A Networked Learning Model for Construction of Personal Learning Environments in Seventh Grade Life Science

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Abstract

This design-based research case study applied a networked learning approach to a seventh grade science class at a public school in the southeastern United States. Students adapted Web applications to construct personal learning environments for in-depth scientific inquiry of poisonous and venomous life forms. API widgets were used to access, organize, and synthesize content from a number of educational Internet resources and social network connections. This study examined the nature of personal learning environments; the processes students go through during construction, and patterns that emerged.

Findings revealed that students applied the processes of: practicing digital responsibility; practicing digital literacy; organizing content; collaborating and socializing; and synthesizing and creating. These processes informed a model of the networked student that serves as a reference for future instructional designs.

Keywords: Personal Learning Environment, PLE, Networked Learning, Web 2.0, API Widgets, Educational Technology, Technology Integration, STEM

Objectives

The purpose of this mixed method design-based research study was to apply a networked learning model to the student construction of personal learning environments as a means of facilitating digital literacy and inquiry learning. This first-iteration design captured the nature of the personal learning environment, documented apparent patterns, and considered implications for future instructional design. It sought to answer the question, what are the processes that students go through as they design a personal learning environment in a middle school science class?

The concept of a personal learning environment (PLE) has been gaining support in the eLearning domain to broadly refer to "how people construct the environment for themselves: the tools they choose, the communities they start and join, the resources they assemble, and the things they write" (Wilson, 2008, p.18). Personal learning environments are "systems that help learners take control of and manage their own learning" (Downes, 2007, p. 24). The seventh grade students in this study were networked learners in training. They used personal pages with API widgets to access, organize, and synthesize content in support of scientific inquiry into poisonous and venomous life forms. In this case, managing learning and individual control were scaffolded over time to allow the students to learn the processes and tools required to support their learning objectives.

Theoretical Framework

Networked learning is a complex learning model, different components of which could span a number of established learning theories. For the purpose of this study, unique aspects of the networked learning model were isolated to better address the theoretical framework that informs the research. First, students were expected to access, navigate, disseminate, and synthesize large quantities of information for the purpose of constructing knowledge. Second, students built an environment with technology through which they could learn. They did not learn *from* the technology, but *through* the process of applying it with the goal of constructing a custom personal learning environment (Jonassen, 2003).

Constructivism provided the theoretical framework for this research. It implies that knowledge is constructed by the learner and encourages "greater participation by students in their appropriation of scholarly knowledge" (Larochelle et al., 1998). This study was informed primarily by David H. Jonassen's constructivist perspective applied specifically to solving problems with technology (Jonassen et al., 2003) and Peter Taylor's critical constructivist perspective of monitoring constructivist classroom learning environments (Taylor et al., 1997).

Jonassen views technology as a collection of tools to support knowledge construction, an information vehicle for exploring knowledge to support learning, a context to support learning by doing, a social medium to support learning by conversing, and an intellectual partner to support learning by reflecting (Jonassen et al., 2003). The key principles are knowledge construction, doing, conversing (or sharing), and reflecting. Each of these components was present in the networked learning model applied to this first iteration design. Students used RSS and social bookmarking to organize information and build upon prior knowledge with the goal of completing a task or meeting a learning objective. Social media, or Web-based applications designed for the purpose of interacting with others online, promoted conversations. Blogs were one example of a vehicle through which students could reflect on the learning process. All of these pieces existed to support a constructive learning experience. The student's personal learning environment (Symbaloo) pulled them all together. Figure 1 represents a prototype of the personal page. Students had the flexibility to move the blocks around and organize the page for their individual needs.

