AN ONLINE, PROJECT BASED UNIT TO ACHIEVE THE GOALS OF THE 2013 BC EDUCATION PLAN

by

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We accept the Process Paper as conforming to the required standard.

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Abstract

The British Columbia Ministry of Education has produced a draft 2013 Education Plan to encourage students to learn and practice 21st century skills and graduate better prepared to enter the workforce in an increasingly technological age. This online, subject integrated, Project based learning unit was developed to provide an example of a pedagogical method to meet the initiatives in this new plan. By using the Project based learning philosophy, students are given more responsibility for their learning and are able to make significant educational choices, while encouraging the development of critical thinking and collaborative skills. The teacher role shifts to guide and mentor, providing students with support, rather than content, creating a learner-centered environment which encourages the development of 21st century skills such as problem solving, creative thinking, self-reliance, innovation, teamwork and collaboration, and technical literacy. The unit is located on the BC Learning Network at www.BCLearningNetwork.com. The unit name is Integrated Project Based Learning Unit. To gain access, a free BCLN account must be created using a BC school district email or a viu.ca email.

Keywords: Project Based Learning, Self-Directed Learning, 21st Century Skills, 2013 BC Education Plan, Subject Integration, Problem Based Learning.
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Chapter 1 – Introduction

Purpose of the Project

Due to changes in the accessibility of information and the types of work environments youth will enter upon graduation, the educational needs of today’s students are changing. It is no longer sufficient to memorize content in order to regurgitate it for exams. In today’s world, students require much more from their educational careers if they wish to meet the changing and challenging demands of their future and become successful citizens. Higher order thinking skills such as critical thinking, problem solving, communication and collaborative skills are necessary educational acquisitions for all students to adequately prepare them for such a future.

One need only to look to the massive volume of content available on the internet to realize that critical thinking and evaluation skills are mandatory to navigate this vast resource successfully and locate reliable, reputable information. Anyone can put content on the internet and without the skills to critically assess this content, resulting knowledge acquisition can be fraught with misinformation and misconceptions. Students must possess both the ability to locate relevant information, and assess that content for reliability and accuracy prior to using and integrating it into their existing knowledge base.

Workforce demands have also changed. Employers demand employees that possess 21st century skills such as communication, collaboration, critical thinking, and problem solving abilities (The Conference Board of Canada, 2014). Andrew J. Rotherham and Daniel Willingham (2009) suggest these skills are not new concepts in terms of education. Teachers have utilized Bloom’s taxonomy (1956) for many years in order to create a hierarchy of questioning that has been the basis of encouraging students to develop higher order thinking
skills, but assessment practices rarely test these skills and many students do not develop them adequately. However, it is no longer sufficient that a fraction of graduating students possess these skills. The education that students receive today must strongly encourage all students to learn them. Rotherham and Willingham suggest that an inquiry method of teaching and learning such as project based learning will meet the needs of 21st century learners and encourage all students to gain the skills required for the future.

To address the needs of 21st century students, the British Columbia Ministry of Education has produced a draft copy of the 2013 BC Education Plan. The Plan’s fundamental directive is a shift in pedagogy to create learner centered classrooms and give students more control over their learning (BC Education Plan, p. 3). The intention of this master’s project was to create an online inquiry program using a project based learning approach that integrates curricula to meet all of the BC Education Plan directives, including the development of 21st century skills that will result in providing students with a clear sense of how to learn.

**Justification of the Project**

The 2013 BC Education Plan, which is still in draft form, highlights concepts such as personalized learning, quality learning, and student choice, as well as practices that encourage critical thinking skills, such as self-reliance, problem solving, innovation, teamwork and collaboration, and technical literacy (pg. 3-5). In order for the Education Ministry’s plan to be successful, the teacher’s role must change from primarily the provider of content to include the role of “guide, mentor and coach” with a focus on teaching student how to learn. Pilot curriculum has been developed for grades 1 – 9, but the distinct lack of exemplars will make planning for the implementation phase difficult. Teachers are challenged to develop programs
that satisfy the new BC Education Plan, while continuing to better prepare students for their future careers. Using the flexibility of an online platform, this project provides an exemplar of a project based learning unit which addresses all of these challenges by design and serves as a guide for teachers to implement directives in the plan.

The benefits to using the online platform for this project are numerous. Building an online resource and integrating it into a learning management system provides flexibility for students. This flexibility is multifaceted and includes access in terms of time and place, as well as providing all resources and tutorials on demand. Additionally, Canadian students are increasingly choosing online options for courses (Barbour, 2013). In fact, according to the 2013 State of the Nation: K – 12 Online Learning in Canada produced by Barbour, online education numbers have ballooned from a mere 25,000 in 1999 to 140,000 in 2009. This number has increased yearly and in BC alone, the total number of students taking online courses in the 2011 – 2012 school year was close to 80,000. These numbers attest to the demand for an online option and providing the unit in an online format makes this choice possible. As well, the incorporation of technology and technical literacy is an important aspect of the 2013 BC Education Plan (pg. 3). Using this platform requires interaction using technology to a large degree and will easily satisfy this mandate. Lastly, and perhaps most importantly, the online format simplifies the sharing of this unit. Accessibility to the educational community in the BC Learning Network website, as well as the modification potential make the online format the most logical platform.

