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The networked student model for construction of personal learning environments: Balancing teacher control and student autonomy

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Principles of networked learning, constructivism, and connectivism inform the design of a test case through which secondary students construct personal learning environments for the purpose of independent inquiry. Emerging web applications and open educational resources are integrated to support a *Networked Student Model* that promotes inquiry-based learning and digital literacy, empowers the learner, and offers flexibility as new technologies emerge. The *Networked Student Model* and a test case are described in detail along with implications and considerations for additional research. The article is meant to facilitate further discussion about K-12 student construction of personal learning environments and offer the practitioner a foundation on which to facilitate a networked learning experience. It seeks to determine how a teacher can scaffold a networked learning approach while providing a foundation on which students take more control of the learning process.

Introduction

Emerging web applications offer unique opportunities to customise the learning environment for individual learners. A 2009 *Horizon Report* sponsored by the New Media Consortium identifies the "personal web" as "a collection of technologies that confer the ability to reorganise, configure, and manage online content rather than just view it; but part of the personal web is the underlying idea that web content can be sorted, displayed, and even built upon according to an individual's personal needs and interests" (*Four to Five Years: The Personal Web* section, para. 2). In the past, learning environments were immediately associated with a physical location such as a school, library or classroom; however, the concept is increasingly expanded to include online learning, virtual schools, and blended opportunities that combine traditional with digital options (Partnership for 21st Century Skills, 2009). Freely accessible, open educational resources (OER) are increasing rapidly. Such resources coupled with user friendly web applications empower networked students to transcend the traditional concept of classroom.

Personal learning suggests learner autonomy and increased self regulation (Atwell, 2007; Aviram et al., 2008). However, increased responsibility and control on the part of the learner do not necessarily equate to learner motivation (Dede, 1996). Students engaging in networked learning research must be more self-directed. Not only are they navigating a number of web-based applications for the first time, they are also required to take an active role in the learning process by making decisions about how to search, where to search, and why certain content meets a learning objective. No

longer is there a smooth, charted path that defines what must be done to get an "A". Traditional, lecture-based classrooms are designed as passive learning environments in which the teacher conveys knowledge and the student responds (Chen, 2009). Imagine the potential frustration that self-regulated learning holds for students who are quite comfortably accustomed to specific teacher directions with finite expectations.

Teachers, on the other hand, are challenged to provide an appropriate balance between structure and learner autonomy in order to facilitate self-directed, personalised learning (Beaudoin, 1990; McLoughlin & Lee, 2010). Such a scenario further presents challenges to traditional forms of assessment. If the learner has primary control, the teacher must consider alternative assessments (Pedersen & Liu, 2003). The role of a teacher within a student-centered approach to instruction is that of a facilitator or coach (Wang, 2006). "He or she supports the students in their search and supply of relevant material, coordinates the students' presentations of individual milestones of their projects, moderates discussions, consults in all kinds of problem-solving and seeking for solutions, lectures on topics that are selected in plenary discussions with the students and conforms to the curriculum" (Motschnig-Pitrik & Holzinger, 2002, p. 166).

The purpose of this test case is to introduce a model for the student construction of personal learning environments that balances teacher control with increased student autonomy. The students in this study are in effect, networked learners in training. Therefore, a level of structure is required to scaffold the learning process. Students use synchronous communication, *Really Simple Syndication* (RSS), information management, and human contacts to learn. Examples of emerging web applications for each of these categories are highlighted. The *Networked Student Model* establishes a baseline that begins to address what level of structure is needed to facilitate networked learning while providing a foundation for greater student control over the personal learning environment.

Conceptual framework

Networked learning, constructivism, and principles of connectivism inform the instructional design and provide a foundation on which future studies can explore the impact of networked learning on K-12 students and teachers. Networked learning refers specifically to "learning in which information communication technology is used to promote connections: between one learner and other learners, between learners and tutors, between a learning community and its learning resources" (Steeples & Jones, 2002, p. 2). It is the combination of these connections, especially in concert with human to human contact, that provide the most powerful learning potential (Goodyear, 2005). Networked learning is manifested in personal learning environments (PLEs), or "systems that help learners take control of and manage their own learning" (Downes, 2007, p. 24).

Networked teacher model

Couros (2008) developed a model of the networked teacher that represents an educator's professional personal learning environment (PLE). A teacher is better equipped to facilitate networked learning if he or she has experienced the construction of such a model first hand. The significant connections in Couros' view of the network

include colleagues, popular media, print and digital resources, the local community, blogs, wikis, video conferencing, chat/IRC, social networking services, online communities, social bookmarking, digital photo sharing, and content development communities (Couros, 2008).