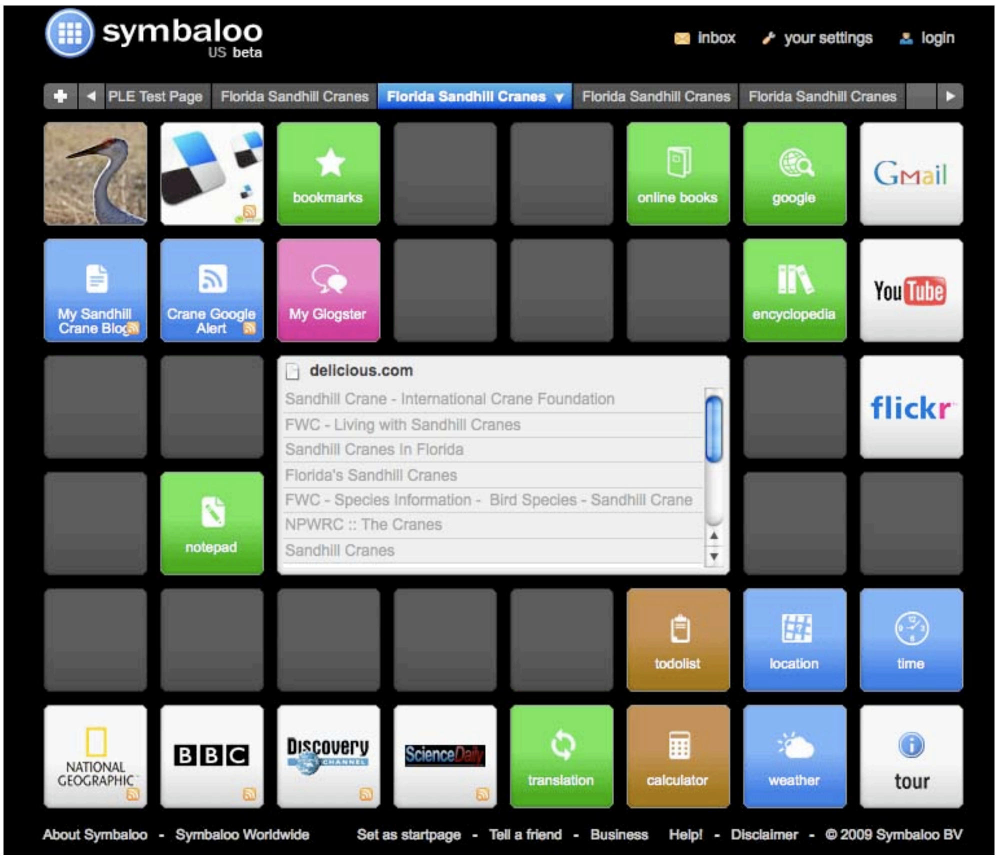

Figure 1. Prototype of personal learning environment with educational blocks (API widgets) clustered in the upper left corner of the personal page.

The ill-defined process reflected in constructive learning (and networked learning) is not necessarily comfortable for the student, especially one who has customarily "engaged in learning activities because they are required, rather than through intrinsic interest" (Jonassen et al., 2003, p. 238). Teacher roles are impacted to the extent that they relinquish some intellectual and management authority while also working to gain familiarity with the technology (Jonassen et al., 2003).

The design of the teacher-facilitated, student-created personal learning environment in this study adhered to constructivist principles with the goal of developing a networked student who took more responsibility for his or her learning while navigating an increasingly complex content base. Creating a learning environment with a culture that supports this student autonomy could be challenging within the cultural myths of a traditional classroom. Taylor et al. (1997) identified these myths as (1) the objectivist view that scientific knowledge embodies universal truths that can be known or discovered and (2) the perceived need to control the classroom environment and view "curriculum as a product that needs to be delivered" (Taylor et al., 1997, p. 295).

Such a teacher-focused perspective failed to take into account the "major cultural restraints that can counteract the development of constructivist learning environments" (Taylor et al., 1997, p. 293). Taylor et al. (1997) suggested taking a critical view of constructivism that addressed the cultural perceptions of the learning environment. Open discourse between teacher and student provide a learning environment that is empowering and negotiable. To achieve this goal, Taylor developed and refined the Constructivist Learning Environment Survey with "five key dimensions of a critical constructivist learning environment: personal relevance, uncertainty, critical voice, shared control, and student negotiation" (Taylor et al., 1997, p. 296).

Networked learning as it is applied to the construction of personal learning environments adopts the view of student empowerment and negotiation. The constructivist and critical constructivist theories support student autonomy and inform the design methodology for this study.