Project based learning is an excellent method to teach students content knowledge and skills outlined in the 2013 BC Education Plan. Studies have shown that a project based learning approach requires students to make several critical choices and decisions which encourages them to build strong critical thinking skills as well as a deep understanding of content. These choices
also support personalized learning and provide students with a large degree of control and responsibility over their learning. The student centered approach shifts much of the decision making from the teacher to the student allowing the teacher to take on the role of mentor, supervisor, and guide (Barron, Schwartz, Vye, Moore, Pretrosino, Zech, & Bransford, 1998). Student decisions usually include the focus of the driving question, resources they will use, and determining the format for project artifacts (Papanikolaou & Boubouka, 2010). When students make decisions regarding coursework, their interest and motivation levels also increase. Thus, the student role is no longer one of a passive learner, but one of an engaged, active learner, responsible for many aspects of his or her project. As students develop and work through their projects, these decisions help them to develop skills such as critical thinking, problem solving, and self-reliance while learning to manage their time and improve self-discipline, all components of the 2013 BC Education Plan.

The advantage of the combination of project based learning approach in an online format is that students can easily work with others to develop teamwork and collaborative skills. The use of technology increases student ability to connect with learning partners and experts around the globe, dissolving geographical barriers. In doing so, they are exposed to alternative points of view and expand their own knowledge base. The technology platform also increases the scope and variety of resources students can access as well as the ways students can demonstrate learning by offering myriad Web 2.0 tools to choose from. Technology integration, a key focus of the BC Education Plan, is highly compatible at every stage in project-based approach. Students may use technology to research their topic, connect with others, build their artifacts, and use it as a platform to share their work. Subject integration, which is highly beneficial to the student as well, is easily accommodated online using a project based learning approach as it
reflects real world problem solving. As we move towards embracing 21st century literacies, an online, project based learning unit will create an effective learning environment for all students and meet the criteria set out in the 2013 BC Education Plan.

**Challenges to be Addressed**

The intention of this project is to provide an example of an online unit using a project based learning approach that addresses the needs of 21st century learners and satisfies the directives of the 2013 BC Education Plan. This student centered unit has a thematic focus from the grade 10 Science curriculum and includes objectives from English Language Arts 10 and Applied Digital Communications 11. The unit promotes personalized learning and components that encourage the development of 21st century skills such as collaboration, critical and creative thinking, communication, time management, and self-discipline.

The unit will serve as a framework for project based unit development and will be available on the BC Learning Network website for teachers to copy and modify as they wish according to their needs. Included with the unit will be student templates, formative and summative assessment rubrics, tutorials for suggested Web 2.0 tools and processes involved with project based learning, and an overview of the project based learning pedagogy.

**Definition of Terms**

The following definitions are provided to assist readers in understanding the scope and purpose of this project:

21st century skills – Higher level thinking skills in Bloom’s taxonomy, such as analysis, synthesis and evaluation, as well as communication and collaboration skills.
Artifact – a tangible product that can be used to demonstrate learning.

Bloom’s taxonomy – a hierarchy of question categories: knowledge, comprehension, application, analysis, synthesis, and evaluation.

Critical thinking skills – Higher level thinking such as analyzing, predicting, and evaluating.

Driving question – An open-ended question that requires rigorous problem-solving.

Formative assessment – Informal assessment that students use to improve learning.

Learning Management System (LMS) – a software application or web-based technology used to create and deliver educational content, monitor student participation, and assess student performance.

Pedagogy – A method of teaching or instructing.

Personalized learning – student centered learning where the student has some freedom to pursue passions and interests.

Project based learning – a pedagogical method where students engage in finding solutions or answers to critical, complex, real world problems.

Rubric – A detailed assessment tool which provides standards and outcomes.

Summative assessment – a final assessment.

Web 2.0 tools – Tools that are located on the web that can perform a specific function and available for public use.

**Brief Overview**
The sample unit is produced online using Moodle as a learning management system and posted on the BC Learning Network website along with a request for feedback and suggestions. The unit is open and available for teachers to download and modify as they see fit. Templates for student use, formative and summative assessment rubrics, tutorials and guiding instructions are included.

The unit is technology based and although this criteria is not mandatory for project based learning to occur, it is a criteria that best reflects the Online Learning and Teaching Diploma program objectives, offers the most flexibility for teachers and students, and satisfies the mandate to increase technology use as per the BC Education Plan. Students are initially responsible to develop a timeline based on the scope of their project, and determine progress points at several intervals throughout the project to foster self-regulation, self-reliance, and student responsibility. The timeline must include frequent collaboration opportunities, both synchronous and asynchronous, with the teacher, peers, and members from online communities to scaffold student learning and provide feedback and mentorship opportunities. Technology based Web tools are suggested for collaboration such as Skype or Google + Virtual Hangouts, as well as asynchronous discussion forums available in the Moodle learning management system and discussion forums on the internet. These collaborative sessions improve communication, creative and critical thinking skills, as well as help to clarify student thinking. As students are exposed to various viewpoints and contemplate how their ideas align with the viewpoints of others, metacognition and self-knowledge improves. Additionally, frequent collaboration provides opportunities for formative assessments and feedback from teacher, mentors, and peers which help to guide student decision making and ensure high quality work. It is important to note, however, that the unit is not required to be delivered completely online. It can easily be
adapted to accommodate a face to face blended learning environment with all components of the unit remaining as is.

The unit will include the integration of subject areas, which is a natural fit for project based learning units. The interdisciplinary approach best reflects real world problem solving and adds authenticity to student work. Students will naturally acquire multidisciplinary knowledge and demonstrate that knowledge in the artifacts they produce. Formative and summative evaluations based on discrete subject learning outcomes will ensure that students are given credit for work that they do in each subject area. However, the thematic focus of the unit is designed to direct students to choose a topic in the science 10 curriculum that is of interest to them. The integration of English Language Arts 10 and Applied Digital Communications 11 is optional, and can easily be disregarded by simply modifying the rubrics to eliminate the objectives pertinent to those subject areas.