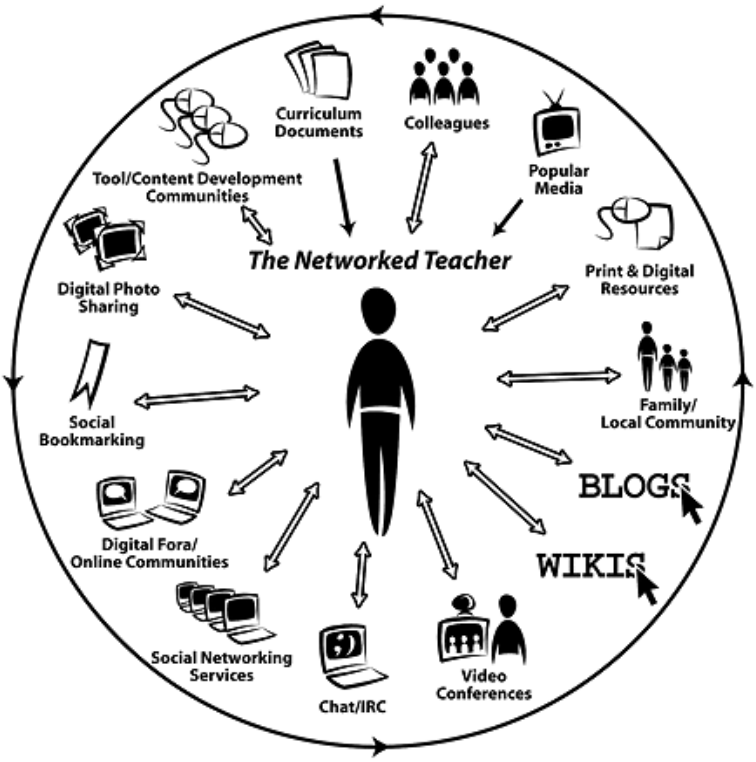

Figure 1: The Networked Teacher (Couros, 2008)

It is a model through which teachers begin to build professional connections to support teaching practice. Couros built this model based on feedback from a number of teachers who were actively participating in networked learning for professional development. He used their input to tweak and revise the model (Couros, 2008). It serves as an example of the numerous connections or nodes that comprise a professional network.

Developing a model of the networked student

The *Networked Student Model* adapts Couros' vision for teacher professional development in a format that is applicable to the K-12 student. It includes four primary categories, each with many components evident in the networked teacher version (Figure 2).

These include academic social contacts, synchronous communication, information management, and really simple syndication (RSS). Social contacts include teachers, classmates, students outside of the class, and subject matter experts. Synchronous communication refers to video conferencing and instant messaging. Information

management activities include locating experts, evaluating resources, accessing scholarly works, and finding other open educational resources (OER). RSS encompasses blogging, subscription readers, podcasts, wikis, social bookmarking, and other social networks. Students will not necessarily make use of every subcategory; however, this list represents the tools available to the student for constructing a personal learning environment on a specific topic of study.