Methodology

A mixed method, design-based research case study was conducted to determine the processes students go through when constructing personal learning environments for scientific inquiry. Typically, design-based research is a lengthy process spanning numerous design iterations. Figure 2 outlines Ma and Harmon's (2009) single-iteration research design methodology that provided the structure of this case study.

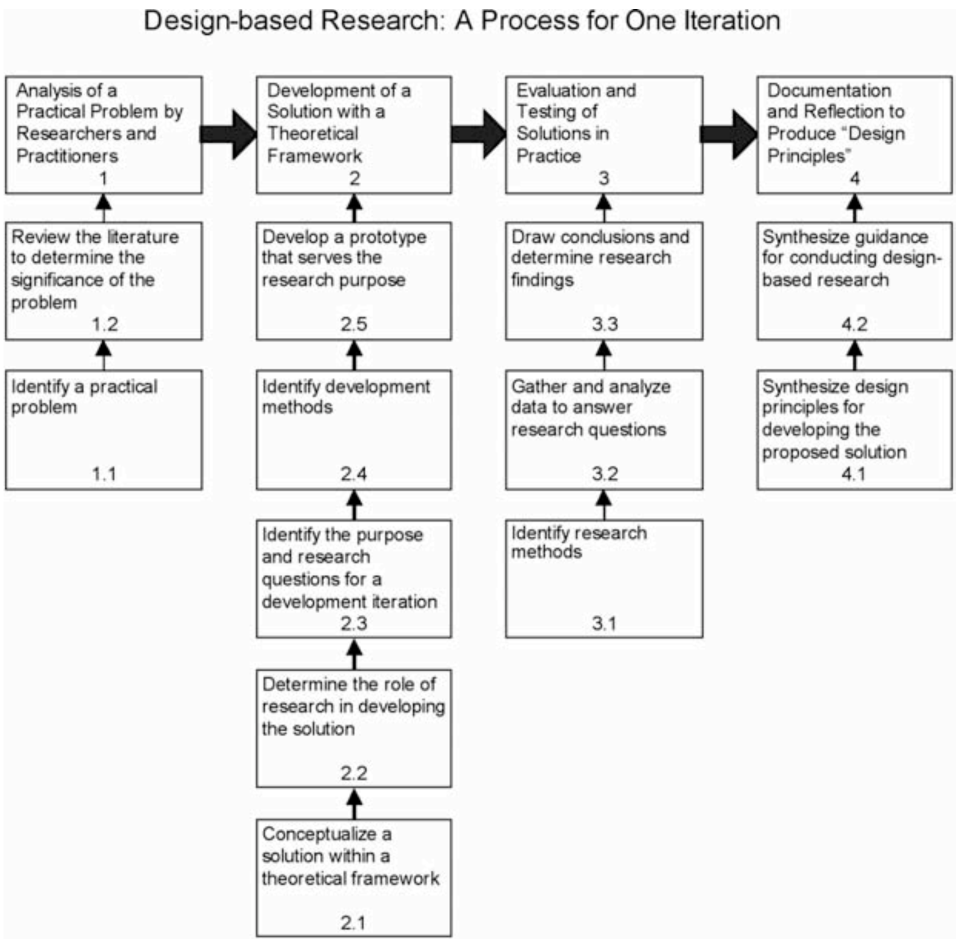

Figure 2. Design Based Research: A Process for One Iteration (Ma & Harmon, 2009 p. 77)

Taylor's (1997) Constructivist Learning Environment Survey (CLES) informed the instructional design and captured whether students perceived the classroom environment as constructivist. The CLES survey informed the instructional design and lessons associated with the facilitation of student personal learning environments constructed for this study. The goal was to determine whether students perceived the learning environment as constructive. The CLES was administered on the first day of class to determine student perceptions prior to the project and again at the end of the nine-week research period to see if there was any change in perception. The CLES scales indicated areas for the teacher to concentrate his efforts in trying to create an environment in which students learn about the world, learn about science, learn to speak out, learn to learn, and learn to communicate (Taylor et al., 1997).

Table 1 highlights the unit plan and steps taken to scaffold student construction of personal learning environments for studying poisonous and venomous creatures.