Besides the frequent formative assessments and constructive feedback by others, students will present their finished project for the final summative assessment to teachers, members of the community, experts, and other evaluators that the student chooses to include. This final presentation can be face to face, virtual, synchronous or asynchronous, depending on student preference, as they will determine the exact details of the presentation and their options are varied. Suggestions for a final presentation will be provided in the unit, but students have the freedom to choose any format they are comfortable with.

The proposed unit will be posted on the BC Learning Network website and feedback from peers requested. Modifications and adjustments will be made accordingly where suitable to address suggestions and concerns voiced by others. The goal of this project is to make the
implementation of the 2013 BC Education Plan a less daunting task for educators and to provide an exemplar of effective project based learning methodology, particularly at the high school level.
Chapter 2 – Literature Review

Introduction

We live in a world today where the volume of information is growing exponentially and access to much of it is at the tips of our fingers. We are bombarded with resources online and critical skills to determine what is reliable and useful are more valuable now than ever before. Moreover, the workforce is changing. Employers seek employees that possess 21st Century skills such as communication, collaboration, critical thinking, and problem solving abilities (The Conference Board of Canada, 2014). Teachers are challenged to meet this new reality and better prepare students for their future careers. An inquiry program using a project based learning approach is an excellent pedagogical choice to address 21st Century educational demands and meet the directives in new curricula that have been developed as well.

What is Project Based Learning?

Project based learning is a pedagogical method where students engage in finding solutions or answers to critical, complex, real world problems. They work to develop and demonstrate their learning through the construction of a project deliverable or artifact (Krajcik et al., 1994; Melin, Axelsson, & Wedlund, 2009; Papanikolaou & Boubouka, 2010; Savery, 2006; Thomas, 2000). The process is student-centered and designed to engage learners in the investigation of authentic problems by asking and refining questions, gathering and analyzing data and resources, making interpretations, drawing conclusions, and representing their acquisition of knowledge and skills (Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991; Grant, 2005; Krajcik et al., 1994). This teacher-facilitated approach allows students to make several of the directive decisions throughout the learning process. These can include choice of a topic or question, types of resources used, final project details and design, and the integration of web based tools (Bell, 2010; Krajcik et al., 1994). Throughout the process of producing a
final project, students learn curricular concepts and content, as well as 21st century skills, and apply these new acquisitions as they are practiced and learned (Krajcik et al., 1994; Savery, 2006).

Why Project Based Learning?

The project based learning approach satisfies the directives in newly developed curricula. Many countries have designed new curricular packages to promote inquiry, many of which incorporate the use of technology to keep up with changing circumstances (McKinsey Education, 2009). As an example, the Ministry of Education in British Columbia has developed a new Education Plan as an attempt to address the changing needs of students. In it, they highlight the need for students to develop 21st century skills, with an increased emphasis on self-reliance, critical thinking, problem solving, innovation, teamwork and collaboration, and technical literacy. The focus is on key elements such as personalized learning, quality learning, student choice, high standards, and the use of technology. The plan also recommends earlier, more effective intervention for struggling learners (British Columbia Ministry of Education, 2013, pg 3 - 5). An online project based learning approach to education is the ideal educational choice to address these changing educational needs and achieve the goals set out in the BC Education Plan.

Characteristics of Project Based Learning

One of the most important aspects of project-based learning is that the project is central in the learning process (Papanikolaou & Boubouka, 2010; Savery, 2006; Thomas, 2000). The project is not an “add on” activity once a unit of study is completed; rather, the project is the unit of study and concepts and skills are constructed while engaged in the process of creating the learning artifact. Students learn by being actively engaged in the project process and work toward completion with understanding (Barron, Schwartz, Vye, Moore, Pretrosino, Zech, &
Bransford, 1998). Thus, students construct knowledge as they progress through the various stages of project development. This construction, however, does not develop without support.

**Teacher Role**

In the project based model, the teacher role shifts from the provider of information to that of a coach, tutor and facilitator (Barron et al., 1998; Krajcik et al., 1994). Barron et al. suggest that this shift is one of the major hurdles to the successful implementation of project based learning programs. Although the reasons for this may be as individual as the teacher, difficulties may arise if the teacher does not feel that students are meeting the mandated outcomes. This concern can be addressed with project based learning, but it occurs in a different way than in the traditional classroom.

As facilitator, the teacher must become adept at scaffolding (Barron et al., 1998; Doppelt, 2003; Krajcik et al., 1994; Melin et al., 2009; Slavery, 2006; Thomas, 2000), which can include modeling, mentoring, encouraging, and teaching students to think and use pre-existing knowledge to help them solve problems. The teacher can also take on the role of project manager, especially when students are new to this type of learning, and assist in breaking down the tasks involved in creating the final artifact (Barron et al., 1998; Krajcik et al., 1994; Thomas, 2000). Gradual release of these supports is necessary as students learn time management skills and become better able to perform these tasks on their own (Krajcik et al., 1994).

Although students often negotiate timelines and checkpoint or benchmark dates, the teacher continually encourages students to adhere to them to ensure accountability to their audience (Bell, 2010; Melin et al., 2009). The teacher may also highlight critical features of a concept or task (Barron et al., 1998; Krajcik et al., 1994) and provide feedback throughout the
process to maintain high standards for student work (Krajcik et al., 1994; Melin et al., 2009). Students rely on the teacher for scaffolding and support, but it is the student that is ultimately in control of the project (Barron et al., 1998).