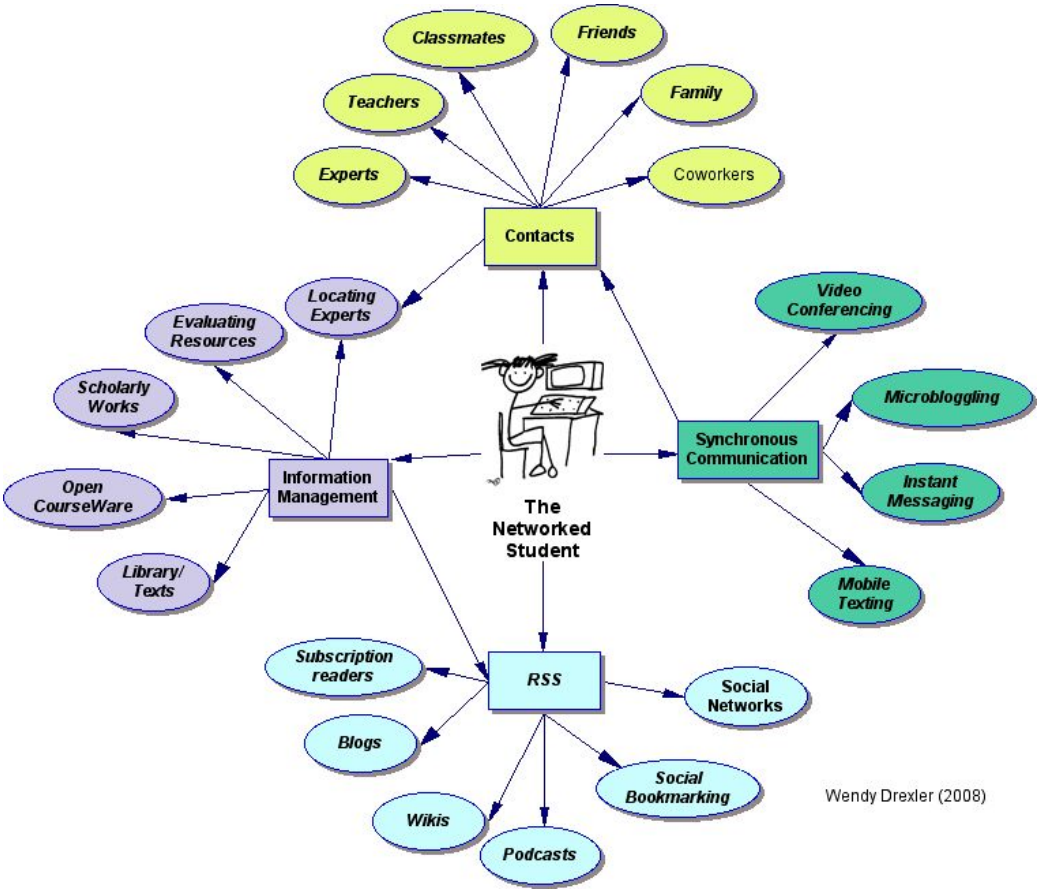

Figure 2: The Networked Student

The networked student follows a constructivist approach to learning. He or she constructs knowledge based on experiences and social interactions (Jonassen et al., 2003). Constructivism encourages "greater participation by students in their appropriation of scholarly knowledge" (Larochelle et al., 1998).

Technology supports this appropriation as a collection of tools that promote knowledge construction, an information vehicle for exploring knowledge, an active learning tool, a social medium to promote conversing, and an intellectual partner to facilitate reflection (Jonassen et al., 2003). Each of these components is present in the *Networked Student Model*. Students use RSS and social bookmarking to organise 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, promote conversations. Blogs are an example of a vehicle through which students can reflect on the learning process. The sub-parts coexist to support a constructive learning experience. The student's personal learning environment pulls them all together.

Siemens (2008) associates the concept of connectivism with networked learning. He asserts that learning and knowledge rest in diversity of opinions, and learning is a process of connecting nodes or information sources (Siemens, 2004). The *Networked Student Model* of constructing personal learning environments is reflected in many connectivist principles. Often the traditional classroom setting provides a forum for a limited point of view, perhaps just the teacher's, a textbook author, and possibly other students in the class. Conversely, in the networked learning environment, blogging is a key component of the personal learning environment through which students respond to and collect the opinions of others. Students identify blogs that target a specific unit of study, and they have the option to respond with opinions of their own. They are taught to discern between fact and opinion and appreciate the value of both.

In a traditional classroom setting, the teacher has primary control over the content. He or she selects or designs the curriculum. Networked learning gives students the ability and the control to connect with subject matter experts in virtually any field. The skill to identify valid content and expertise, recognise questionable sources, and compare conflicting viable points of view is essential in an ever-expanding information age. The connection to humans is an essential part of the learning process. That connection expands to include access to resources and creative artifacts. Computers and mobile devices continue to broaden access to all types of information and learning sources. As quickly as content becomes available, web applications are released to assist in the management of that content. Subsequently, learners take advantage of the availability of content presented in a newly organised format. Ultimately, the personal learning environments that are constructed by humans become available to others who wish to study the same topics. New learners, only connected via their computer or mobile device, may not have personal contact with the originator of the personal learning environment, but they learn from and contribute to the collection of sources. The networked student constructs knowledge that can be built upon in other contexts. That knowledge resides within the network to be activated by the learner at any time in the future. There is always the capacity to add nodes to the network (Siemens, 2009).

The networked student constructs a personal learning environment one node at a time. Once these connections are formed, they must be revisited and built upon to facilitate further learning. The personal learning environment lives beyond time spent in a classroom, especially if the learner chooses to activate it. Yet even in the situation where one learner abandons the personal learning environment, if created as an open resource, it becomes a strong node from which others can learn.

With so much information to manage, it is increasingly difficult to stay abreast of changes in a given field, much less track implications arising from related fields. *Really Simple Syndication* (RSS) allows learners to subscribe to changing content and makes tracking changes easier. Yet it is still up to the student to determine what to include within the context of study. As more control is shifted from teacher to learner, increased responsibility falls on the individual to make decisions about which nodes in a network are most important. This decision making process comes with experience. Networked learning provides a means for K-12 students to become comfortable in this rapidly changing environment.