Table 1. The Networked Student Unit Plan

The Networked Student Unit Plan – 9 Weeks
Unit Objective: The student will model the scientific method through the construction of personal learning environments to research a self-selected topic in life science.
Preparation – 2 weeks • Teacher introduces the scientific method, what it means to be a scientist, and how to think like a scientist. Students embark on a scientific exploration based on the scientific method. Each student selects his or her topic of study, conducts a KWL (what you know, what you want to know, what you learn), and establishes a research question and hypothesis. • Acceptable/Responsible Use Policy is discussed and signed by each participating student. • The project is positioned within the following perspective. What if your teachers disappeared and you had to learn on your own? Would you give up on learning? Where would you begin? Why would learning be important? You are an empowered learner. You have the power to learn anything. How much you learn is up to you. How you manage your learning is up to you. How you manage your time is up to you. A big part of your success will depend on how well you are organized.

Introduction of Tools – 2 weeks

Web applications are introduced one at a time to give students the chance to master the tool within the context of the study topic. Digital literacy is integrated into these lessons as needed. The essential questions of digital literacy are presented. Where can you go for good information? How do you know if you can trust what you find? How will you find subject matter experts you can trust to help you learn? Why is reflection important when you are learning something new? Why is it important to share what you've learned? How will you share?

Web Application (Networked Student Component)	Tool Used in Prototype	Student Activity Level of Structure
Social Bookmarking (RSS)	Delicious http://delicious.com/	• Explain Really Simple Syndication (RSS) and evaluation of Websites • Set up the account • Subscribe to each others accounts • Bookmark and read at least 5 reliable websites that reflect the content of chosen topic • Add and read at least 3 additional sites each week.
Note Taking (Information Management)	NoteFish http://www.notefish.com	• Create NoteFish account • Begin content collection
News and Blog Alert (RSS)	Google Alert http://www.google.com/alerts	• Create a Google Alert of keywords associated with selected topic • Read news and blogs on that topic that are delivered via email daily • Subscribe to appropriate blogs in reader
Personal Web Aggregator (RSS, Information Management)	Symbaloo http://symbaloo.com	• Introduce Symbaloo • Customize page • Start by creating a social bookmarking gadget • This will build as students learn new tools
News and Blog Reader (RSS)	Symbaloo RSS Feeds http://symbaloo.com	• Search for blogs and newsfeeds devoted to chosen topic • Subscribe to blogs and newsfeeds to keep track of updates. Set up gadgets in

		Symbaloo
Personal Blog (RSS)	EduBlogs http://www.edublogs.org	• Create a personal blog • Post a personal reflection each day of the content found and experiences related to the use of personal learning environment • Students with similar topics subscribe to each others blogs in reader
Internet Search (Information Management, Contacts, and Synchronous Communication)	Google Scholar http://scholar.google.com/	• Conduct searches in Google Scholar and library databases for scholarly works. • Bookmark appropriate sites • Consider making contact with expert for video conference
Podcasts (RSS)	iTunesU http://www.apple.com/itunes/whatson/itunesu.html	• Search iTunesU for podcasts related to topic • Listen to at least 2 podcasts if possible
Video Conferencing (Contacts and Synchronous Communication)	Skype http://www.skype.com	• Identify at least one subject matter expert to invite to Skype with the class.
Daily research, reflection, share 3 weeks Once the personal learning environment is constructed, the student will continue to conduct research and navigate new content on a daily basis. Daily activities should be divided between introducing a tip or offering a research theme for the day, actual time spent conducting research, ten minutes to reflect, and 15 minutes to share		
Content Synthesis- 1 to 2 weeks	Glogster http://www.glogster.com	• Digital science poster in Glogster to reflect student research within the context of the scientific method

Data Sources and Analysis

Documentation included the unit plan, teacher lesson agendas, student notes, teacher emails, researcher field notes, subject matter expert responses to student projects, and CLES results. Physical artifacts included the personal learning environment as constructed by the student using Symbaloo, personal blogs, scientific reports, and final Glogster projects. In-depth interviews were conducted with the teacher over time and in one final recorded and transcribed hour-long session.