Savery (2006) suggests that in project based learning the teacher still plays a major role in decision making and may dictate several aspects of the project, such as the type of artifact. He also suggests that teachers maintain the role of expert, rather than tutor. Savery’s criteria differs in this regard compared to most researchers and his description of problem based learning aligns more closely with scholarly articles on project based learning. Although the degree that teachers relinquish power and control over to students may vary, project based learning is not teacher-centered. The role of the teacher is primarily that of a facilitator and is there to help students through the learning process.

Student-Centered Approach

Project-based learning is student-centered (Bell 2010; Doppelt, 2003; Frank & Barzilai, 2004; Grant, 2005; Melin et al., 2009; Papanikolaou & Boubouka, 2010; Savery, 2006; Thomas, 2000). Students must have the flexibility to choose aspects of the project, ideally including the focus of the driving question, resources they will use, and the format for their project artifacts (Krajcik et al., 1994; Papanikolaou & Boubouka, 2010). However, a balance needs to be struck so that students who are unfamiliar with the process do not become overwhelmed by the myriad of choices, yet still have enough input to gain a sense of ownership (Blumenfeld et al., 1991). The teacher, adopting the role as guide, can initially help students navigate through the decision making process until that balance is determined. Students with different learning styles and previous knowledge bases can easily be accommodated because they develop a comfortable level
of control over decisions (Bell, 2010; Grant, 2005; Melin et al., 2009). This contributes to the personalization of learning and accommodates individual learning styles and ability, both key components of the BC Education Plan (British Columbia Ministry of Education, 2013). As the shift in classroom dynamic changes, so does the role of the student.

Students are responsible to ask and refine questions, collect and analyse resources and data, and draw conclusions. Throughout the process, students work to create one, or several artifacts that demonstrate new understanding of concepts, skills, and content knowledge (Barron et al., 1998; Blumenfeld et al., 1991; Krajcik et al., 1994; Papanikolaou & Boubouka, 2010). Thus, the role of the student shifts dramatically from being a passive recipient of information to an actively engaged learner (Barron et al., 1998; Savery, 2006), responsible for many aspects of his or her own educational path. This responsibility for educational decisions results in increased student motivation to learn (Bell, 2010; Blumenfeld et al., 1991). One of the student’s first responsibilities is to choose a question based on an area of interest.

**Project Focus**

In a project based learning environment, the student’s driving question must be authentic, have some real world application, and have intellectual value for the student (Bell, 2010; Krajcik et al., 1994; Melin et al., 2009; Savery, 2006; Thomas, 2003). In order for a driving question to be authentic, it needs to be ill-structured, which means that many solutions to the question are possible and there is not a pre-determined outcome for the solution. This “ill-structure” adds authenticity to the question as it reflects real world problems (Blumenfeld et al, 1991; Laffey, Tupper, Musser, & Wedman, 1998; Papanikolaou & Boubouka, 2010; Savery, 2006). Students must choose between several viable solutions to the problem and provide evidence that the
solution they have developed is the most valuable. All activities, artifacts, or products that result in the final project must address the central question (Blumenfeld et al., 1991).

In project based learning, students usually have the freedom to choose their own question, which draws on their experiences and interests (Krajcik, et al., 1994; Papanikolaou & Boubouka, 2010). The ability to create good questions comes from experience (Krajcik, et al., 1994), which novice students typically lack. Initially, teacher support may be required to ensure that students choose a quality question, as it is the driving force behind the entire process. Teachers guide students to ensure that questions are intellectually worthwhile and challenging to the student, as well as having sufficient depth to sustain inquiry over an extended period of time (Blumenfeld et al. 1991; Krajcik et al., 1994; Thomas, 2000).

The benefit of engaging students in the process of choosing the driving question cannot be underestimated. Choice in the topic area that a student has interest in increases student motivation and deepens learning (Bell, 2010; Blumenfeld et al., 1991). Real world, or authentic problems increases interest, deepens learning and adds value for students increasing motivation as their efforts and engagement to find feasible solutions are viewed as worthwhile and meaningful. Once their question is determined, students begin their learning journey, but they are not alone.

Collaboration

Collaboration is also an essential component of project based learning (Bell, 2010; Blumenfeld et al., 1991; Krajcik et al., 1994; Laffey et al., 1998; Melin et al., 2009; Papanikolaou & Boubouka, 2010; Savery, 2006). Collaboration can occur with peers, members of the community, university students, experts in the chosen field, or any other useful contact.
that the student is able to secure (Krajcik et al., 1994; Laffey et al., 1998). Through collaboration and conversation, students exchange information, solidify ideas, seek advice and alternate points of view, and expand their own knowledge (Krajcik et al., 1994; Laffey et al., 1998; Papanikolaou & Boubouka, 2010). Students can also access the expertise of others and in the process, have the opportunity to reflect on their own ideas (Krajcik et al., 1994; Laffey et al., 1998).

Students enjoy and appreciate collaborative opportunities as it helps to clarify their thinking, increase motivation, enhance achievement and cultivate positive attitudes (Frank & Barzilai, 2004; Papanikolaou & Boubouka, 2010). During collaboration activities, students also develop 21st century skills as they become productive communicators and learn to negotiate by discussing alternative solutions. They increase their metacognitive knowledge as they reflect and reconcile the differences of their ideas with those of others, and increase their self-knowledge throughout the process (Papanikolaou & Boubouka, 2010; Savery, 2006), all components of the 2013 BC Education Plan (British Columbia Ministry of Education, 2013). Students also learn respect for others as they become active listeners (Bell, 2010) and appreciate the sense of community established by the collaboration opportunities (Papanikolaou & Boubouka, 2010). It is through the collaboration process that students often gain a clear sense of focus as they begin the process of creating their learning artifacts.