Ultimately, meaningful learning occurs with knowledge construction, not reproduction; conversation, not reception; articulation, not repetition; collaboration, not competition; and reflection, not prescription (Jonassen et al., 2003). Jonassen's perspective of meaningful learning guides the design of constructivist learning environments. 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 increased responsibility for his or her learning while navigating an increasingly complex content base. The teacher was a facilitator in the process helping the student scaffold network learning and manage the content as it became more complex.

Construction of a personal learning environment does not necessarily facilitate comprehension or deep understanding. Learning potential exists in what the student does with the compilation of content and how it is synthesised. The networked student model is one of inquiry, or the process of "exploring problems, asking questions, making discoveries, achieving new understanding and fulfilling personal curiosity" (National Science Foundation, as quoted by Chang & Wang, 2009, p. 169). Inquiry is no more effective than other instructional methods unless the delicate balance is struck between teacher-centered and student-centered approaches. The instructional goal is "to actually promote cognitive activities" (Chang & Wang, 2009, p. 169). In guided inquiry, the teacher provides the problem and directs the students to the materials for investigation (Colburn, 2000). The teacher is necessary to help the students navigate the breadth of content, apply the tools properly, and offer support in the form of digital literacy skills and subject matter expertise. Yet the teacher may not be the only expert in the learning process. The ability to locate expertise beyond the classroom walls is one powerful benefit of a well-structured personal learning environment.

Principles of connectivism equate to fundamentals of learning in a networked world. The design of the teacher-facilitated, student-created personal learning environment in this study adheres to constructivist and connectivist principles with the goal of developing a networked student who will take more responsibility for his or her learning while navigating an increasingly complex content base.

Context

The test case for this model took place at a K-12 independent school in the southeastern United States. Fifteen students participated during a nine-week term as part of a contemporary issues research project. The contemporary issues course was unique to the school in its delivery. It was the first time a blended format had been offered. Students attended class three days face to face and two days online. Course assignments and discussions were organised using *Moodle*, an open source content management system. The class included 15 students representing the final 3 years of secondary school in the United States. Eleven students were in grade 12, two in grade 11, and two in grade 10.

For the networked student project, each student selected a contemporary issue or topic for which he or she had a strong interest. Student choice was an important aspect of the *Networked Student Model* as it represented a key requirement for self regulated learning (Boekaerts, 1997). During the course of the project, the students had to be motivated enough to maintain various network connections with the goal of learning more. Passion for a topic was one means of motivation. A final project for which the

student received a grade provided assessment of each student's ability to synthesise the research. It also served as an additional extrinsic motivator. The ultimate goal was for the student to learn the process of building a personal learning environment to be activated as needed for future learning in any subject area.

Method

The networked student test case follows a single iteration, design based research process (Ma & Harmon, 2009) for analysing a problem, developing a solution, testing a prototype, and reflecting on the results. It addresses the problem of determining the level of structure needed to facilitate networked learning while providing a foundation for greater student control over a personal learning environment. A prototype is designed, based on a theoretical framework of networked learning, connectivism and constructivism, and tested through the implementation of the design in a high school classroom.

Data

Documentation data include the unit plan, teacher lesson plans, researcher field notes, assessment rubrics, and a reflective survey. Physical artifacts include the finalised *Moodle* course, the personal learning environments as constructed by the students, personal blogs, and a final essay.

Upon completion of the semester, an open ended survey was administered to collect student perceptions of the learning experience relative to their autonomy and comfort with the networked learning format. The survey took into account the general format of the course and isolated questions targeted to understand student perceptions of networked learning specifically. Items 3, 4, 5, and 6 reflect that focus. The following survey was administered after the coursework was finished, but before students were aware of their final grade.

> This course has been different from others you have experienced in a number of ways. Please reflect on your experience in each of these categories with regard to difficulties, positive and negative outcomes, and how it impacted your learning.
>
> 1. Three days face to face, two days online
> 2. *Moodle* as a way to organise the course
> 3. Use of technology to complete projects
> 4. Creation of a personal learning environment in place of a traditional text book (blogs, *Google Reader*, articles, connecting with experts)
> 5. Managing your time and work load for the course
> 6. Do you feel equipped to study other topics in this type of format with less guidance from a teacher? Explain why or why not.
> 7. What was the most enjoyable aspect of this course?
> 8. What was the most difficult?
> 9. What advice do you have to make the class better?
> 10. What advice would you give other students who may take this course in the future?

Design

The teacher addressed two key considerations when introducing the *Networked Student Model*. The first was student familiarity with web applications used to build the

personal learning environment. At this point, few students had a working knowledge of all the web applications available for learning. Therefore, significant time was allotted to introduce each tool and give students the opportunity to experiment. Second, considerably more structure was required since this was the first time each student embarked on the *Networked Student Model*. The teacher gauged the level of structure depending upon the student's motivation, comfort with technology, and interest in the topic.