Direct observations of one class were conducted over nine weeks. The middle school was on block scheduling to allow for more uninterrupted instruction time. All classes met on Mondays for 45 minutes each. For the remainder of the week, half the classes met on Tuesdays and Thursdays for 1 hour and 40 minutes each. The others followed the same schedule on Wednesdays and Fridays. The selected class in this study was observed for a total of 18 days (31 hours) over nine weeks of contact time. Two students were selected for in-depth observation over the latter seven weeks of the project. The classroom teacher identified one of the students as having above average reading scores on the Florida Comprehensive Achievement Test (FCAT). The other was selected based on below average FCAT reading scores. Both students were interviewed separately at the conclusion of the 9-week project.

Field notes were taken and analyzed to inform a protocol of behaviors that further informed the nature of networked learning in a seventh grade science class. Data triangulation was accomplished through the collection of data from multiple sources including documentation, physical artifacts, interviews, and direct observation.

The researcher's role was one of collaborative participant observer (Merriam, 1998). As such, the researcher worked hand in hand with the classroom teacher to assist in the instructional design of the networked learning project serving as a coach and consultant. The students were aware of the researcher's role as a collaborative participant.

Documentation data were organized first by "developing a matrix of categories and placing the evidence within such categories" (Huberman as quoted by Yin, 2009). From these matrices, the data were open coded to further identify themes that emerged from the data (Hoepfl, 1997). Axial coding was conducted to determine how the themes were linked and to understand the construction of personal learning environments as a potential learning tool (Strauss and Corbin, 1990). The levels of coding were an iterative process. As patterns became evident, new codes were established and data were revisited to determine how they fit into the new categories.

Results

The following process themes were identified through coding of case study data.

- Practicing digital literacy
- Practicing digital responsibility
- Organizing content
- Dealing with technology
- Collaborating and socializing
- Synthesizing and creating
- Taking responsibility and control for learning

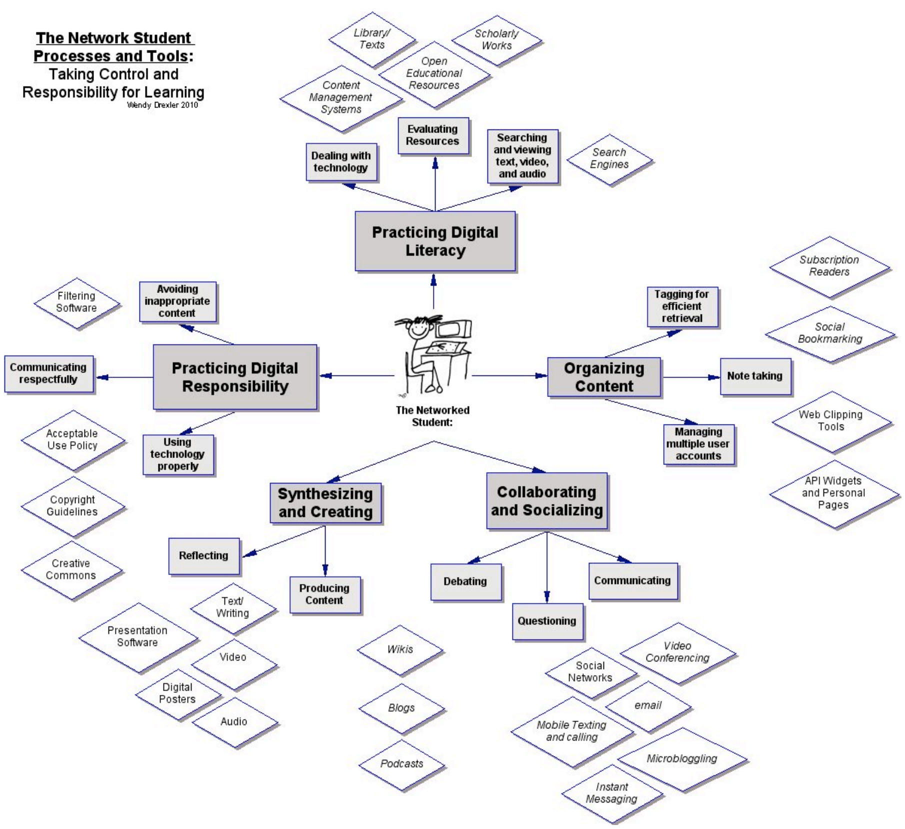

Figure 3. Networked Student Process Model

As a result, a model evolved (Figure 3) in which various tools were applied to support those learning processes. The rectangles represent processes. The diamonds represent decisions. When constructing a personal learning environment, the student (or teacher facilitating networked learning) makes a decision about the proper tool to use in support of a given process. Students are challenged to determine which tool is most effective. Prior research indicates students are not necessarily capable of selecting the optimal tool for the learning objective (Clarebout & Elen, 2007).