**Producing Artifacts**

Through the process of producing artifacts, students construct their knowledge, apply information, and represent it in a variety of ways (Blumenfeld et al., 1991; Krajcik et al., 1994; Laffey et al., 1998). The construction of knowledge requires students to engage in cognitive
processes, such as assimilating new information and integrating it into their existing knowledge base, building connections between concepts and ideas, and restructuring their existing knowledge base when necessary (Laffey et al., 1998).

Completed artifacts reflect the individual differences of each student supported by personalized learning. Each student’s natural abilities, as well as their preferred learning styles are evident, as students gravitate toward using abilities in areas where they excel and incorporate them into their learning artifacts (Grant, 2005). The completed artifacts are representations of the student’s newly acquired knowledge and skills as well (Krajcik et al., 1994). Students develop rich domain-specific knowledge and typically outscore their traditionally educated peers in basic academic subject proficiency (Bell, 2010; Blumenfeld et al., 1991). As domain knowledge increases, artifact construction better reflects the student’s personal understanding (Grant, 2005; Krajcik et al., 1994).

The artifact also demonstrates metacognition as they are the product of student decisions and reflections. Students must analyze available resources and consider their comfort level in working with them. Other considerations include the complexity of the tasks and the time it will take to complete the artifact (Grant, 2005). For these reasons, the process of constructing artifacts improves student’s critical and creative thinking skills, another goal of the 2013 BC Education Plan (British Columbia Ministry of Education, 2013).

Artifacts are not only evidence of student learning, but they are also a vehicle to share their ideas (Blumenfeld et al., 1991; Krajcik et al, 1994). Feedback from peers, teachers, and others, encourages students to reflect on and extend their learning and incorporate revisions and to enhance understanding (Blumenfeld et al., 1991; Krajcik et al., 1994; Laffey et al., 1998).
Sharing the completed artifact also promotes a profound sense of pride and accomplishment for students (Barron et al., 1998). The process of constructing a meaningful artifact that highlights a solution to an authentic question increases interest and value in the learning process (Blumenfeld et al., 1991).

**Assessment**

Critical to the success of project based learning approaches is a shift in assessment practices. Rather than paper and pen assessments, alternate assessments are used, which are more valid and reliable in terms of measuring both skill and content knowledge (Frank & Barzilai, 2004). Formative assessment, based on a number of diverse information sources, has a much greater role because real learning is often in the “doing” in project based learning environments (Barron et al., 1998). This type of assessment can be accomplished using a variety of methods such as meetings and discussions, observations, reports, personal reflections, or portfolios, just to name a few (Frank & Barzilai, 2004).

Frequent formative assessment by peers, teachers, or the students themselves, help to develop the ability to monitor and reflect on their understanding and find resources to deepen it when necessary. This ultimately improves the quality of learning and maintains standards as required by the curriculum (Barron et al., 1998; Frank & Barzilai, 2004; Melin et al., 2009; Savery, 2006). Formative assessment can also help the teacher identify misconceptions and student difficulties and provide scaffolding and support where necessary (Frank & Barzilai, 2004).

It is imperative that students and teachers view the need for revisions as learning opportunities, not as errors. This concept is often difficult for students to grasp as they often take
their work personally. However, teachers can help students understand that revisions are a natural component of learning and a consequence of working on an ambitious task. Students learn to appreciate and reflect on formative feedback from peers and teachers and incorporate revisions as they see fit. (Barron et al., 1998; Blumenfeld et al., 1991).

Studies done by Papanikolaou & Boubouka. (2010) and Frank & Barzilai (2004) demonstrate that the majority of students find peer assessments and reviews very helpful in that it stimulates them to clearly explain their ideas, thus increasing their level of performance. Peer assessment also encourages critical thinking and reflection. Students that perform peer reviews also appreciate the opportunity to learn how the ideas of others work. Frank and Barzilai (2004) report that students find continuous formative assessment helpful with many aspects of the process such as, keeping them on track, improving their problem-solving skills, helping to locate areas that needed improvement, and providing strategies to cope with group conflicts.

Formative assessment opportunities such as public performances or presentations require students to integrate prior knowledge with new and to exhibit mastery in the discipline (Krajcik et al., 1994). Outside audiences for those performances or presentations not only give students more incentive to prepare and revise, it also makes the work more meaningful for students and provides new opportunities for them to expand their learning (Barron et al., 1998).

**Subject Integration**

Although subject integration is not mandatory for project based learning, integration is easily accommodated and adds authenticity to the process. Because the driving question and solution must have real world applications, the process is very well suited to an interdisciplinary approach (Bell, 2010; Blumenfeld et al., 1991; Doppelt, 2003; Frank & Barzilai, 2004; Grant,
Typically, real world problems are not solved using knowledge and concepts from discrete subject areas. To effectively evaluate the problem and identify possible solutions, a multidisciplinary, holistic approach is more authentic. Students engaged in project based learning acquire interdisciplinary knowledge by the nature of the investigation (Frank & Barzilai, 2004). A pre-planned approach to subject integration provides students the opportunity to earn credits in multiple subjects. Since the integration process is a natural aspect of the project based learning process, it is logical to give credits for the work and learning that students do. Receiving credits due to the multi-disciplinary nature of the process is clearly beneficial and this option is certainly worthy of consideration.