The students had never participated in networked learning, so a significant amount of time was allotted at the beginning of the project to address digital literacy as well as task and organisational skills that would be required in the online environment. A number of combinations of Goodyear's (2005) patterns for networked learning (Table 1) were applied in the preparation and implementation phases of the unit. Selecting from tasks, organisational forms, and learning environments in Table 1, the teacher differentiated instructional strategies and student activities. These were modeled in the classroom environment before moving to contacts outside the classroom. For example, students participated in classroom debates relative to contemporary topics of the time. Face to face arguments were supported with online resources. Individuals, pairs, or small groups investigated and evaluated the resources to determine the validity of the content. Further discussion was facilitated to critique resources and investigate alternatives. The learning environment slowly shifted from the classroom to online.

Table 1: Patterns for networked learning (Goodyear, 2005, p. 1)

Tasks	Organisational forms	Learning environment (tools, resources)
Discuss	Dyad	Self selecting group
Debate	Triad	E-print
Brainstorm	T-group	E-journal
Investigate	Learning set	Virtual library
Critique	Tutorial group	Discussion board
Assess	Seminar group	Chat room
Summarise	Whole class cohort	Whiteboard
Solve puzzle	Project team	Shared folder
Write essay		Wiki
Develop tool	*Roles:*	Virtual café
Memorise	Summariser	Portal
	Motivator	

Table 2 provides the list of tools in the order introduced for this test case, along with the level of structure associated with each component. This research in no way promotes selecting one tool over another. In fact, new web applications emerge regularly that may be more effective than those selected for this project. *Google* is used repeatedly because signing up for one account gave students access to a number of useful learning tools. Still, there are numerous tool options for any given component of the *Networked Student Model*. It's helpful to explore all the options and select the tool that best meets the instructional needs. The level of structure is adjusted based on the prior experience of individual students.

The process and tools are overwhelming to students if presented all at once. As with any instructional design, the teacher determines the pace at which the students best assimilate each new learning tool. For this particular project, a new tool was introduced each day over two weeks. Once the construction process was complete, there were a number of personal web page aggregators that could have been selected

Table 2: Personal learning environment toolset

Web application (networked student component)	Tool used in test case	Student activity level of structure
Social bookmarking (RSS)	*Delicious* http://delicious.com/	• Set up the account • Subscribe to each others accounts • Bookmark and read 10 reliable websites that reflect the content of chosen topic • Add and read at least 3 additional sites each week.
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
News and blog reader (RSS)	*Google Reader* http://reader.google.com	• Search for blogs devoted to chosen topic • Subscribe to blogs to keep track of updates
Personal blog (RSS)	*Blogger* http://www.blogger.com	• 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 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 • Subscribe 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.
Content gathering/ digital notebook	*Evernote* http://evernote.com/	• Set up account • Use *Evernote* to take notes on all content collected via other tools
Content synthesis	*Wikispaces* http://www.wikispaces.com	• Post final project on personal page of class wiki

to bring everything together in one place. Options at the time included *iGoogle, PageFlakes, NetVibes*, and *Symbaloo*. These sites offer a means to compile or pull together content from a variety of web applications. A web widget or gadget is a bit of code that is executed within the personal web page to pull up external content from other sites. The students in this case designed the personal web page using the gadgets needed in the format that best met their learning goals. Figure 3 is an instructor example of a personal webpage that includes the reader, email, personal blog, note taking program, and social bookmarks on one page.

The personal learning environment can take the place of a traditional textbook, though does not preclude the student from using a textbook or accessing one or more numerous open source texts that may be available for the research topic. The goal is to

access content from many sources to effectively meet the learning objectives. The next challenge is to determine whether those objectives have been met.