Based on the findings of this study and the value of guided instruction (Mayer, 2004) in an open learning environment (Clarebout & Elen, 2007), the teacher is challenged to develop a design that strikes the delicate balance between structure, guided instruction, and student directed inquiry. Again, the goal of personal learning is to empower the student to independently construct rich, effective networks in support of his or her learning objectives. Effective independent inquiry does not happen automatically (Mayer, 2004). This design-based research study further indicated that direct instruction, guided inquiry, exposure to numerous tools, and practice provides a foundation on which a future of independent personal learning is built. Consideration of the networked student diagram informs next iteration designs and offers a structured approach for instructional and student designers.

Constructivist Learning Environment Survey (CLES)

The Constructivist Learning Environment Survey (CLES) measured student perceptions of the classroom learning environment within five scales: personal relevance, uncertainly, critical voice, shared control, and student negotiation. It consisted of 25 questions with 5 questions in each of the 5 scales. The survey was administered to 96 seventh grade science students in 5 classes within the first week of school to document their perceptions prior to engaging in the networked learning project. It was administered again at the end of the project. Results were compared to determine whether student perceptions of the constructivist environment changed as a result of participation.

Based on the post-survey descriptive statistics, students scored highest in the scales of personal relevance, uncertainty, and student negotiation. They felt they could connect science to their everyday experiences between "sometimes" and "often". They believed opportunities were provided to experience scientific knowledge from theoretical inquiry, and they were comfortable sharing the viability of their scientific ideas with fellow classmates (Taylor et al., 1997).

Table 2. Average item mean and standard deviation for CLES Scales

Scale	No of Items	Unit of Analysis	Average Item Mean	Standard Deviation
Personal Relevance	5	Individual Class	3.94	.69
Uncertainty	5	Individual Class	3.85	.59
Critical Voice	5	Individual Class	3.61	.95
Shared Control	5	Individual Class	2.90	1.15
Student Negotiation	5	Individual Class	3.94	.99

Figure 4 indicates that students perceived their science class reflected constructivist aspects between 'sometimes' and 'often' (Lee & Fraser, 2000).

