A Pedagogical Pipeline for Developing Educational Applications for Mobile Learning

Beyond adopting existing services and applications, we detail our production path for developing educational applications for these devices. Our goal is to create a pedagogical pipeline from the classroom course management system, Moodle, to the iTunes U site where teachers can upload content, and students and parents can have access. Our goal is to leverage the extremely viable iTunes Apps Store model to facilitate a market of educational applications created for and by teachers in the state of Virginia and beyond.

One of the challenges for the effective use of mobile devices in educational settings is the availability of the applications and content that fits the specific pedagogical goals for the class. Our goal is to provide support for a pedagogical pipeline (Figure 2) to streamline design, development, delivery, use and evaluation of educational content on mobile multi-touch platforms (for the current project focus is on the iPod Touch).

The key component of the pipeline is Mobile Learning Adaptation Engine, a mobile application that allows students to select/download content (lesson) from the lessons portal, "play" the lesson and collect the results (including use statistics) that can uploaded back to the lessons portal. The engine analyzes the downloaded content and dynamically creates the corresponding user interface/display leveraging the Model-View-Controller pattern.(Figure 2)

The event-based programming paradigm and database storage used in iPhone/iPod Touch application development lends itself nicely to provide for logging capabilities. A relational database providing persistent storage on iPhone/iPod Touch devices is used to record user data including high-level content/lesson specific data (answers provided, times spent on each lesson segment, number of attempts, etc.) and low level device specific data (timestamps and locations of individual touches, movements of the device - 3D accelerometer data, etc.).

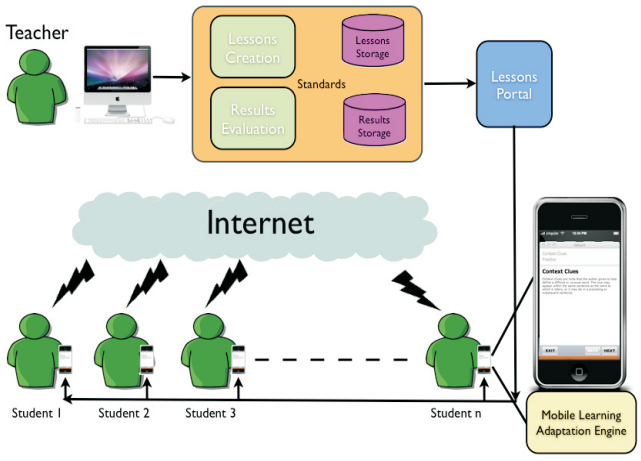


Figure 2. Learning Without Boundaries service architecture.

A teacher is free to develop content without worrying about the underlying mobile technology. The use of standards such as SCORM enables interoperability and use of freely available content development tools. We are using a set of tools (mostly open source) with some translators (for different formats) to provide an integrated lesson development environment. We are also developing lesson templates, such as those shown in Figure 2, where a teacher provides textual information that is then packaged within the lesson content and displayed on iPhone/ iPod Touch by the Mobile Learning Adaptation Engine.(Figure 3)

The underlying communication architecture that is being developed in support of the pedagogical pipeline includes:

1) iTunes U site hosted by the Virginia Department of Education.
2) Moodle site hosted by the local public school district.
3) Content/logging data delivery/storage server hosted at Virginia Tech.
4) Lessons portal as afront-end web server hosted at Virginia Tech.

The iteL*RM project promotes the idea that technology-enhanced active learning in combination with cooperative learning can have profound impact on the primary and secondary classrooms. Mobile, multi-touch devices used aid in a different way and call for different outcomes. "Many elementary school children are gamers and emerging tech-savvy digital natives. They crave engaging experiences with new technologies, and today they want to learn socially and collaboratively, using digital tools that allow them to participate in learning communities and to produce media and knowledge" (Gee, 2008, p. 29). In this situation learning not only develops, but it is also shared between peers. According to iPod in Education: The Potential for Teaching and Learning (Pasnik, 2007) "iPod educational content has the potential to extend and reinforce students' understanding of content areas and specific disciplines" (p. 2). For example, an iPod game might have a student match math facts they learned in a previous grade to new math problems they are learning in their current grade. After each question, the student can view whether or not their answer was correct, enabling them to discern whether they should move on or try again.

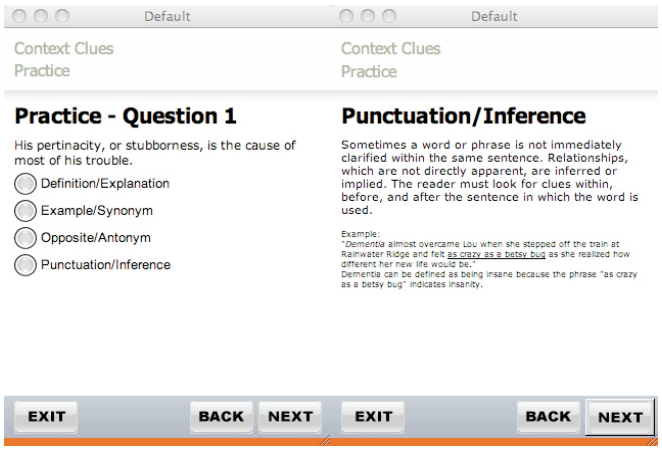


Figure 3. Customized educational application for iPod Touch Grade 8 Context Clues Lesson.

In this research article we argue that the more familiar children are with the technology, in this case mobile, wireless devices, the more teachers should incorporate them into planned and serendipitous learning situations. One of the most popular devices is the iPod: "In addition to providing students with opportunities to personalize their use of media, teachers can use iPod to get students interacting, which requires them to confront one another's strengths, ideas, opinions, and content understanding" (Pasnik, 2007, p. 7). It is for this reason we work to explore ways by which teachers can satisfy standards-based evaluations with more learner-centered pedagogy.

Conclusion

The authors anticipate using iPod Touches with web-based collaboration technologies, including Web 2.0 concepts, to broadcast and share narratives among the participants creating a social network of collaborators and peers. Digital artifact development and technology, using open-source software where available, further exposes participants to concepts and practices in computer science, human-computer interaction, and instructional design. Our approach reflects the values of *participatory culture*, "…a culture with relatively low barriers to artistic expression and civic engagement, strong support for creating and sharing one's creations, and some type of informal mentorship known by the most

experienced is passed along to novices" (Jenkins et al., 2006, p. 3). Participatory culture is a forward-looking principle for how scientists, engineers, citizens, and public officials will engage.

By utilizing mobile, wireless technologies in a variety of learning situations, students gain valuable experience and develop skills needed to prosper in the ever-changing technological society of the 21st century. This situation leads one to conclude that technology only enhances learning as long as the proper steps are taken to educate teachers about how to use the technology effectively in differing situations. According to Gee (2008) technology can be used to problem solve, simulate real experiences, collaborate with peers, gain knowledge and produce projects. By rethinking learning and teaching, students can make the transition from school to professional in a 21st century way.

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