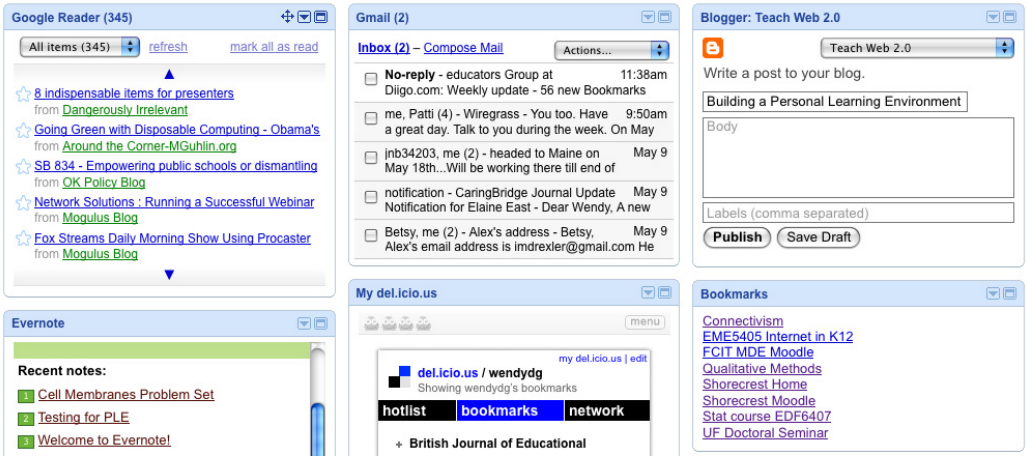

Figure 3: Personal web page compiles learning tools

Assessment

There were four components of the assessment process for this test case of the *Networked Student Model*: (1) Ongoing performance assessment in the form of weekly assignments to facilitate the construction and maintenance of the personal learning environment, (2) rubric-based assessment of the personal learning environment at the end of the project, (3) written essay, and (4) multimedia synthesis of topic content.

Points were earned for meeting the following requirements:

- Identify ten reliable resources and post to social bookmarking account. At least three new resources should be added each week.
- Subscribe and respond to at least 3 new blogs each week. Follow these blogs and news alerts using the reader.
- Subscribe to and listen to at least two podcasts (if available).
- Respectfully contact and request a video conference from a subject matter expert recognised in the field.
- Maintain daily notes and highlight resources as needed in digital notebook.
- Post at least a one-paragraph reflection in personal blog each day.

At the end of the project, the personal learning environment was assessed with a rubric that encompassed each of the items listed above.

The student's ability to synthesise the research was further evaluated with a reflective essay. Writing shapes thinking (Langer & Applebee, 1987), and the essay requirement was one more avenue through which the students demonstrated higher order learning. The personal blog provided an opportunity for regular reflection during the course of the project. The essay was the culmination of the reflections along with a thoughtful synthesis of the learning experience. Students were instructed to articulate what was

learned about the selected topic and why others should care or be concerned. The essay provided an overview of everything learned about the contemporary issue. It was well organised, detailed, and long enough to serve as a resource for others who wished to learn from the work. As part of a final exam, the students were required to access the final projects of their classmates and reflect on what they learned from this exposure. The purpose of this activity was to give the students an additional opportunity to share and learn from each other.

Creativity is considered a key 21st century skill (Partnership for 21st Century Skills, 2009). A number of emerging web applications support the academic creative process. Students in this project used web tools to combine text, video, audio, and photographs to teach the research topics to others. The final multimedia project was posted or embedded on the student's personal wiki page.

Analysis and assessment of student work was facilitated by the very technologies in use by the students. In order to follow their progress, the teacher simply subscribed to student social bookmarking accounts, readers, and blogs. Clicking through daily contributions was relatively quick and efficient.

Results

The student-selected topics of study included: the Internet's effect on the music industry, influence of media on body image, biological warfare, gay rights, animal rights, impact of Indie music on the industry, war in Iraq, cancer, censorship in news media, Medicare, legalisation of marijuana, and global warming. Each face to face class period was dedicated to sharing research findings and discussing the implications. Seven subject matter experts responded to student requests to *Skype* with the class. Video conferences were conducted with two independent music producers, a documentary movie director, a biological warfare consultant with the United States government, an animal rights activist, a Second Amendment Right to Bear Arms advocate, and a high level manager with a nationally recognised news paper. All students participated in the video conferences and identified subject matter expertise as a key element of a personal learning environment.

Four key areas were targeted to assess the success of the project and determine whether an effective balance between teacher control and student autonomy was achieved:

1. Creation of the personal learning environment as a replacement for a traditional textbook was the primary objective of the project. Success was measured based on assessment rubrics constructed by the teacher.
2. Student use of technology to complete projects was identified as important because the students had little prior exposure to technology as a learning tool. All students had access to computers at home, yet few were familiar with the web applications used in the project. Nor did many view technology as a primary tool for learning.
3. Time management and workload were tangible measures of comparison from the student's perspective and indicated his or her ability to self regulate the learning process.
4. Student perception of whether he or she felt equipped to study other topics in this format with less teacher intervention provided some indication as to whether greater student autonomy was achieved. Evidence of success was determined

through analysis of assessment rubrics, the personal learning environments as constructed by the students, personal blogs, a final essay, and the student reflective surveys.