**Integration of Technology**

Another component which is highly beneficial to project based learning is the use of technology, specifically a computer with connectivity (Blumenfeld et al., 1991; Doppelt, 2003; Grant, 2005; Krajcik et al., 1991; Papanikolaou & Boubouka, 2010; Thomas, 2000). Technology adds another layer of choice by providing multiple levels of tasks to match student knowledge, proficiency and skill level (Blumenfeld et al., 1991). These provide the opportunity for personalization as students can access information, resources, and Web 2.0 tools that match their abilities. Access to the internet offers a wealth of information in various forms and is a rich learning environment that expands the range of questions that can be investigated (Krajcik et al., 1994).

Using technology gives students access to a variety of types of current information and resources and adds authenticity to tasks by replicating practices currently undertaken by professionals in the field (Blumenfeld et al, 1991; Grant, 2005; Krajcik et al., 1994). Relying on
hard copy books and journal articles is no longer sufficient, as the information within them may be obsolete, causing misguidance that will impair the decision making process for the student. Using the internet to find resources increases access to current information. As well, search results can be narrowed to provide resources at a chosen reading level, minimizing frustration for struggling students.

Technology also increases the opportunity for interaction and connection with professionals working in the field of study the student has chosen to focus on. Technology easily accommodates synchronous and asynchronous discussion resulting in a useful platform for collaboration and blending of the learning environment (Krajcik et al., 1994; Papanikolaou & Boubouka, 2010). Having access to experts in the field and communities interested in the same topic, where relevant conversations can occur and student questions can be answered, is a benefit that cannot be duplicated at the same rich level without use of the internet. Using the computer for these interactions dissolves geographical boundaries and allows students to access experts from around the globe. This also adds to the authenticity of the project and enhances the interest level for students challenging them to think more deeply about the issues at hand (Blumenfeld et al., 1991; Laffey et al., 1998; Papanikolaou & Boubouka, 2010).

Technology further helps to relieve the cognitive load for students as they can use applications and programs to help them perform several tasks such as finding resources, summarizing information, organizing work, and analyzing data (Blumenfeld et al., 1991; Grant, 2005; Papanikolaou & Boubouka, 2010). Students can also use technology to create artifacts using Web 2.0 tools and it provides a platform on which they can share them (Blumenfeld et al., 1991; Grant, 2005; Krajcik et al., 1994; Papanikolaou & Boubouka, 2010). Using technology also helps to sustain student motivation and support learning (Blumenfeld et al., 1991).
Technology integration is a high priority in the 2013 BC Education Plan and the BC government is currently spending millions of dollars to upgrade systems in the province so that this integration can occur (British Columbia Ministry of Education, 2013).

**Challenges**

Although project based learning has many benefits, it also has challenges that need to be considered and addressed. Learning in complex environments can be difficult for students and they may progress through the process simply by following procedures, rather than completing tasks with understanding. Learning-appropriate goals and objectives that define connections between activities and required conceptual knowledge need to be clarified to help the student understand the how and why of a project (Barron et al., 1998; Melin et al., 2009). Goal setting, opportunities for feedback, encouragement, and group work will also help to sustain students throughout the process as difficulty increases (Blumenfeld et al. 1991).

Students may also lack adequate cognitive skills and background knowledge to explore a topic effectively (Blumenfeld et al., 1991; Krajcik et al., 1994; Papanikolaou & Boubouka, 2010). Students may also lack basic skills using technology (Krajcik et al., 1994). Although basic computer skills are typically learned fairly quickly by students, this deficit could combine with the lack of background knowledge necessary to engage successfully in the inquiry process. Poor internet search skills, coupled with inadequate literacy skills to read and evaluate material could make locating resources difficult for students (Krajcik et al., 1994). Personalized learning can be accommodated by teacher guidance in topic choice and scaffolding to help break down large tasks into several smaller, more manageable ones (Krajcik et al., 1994; Papanikolaou & Boubouka, 2010). Technology can also be used to filter the level of difficulty of resources in
search results and offer Web 2.0 tools that are not as challenging to use (Papanikolaou & Boubouka, 2010). Teacher support, as well as appropriate choices using technology will help students experience growth in content knowledge and skill acquisition, regardless of their starting point.

Student metacognitive skills such as self-regulation, motivation, planning, goal-setting, and collaborative skills may also not be adequately developed (Blumenfeld et al., 1991; Papanikolaou & Boubouka, 2010); however, collaboration, scaffolding, and frequent formative assessment opportunities may help students to develop these skills as they work through their projects (Papanikolaou & Boubouka, 2010). Also, technology integration for collaboration and the use of organizational applications or programs can help develop such skills as well (Papanikolaou & Boubouka, 2010).

Students may also be challenged by the lack of experience in the learning approach and may prefer a traditional approach that requires less effort because the information they “need to know” is provided (Frank & Barsilai, 2004). Students and teachers may have experienced success and established a comfort level in the traditional classroom and therefore, may be very reluctant to explore new methods of learning. As well, these students may struggle with the ambiguity, complexity, and unpredictability inherent in inquiry-learning. In reality, students face challenges with every teaching method. Being aware of these challenges helps their teachers prepare strategies to help students overcome them.