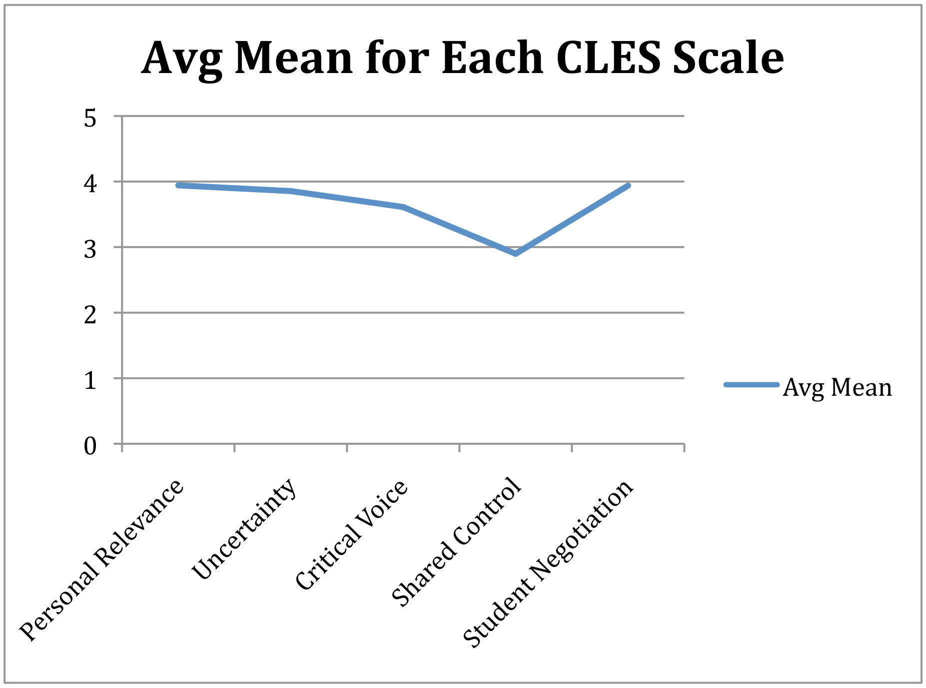

Figure 4. Seventh Grade Science Students Perception on Post CLES Survey

In addition to the descriptive statistics collected from the post-CLES survey, a paired samples t test (Table 3) was conducted to compare student responses in the pre-CLES survey (given at the start of the school year based on student perceptions of their sixth grade science class) to the post-CLES survey (based on student perceptions of their seventh grade science class after the networked learning project). The survey was divided into 25 questions, five questions in each category corresponding to five different scales. The first five questions are titled “Learning about the World”. They correspond to the personal relevance scale. Questions 6-10 are titled “Learning about Science”. They correspond to the uncertainty scale. Questions 11-15 are titled “Learning to Speak Out”. They correspond to the critical voice scale. Questions 16-20 are titled “Learning to Learn”. They correspond to the shared control scale. Questions 21-25 are titled “Learning to Communicate”. They correspond to the student negotiation scale.

Table 3. Paired Samples t test comparing pre-CLES to post-CLES

Paired Samples Test

		Paired Differences: 95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
		Lower	Upper			
Pair 1	World - World	-2.519	.592	-1.242	54	.220
Pair 2	Science - Science	-1.394	1.140	-.201	54	.841
Pair 3	Speak out - Speak out	-4.750	-1.287	-3.495	54	.001
Pair 4	Learn - Learn	-4.180	.362	-1.685	54	.098
Pair 5	Commun - Commun	-3.634	-.293	-2.357	54	.022
Pair 6	PRETotal - POSTTotal	-14.232	-1.731	-2.560	54	.013

The means for all scales increased from the pre-CLES survey to the post-CLES survey. However, these increases were significant with a 95% confidence interval in the critical voice scale (Speak out - .001 significance) and student negotiation scale (Communicate - .022 significance). Student responses in the post-CLES survey represent a significant increase in perceptions of their ability to question the teacher and to express concerns about any impediments to their learning. Responses further indicate a significant increase in students' perceptions of opportunities to openly express their scientific ideas and views.

Educational or Scientific Importance

Implications for students, teachers, and policy

Students in this study continued to maintain their personal learning environments and practice networked learning for the remainder of their seventh grade year. There were no provisions in the school program for providing similar opportunities in eighth grade or after. Presumably, these students moved on with traditional curricula. If their exposure to technology at the school prior to this study indicated future technology integration, their opportunities to take advantage of online resources remained inconsistent across the curriculum and upper grades. It was not clear how their participation in this study affected their attitudes about returning to a traditional format. Most of the students had access to technology at home and took advantage of the option to complete or continue work outside of class. The increased comfort with technology and Web applications may have encouraged self-directed exploration for future learning, as well as online social behavior. Longitudinal studies with a single group might provide insights into the implications of constructing personal learning environments over time.

Teacher practice was significantly altered as a result of implementing the first iteration design. In spite of the challenges, the participating seventh grade science teacher reflected that he could not imagine returning to the way he previously taught. This was especially interesting, as this teacher was already known for his constructivist teaching style. At the same time, he had numerous conversations with other teachers at the school, most of whom would not consider a networked learning approach. Each expressed concern about the reliability of technology and time constraints that resulted from dealing with the technical difficulties. Teachers also worried about student behavior, access to inappropriate materials, and general lack of control. Further research is necessary to confirm, but presumably this would be a common concern for most teachers and a limitation of scalability in traditional K-12 schools.