All fifteen students participating in the project completed required assignments and successfully constructed a personal learning environment that facilitated the study of a self-selected contemporary issue. Responses to a reflective survey were collected, coded, and identified as positive, negative, or neutral relative to their feelings about using a personal learning environment to replace the traditional textbook in a classroom. Eleven responses were tagged positive, 3 negative, and 1 neutral. Positive comments referred to the breadth of study provided in this format, the quality of learning, and how well it might prepare the student for college.

> I thought this was the best part of the course. Having us create out own learning tools such as our blogs required me to become much more knowledgeable about a topic than say just reading from a textbook. Also, I got a sense of pride in being able to look at my completed blog and say, "I did this". (Student 3, Reflective Survey, 17 December, 2008)

> I liked this because it made me a more well-rounded student, and I'm pretty sure all of this networking will be a huge help in college next year. Especially since I will most likely be taking some Internet courses over the years. (Student 1, Reflective Survey, 17 December, 2008)

Negative comments focused on the time it took to build the learning environment and a level of discomfort in trying to adopt a different style of learning.

> This, I was not as interested in personally. I really did not find this fun or entertaining but that is just me. Others may love doing this. I just found it very time consuming and I did not really have the time or will power to constantly be updating or working on it. (Student 5, Reflective Survey, 17 December, 2008)

The reference Student 5 makes to fun and entertainment is interesting. Perhaps learning with technology was perceived as something that should be fun and entertaining. Though it is doubtful this student would have referred to the traditional learning environment as such. The teacher did not present the personal learning environment as fun and entertaining, but merely as a different approach to learning.

The following comment, also tagged as negative, offered a provocative perspective on the way Student 8 perceived prior learning experiences and how they affected her opinion.

> I thought it was a little more difficult. I was actually thinking about this last night. I think it was more difficult because we are used to textbooks and etc. But if we started out young I can see things getting done much faster. I can imagine that in the future (just speculating) that our society could be much more efficient with our time if we did much more on computers at a younger age rather than in textbooks. (Student 8, Reflective Survey, 17 December, 2008)

Use of technology for learning, other than typing papers or conducting searches, was new to the students. There was minimal and inconsistent integration of technology by teachers in the high school. Students had little prior exposure to digital literacy skills. Responses relative to the use of technology were positive in 10 instances, negative in 3, and neutral in 2. Most positive responses were related to increased comfort with technology and improved learning through its use.

> When I came into this class, I wasn't very good at working with technology. I have taken so much knowledge away from all of the technology that we have used. (Student 7, Reflective Survey, 17 December, 2008)

> The use of technology to complete projects helped out a lot, because you can get so much more information through the internet and at a much faster speed, than you would with a text book or other books. I also think that the different types of projects that we were able to do through the computer were much better. (Student 12, Reflective Survey, 17 December, 2008)

Negative responses reflected a general frustration in dealing with technological difficulties and could be summarised in this response. "I didn't really like this because I always seem to have technological difficulties" (Student 2, Reflective Survey, 17 December, 2008)

Nine out of 15 students indicated that time management was the most difficult aspect of the course. Yet, of the fifteen students participating in the project, thirteen were able to manage weekly assignments per the schedule. Two students fell behind and expressed frustration at the amount of work required to catch up. Teacher intervention was required to facilitate their successful completion of the course. They were given a daily list of tasks designed to scaffold the time management aspects of the project. Time management issues were less associated with construction of the personal learning environment and more concerned with the blended format of the delivery. It was an adjustment for students to manage work outside of class even though they enjoyed the freedom of attending a formal class meeting only 3 out of 5 days a week.

Fourteen out of fifteen students answered positively when asked if they felt equipped to study other topics in this type of format with less guidance from a teacher. The one student responding in the negative qualified the response with, "Not yet, probably next year I'd be able to, but I definitely couldn't do that, say, tomorrow" (Student 2, Reflective Survey, 17 December, 2008). The remaining comments indicated greater comfort with technology, increased confidence, and an ability to do more independently as long as a teacher was available at some level for assistance.

> Yes, I believe I would do great in another class like this because I am passt the getting use to technology so I could jump right in without wasting time being confused or lost. (Student 11, Reflective Survey, 17 December, 2008)

> I do feel equipped to study like this with less guidance from a teacher, I feel I have all the resources I need in order to do well in another study. (Student 12, Reflective Survey, 17 December, 2008)

> Yes, because I feel this format is very straightforward and could suffice as a once or twice a week class even because everything we need is online and outlined in *Moodle*, and as long as the teacher would still be there to answer the occasional questions, I would feel equipped. (Student 1, Reflective Survey, 17 December, 2008)

> Yes, I definitely feel equipped enough to study other topics in this format with less guidance from a teacher. Even though we only met three times a week, I still felt like I could talk to the teacher at anytime because all I had to do was write an e-mail. (Student 4, Reflective Survey, 17 December, 2008)

> Personally I think that as long as the teacher is there to answer any questions that we may stumble across, that I feel equipped to study other topics in this format. It helped being able to email you with any questions that we had. (Student 5, Reflective Survey, 17 December, 2008)

Five of 15 responses directly mentioned the teacher as still necessary, even if the student was prepared to take on more of the responsibility for learning.