Benefits

Even though some students may experience challenges, the overall benefits for students engaged in technology-enhanced project based learning are impressive and it is an effective
method of teaching and learning to achieve the goals of the 2013 BC Education Plan. Students generally work with enthusiasm and are motivated to complete tasks that reflect their understanding (Barron et al., 1998; Doppelt, 2003) and interest and energy is sustained throughout their project (Barron et al., 1998).

As students develop a deep and integrated understanding of content and process (Frank & Barzilai, 2004; Krajcik et al., 1994), social learning and 21st century skills such as, communication, negotiation, and collaboration are promoted (Bell, 2010; Frank & Barzilai, 2004; Papanikolaou & Boubouka, 2010; Savery, 2006; Thomas, 2000). Inquiry, critical and creative thinking, and problem solving skills are also encouraged throughout the process (Frank & Barzilai, 2004; Savery, 2006; Thomas, 2000). Additionally, metacognitive skills such as time-management and self-discipline are developed as students learn to take responsibility for their own learning (Doppelt, 2003; Grant, 2005; Frank & Barzilai, 2004).

Feedback from students engaged in project based learning programs is generally positive as well. Students consider working on a project a very important experience (Barron et al., 1998) and appreciate and value the teacher in their role as a partner and helper in student learning (Doppelt, 2003). Students also report an increase in self-esteem and confidence as they are able to participate and demonstrate their knowledge in ways that matched their learning styles (Frank & Barzilai, 2004). Project based learning is highly beneficial for students and provides many opportunities to learn 21st century skills by encouraging responsibility and engaging students in decision making, problem-solving, and collaboration.

Conclusion

In summary, project based learning is an excellent method to teach students content
knowledge and skills outlined in the 2013 BC Education Plan. It supports personalized learning and provides students with a large degree of control and responsibility over their learning. Students make many decisions regarding their course work, which increases their interest and motivation levels. As students make these decisions, they develop skills such as critical thinking, problem solving, and self-reliance. Students also learn to manage their time and improve self-discipline. Students work with others and develop teamwork and collaborative skills. Working with others also improves communication and negotiation skills. The use of technology allows students to connect with learning partners and experts around the globe, dissolving geographical barriers. In doing so, they are exposed to alternative points of view and expand their own knowledge. Technology integration, a key focus of the BC Education Plan, is highly compatible at every stage in project based learning. Students use technology to research their topic, connect with others, build their artifacts, and use it as a platform to share their work. Subject integration, which is highly beneficial to the student as well, is easily accommodated in project based learning as it reflects real world problem solving. As we move towards 21st century literacies, project based learning will create effective learning environments for all students and meet the criteria set out in the 2013 BC Education Plan.
Chapter 3 – Methodology

Introduction

The intent of this project was to provide the teaching community with an example of an online, integrated, Project based learning unit that satisfies the initiatives in the 2013 BC Education Plan. Although this unit is designed to expose students to the prescribed learning outcomes in the Science 10 Life Science unit, it can easily be modified to another main subject area. I have created the unit as a fully online format, blending the face to face interactions virtually. This too can be modified to accommodate a blended approach with brick and mortar face to face meetings, or fully face to face blending the online environment using the unit and web 2.0 tools to create artifacts. The unit is fully flexible by design.

The unit is available to teachers on the BC Learning Network (BCLN) website. Having it available there exposes the unit to a large number of teachers currently working in the online environment. However, if a teacher currently does not have access to BCLN, every teacher in the province of BC can create an account and freely use the resources within the network, including this unit. Accommodations can be made for “out of province” teachers as well.

The preparation to produce this unit began some time ago. In the two years previous, right from OLTD 501, I had been encouraged by my instructors to think about this project. Many decisions about the project had already been made based on the lessons in OLTD. However, thinking and doing are two very different things. The research and academic knowledge may have laid the foundation to help with decisions, but when it got right down to building the project, the thought and challenges that went into producing it were definitely more than anticipated.
Major Project Design Considerations

Prior to starting to build my project, one of the first considerations was where to put it. The delivery platform needed to allow the incorporation of the critical elements of a project-based course such as collaboration, and student choice. It seemed practical to consider options that I had already used, as I did not want the learning curve of a new program to impede my progress. Throughout the OLTD program, I had experimented with a few options for course delivery platforms such as the LMS (Learning Management System) Moodle, as well as non-LMS platforms such as WordPress and Weebly.

I would have chosen Moodle immediately, but there are a few drawbacks with the LMS. My major complaint with Moodle was, and is the grading system. The difficulty occurs when looking for a student’s mark who happens to have a last name that starts with the end half of the alphabet. The top assignment name is not fixed, so while scrolling down to find the student, you lose the name of the assignment. A simple highlighting of the assignment solves the issue, but looking at several assignments for that student does get cumbersome. Also, user reports are not easily generated for school to home contact. This feature is very important and a huge oversight that caused my initial search for a better platform. I also like a platform that I can customize. Moodle’s three column set up with content streamed down the center seems to be standard. I am a creative and aesthetic person and craved a bit more flexibility. This may not be a consideration for others at all, but it was the second issue that caused me to investigate a non-LMS quite seriously.

I experimented with both WordPress and Weebly to create non-LMS units for assignments in courses that I completed in the OLTD program at Vancouver Island University.
Both of these platforms had a high degree of customization ability, which, in my opinion, resulted in a much more visually appealing product. WordPress was the more complicated and less intuitive website generator of the two and even though I have more experience with it, it was much more difficult to achieve the look of the web space that I was after. The Weebly site was very easy to work with and I was very happy with the end result. I sourced out Web tools for all of the functions I wanted to incorporate, such as discussion boards, wikis, and grades, to name a few. Each of the web tools did perform the intended functions well, but incorporating so many tools had drawbacks, especially for the end user. Many of the tools required a username and password to use, which made them a bit of a burden for students. After completing units in both WordPress and Weebly, I came to appreciate the convenience and value of a good LMS.