The roles of the teacher changed drastically in this environment. There was little if any lecture, considerable technology trouble-shooting, and a lot of one-on-one or small group facilitation. Student success depended on his or her motivation but also greatly on the strategic guidance of the teacher. The teacher's intuitive ability to gauge student's understanding and progress were key to achieving the delicate balance between student autonomy and teacher intervention. Adopting a networked learning approach would require considerable teacher professional development and possibly a philosophy different from that of most current educators. The implications of the latter on the potential of networked learning are far reaching. They extend to school policy, hiring practice, and pre-service teacher education.

Many school policies hindered the success of this first iteration design. There was a technology acceptable use policy (AUP) in existence, but students were only minimally aware of its contents. Numerous Websites were blocked. Access to sites and applications was greatly restricted. This design could not be replicated or improved upon without significant changes to school policy. Administrative support was excellent, however the research team underestimated the need for network administrative support in addition to leadership support. The network administrator was concerned for the safety of students and their use of online resources. He had valid concerns. Applying networked learning on a school or district-wide basis would require sweeping changes in policy, the assumption of greater risk, and support of teacher professional development. Parents and community members would have to be part of the conversation leading to these changes. One of the most difficult obstacles would be how effectively balance access with safety. What is the district's realistic liability? How are students made aware of expectations? What kind of training is effective for teachers? How much technology integration is expected as part of the job requirement?

Another major issue and teacher concern is assessment. It is not clear how networked learners would do on standardized tests for accountability. Teachers are well conditioned to build their curriculum around these tests. Even those who do not teach to the test are mindful of the need for their students to show progress. Some of these political implications indicate that networked learning and the construction of personal learning environments may have greater chance for implementation in non-traditional schools.

Implications for delivery

This first iteration design-based case study was conducted in a traditional school with conservative access to computers. Design was impacted by the need to work around those applications for which access was delayed or restricted. Students did not have unlimited access to computers. A rolling laptop lab was used. Students were unable to save files to the individual laptops because policy was in place to limit downloads on individual machines. Nor would this have been practical considering many students used each computer during the course of a school day. Design may have been better supported in a laptop school in which many of the policy considerations have been taken into account before implementing a 1:1 computer ratio. In such an environment students would have more control over the computer along with the ability to use it at home to extend learning experiences beyond the school day.

Expanded learning time (ELT) through distance education has the potential to increase student learning, provide individual attention, incorporate more professional development, and make time for extracurricular activities (Cavanaugh, 2009). A blended approach, one that combines the best of face-to-face with online instruction, would be a more effective outlet for a networked learning design. Time spent face-to-face with students would be best used for collaboration with other students and individual guidance from the teacher. The student would then be free to focus time outside of class on Internet research, communication with experts and peers around the globe, and building the personal learning environment. A guided approach in a blended environment facilitates independent learning (Cavanaugh, 2009). Furthermore, students learn how and when to ask for guidance (Cavanaugh, 2009) creating a foundation on which 21st century students can build life-long learning skills. One of the most important design implications as highlighted in this study is the need for scaffolding in a networked learning approach. Similar to guided inquiry (Mayer, 2004), the student construction of personal learning environments is best facilitated with strategic guidance from the teacher. A blended learning delivery may provide a better outlet for a networked learning design. Furthermore, most students who use their own computers in a blended or online learning environment have less restricted access to Internet resources at home than at school. While this may bring up issues of safety beyond the realms of this study, it also offers more direct access to many educational Web applications that could be inadvertently blocked by the school network.

Hence, there is also potential for implementation of networked learning in a fully online virtual school. One benefit of online learning is the access it provides to a wider range of courses (Cavanaugh, 2009). Implementing networked learning for the student construction of personal learning environments extends study to virtually any topic. Teacher facilitation and guidance is still a requisite part of the process, but could be conducted easily in the online environment through synchronous and asynchronous means. Again, virtual school relies on network access from a remote location. If the student is learning from home, there are fewer concerns about restrictive filtering. Parents could monitor online behavior as necessary and even support the student's efforts along with the teacher.

How students and teachers choose to take advantage of these opportunities will define the future of networked learning and personal learning environments within the structure of school. However, the nature of personal learning is such that students with Internet access can choose to participate without that structure. Their success may depend on how well they have been prepared in the processes that support learning in an ever-changing, increasingly networked world.

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