Implications

Achieving the delicate balance between teacher control and student autonomy is an ongoing challenge when facilitating student use of new technologies for self-regulated learning (McLoughlin & Lee, 2010). Motivation, self direction, and technical aptitude are key considerations for implementing a networked student design. The students constructing personal learning environments in this test case were successful in the contemporary issues course. Still, the teacher intervened and offered varying levels of support based on individual need. Minimum weekly expectations were documented for students to follow and were necessary to maintain momentum and scaffold the learning process. Students who had minimal experience with technology required more support than those who had used other web applications. Students who were organised were better able to manage time and synthesise large quantities of information. Most students expressed comfort assuming greater control of the learning process over time, though how much control and how much time would differ by individual.

Varying levels of student comfort with technology, motivation, and self direction have implications for future design iterations. Students in this test case were accustomed to a preparatory school curricula relying primarily on traditional teaching methods such lecture, note taking, discussion, small group work, and papers. The students, though generally motivated, were primarily concerned about what is minimally required to earn a high grade. Moving from a passive to active role in the learning process was a new experience for them. While the *Networked Student Model* affords the learner more control and responsibility, the teacher must continually balance this freedom with enough structure to keep students on task and engaged in the learning process. Longitudinal studies with students who have a solid foundation in technological skills and digital literacy would provide a more accurate measure of the level of teacher control and scaffolding that could be adjusted as students mature in the process.

Teacher practice was significantly altered as a result of implementing the *Networked Student Model*. There was little if any lecture, considerable technology trouble-shooting, and a lot of one on one or small group facilitation. A student's success depended upon his or her motivation but also greatly on the strategic guidance of the teacher. The teacher's ability to gauge students' understanding and progress were key to achieving a balance between student autonomy and teacher intervention. Adopting a networked learning approach would require considerable teacher professional development and 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.

Networked learning blends the concept of educator expertise with learner construction and views the role of teacher as curator, an expert learner who creates spaces in which knowledge can be created, explored, and connected (Siemens, 2007). The teacher in this study had characteristics and beliefs quite different from many of her teaching peers. Teacher beliefs about the value of technology as a teaching tool may determine effective integration more than traditional forms of professional development (Mueller et al., 2008). Even in an organisation in which the culture supports innovative

programming, teachers will need ongoing mentoring and support. A cognitive apprenticeship model in which less experienced teachers practise with the guidance of those who have already implemented networked learning is likely a more effective approach than traditional professional development. Similar consideration is warranted for pre-service teaching programs. Providing opportunities for pre-service teachers to experiment with network learning from both a teacher and learner perspective may influence the likelihood that they will apply these techniques in their future classrooms and gain the experience to gauge teacher versus learner control.

The *Networked Student Model* is a work in progress. As web technologies evolve and personal learning management becomes easier, students will gain even greater access to knowledge and more learning control. The construction of personal learning environments has potential; however, extensive research is needed to document best practices, explore the changing role of teacher and student, apply evolving innovations, refine instructional design, and consider pedagogical implications. Social networking and sharing of personal learning environments between students holds further promise as more students participate in networked learning and post their results in an open forum.

This networked student test case, conducted with high school sophomores, juniors, and seniors, reflects a small group of homogenous students in an independent preparatory school. It does not inform the outcome of a networked learning approach in an inner city school with a widely diverse population or within alternative learning environments such as virtual schools. Student success and amount of teacher control and scaffolding may be quite different in these environments.

Conclusion

In spite of the challenges highlighted above, the *Networked Student Model* offers a design and framework through which teachers can explore a student-centered, 21st century approach to learning. It further provides a foundation for constructing a personal learning environment with potential to expand as new learning avenues emerge. The student is challenged to synthesise diverse and extensive digital materials, connect to others interacting in respectful and meaningful ways, self-regulate an active approach to learning, and develop an option for life long learning that applies to virtually any curricular area. Once a student has learned how to construct a personal learning environment, he or she is left with a model of learning that extends beyond the classroom walls, one in which the learner assumes full control. Regardless of teacher control, the students' success will depend on how well they have been prepared in the processes that support learning in an ever changing, increasingly networked world.

The researcher welcomes further discourse on the *Networked Student Model*, its potential value, and challenges. A video representation of the project is available on *YouTube* at http://www.youtube.com/watch?v=XwM4ieFOotA

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