Even with the other minor drawbacks of Moodle, having all of the functionality housed in the same platform is convenient and makes the development of the course much more streamlined. It is ultimately much more user friendly for students and, as the end user, they do need to have primary consideration. Having the basic user “tools” provided in the LMS simplifies navigation and prevents students from creating usernames and passwords for several other sites. Other key aspects that I considered were my familiarity working with Moodle, and the ease of sharing my project with others.

As mentioned previously, I have used Moodle for several years and I am confident with my proficiency in the program. That is not to say that I know everything, as there are many bells and whistles available in Moodle that I have never used. This does leave room for growth in terms of what I can offer students in the future. For example, I experimented with Moodle features while making this unit, and discovered some modifications that I think improve the
overall look of the unit. I do not have 100% administrative control in my shell, but if I did, I could have modified the look further, but I am happier with the aesthetic results of the unit.

My familiarity in working with Moodle allowed me to focus on important elements that I wanted to include in the project, rather than spending time figuring out how to add them. This saved time enabled me to think more creatively and productively. The Moodle shell that I used is located on the BC Learning Network site, so sharing the project with others, especially teachers that currently have online teaching experience, is done easily.

The next important consideration was the subject areas that would integrate smoothly. The project based learning (PBL) approach encourages subject integration and I wanted to ensure that students received credit for more than one area of study. Biology is my major and in terms of providing feedback and evaluating student work, was the most logical primary theme focus. The sciences are also chock full of good fodder for project based learning topics that encourage students to learn content.

English Language Arts objectives combine well with any subject area as is a natural fit for project based learning. Students spend time researching their topics by reading and evaluating information from different genre such as a variety of websites, newspapers, discussion forums, research papers, and many others. They also conduct interviews, ask and refine questions and develop their listening skills. Other valuable sources of information are documentaries, videos, and the news. In short, students gain information by reading, questioning, listening and viewing. They also write formally and informally about their experiences and topic and are involved in many presentations, both formal and informal as well,
to share their learning. All of these skills are part of the grade 10 English Language Arts curriculum.

Another subject area that is a perfect fit for any project based program is the Applied Digital Communications. I am currently teaching this course virtually and the objectives are met by engaging students in the use of the internet, computer programs and Web 2.0 tools. Digital citizenship to some degree is included as well, due to the student’s online presence and active participation in discussion forums, focus groups, and online collaborative opportunities. The Applied Digital Communications credits work well because of the student’s required online activity, and use of Web 2.0 tools, computer programs, and the internet in general.

The last consideration prior to building the unit, were the project based learning elements to incorporate. I relied on concepts that I learned in the OLTD program, my research, as well as my previous experience using a project based learning approach. Student choice and control were the most important aspects I wanted to incorporate. Other mandatory components were collaboration, artifact creation, presentations, multiple opportunities for formative assessments and reflection. From my previous experience with PBL, I knew that goal setting would be critical to help keep students engaged and on track and reflection to help students become critical thinkers and increase metacognition. Both of these components would also serve to shift the responsibility for learning onto the student.

**Major Project Development**

One of the major premises of project based learning is that students have choice and I wanted to make sure that I had a good balance in this area. I did not want to provide students with too much choice and risk overwhelming them, or not give them enough choice and have
them feel that they did not have any control. My research demonstrated that the ideal scenario
would have students make choices in the areas of topic, methods of learning the information, and
the artifacts they would develop to demonstrate their learning, presentation methods, and
timeline.

I have provided a theme focus for students to help in their question development and to ensure that there was potential to meet the learning outcomes. The thematic unit was based on the Science 10 curriculum unit Life Sciences. One of the major hurdles in project based learning is teacher concern that learning objectives will not be covered, so providing a solid theme would get students off in an academic direction. I chose the impact of human activity on the environment as there are many appropriate specific examples for students to choose from. I have provided several example focus areas in the unit under “Topic Choice”, but students are welcome to choose their own if they have an interest in another area, as long as it suits the learning outcomes in this unit of study.

The first major decision the student will make is the research area, and question development. Making decisions can be difficult process for students as at this point, it may be a very new concept. This is one of the reasons that students will have one on one weekly meetings with the teacher so that the scaffolding process can begin right away. I wanted students to realize immediately that the teacher was there to help and to support their ideas and efforts. A poorly developed question will affect student learning, so this step is critical in the process. It is clear at this phase of the project, that the question may be revised as students gain knowledge and understand their chosen topic better.
Having every student working on different topics in the unit may be very difficult for the teacher, who will likely not be an expert on every topic. Also, there is a concern that students may not have the acuity to critically assess the reliability of the information they are obtaining. To ensure that student have expert guidance, the second choice is to choose a mentor or expert in their area of study to work with. The mentor will be a contact for the student and provide expert knowledge and guidance. I developed an assignment to ensure that students conducted research and chose their mentors from reliable sources. The mentor is an integral part of the project and will be instrumental in student success, so careful selection is required and will be demonstrated. This assignment is handed in very early in the process so that the teacher can also contact the mentor to discuss his/her responsibility to the student. The teacher may not be aware of misinformation in each particular area of study, so not only is frequent student/mentor contact necessary, but teacher/mentor communication is also key. One on one weekly meetings with teacher, as well as frequent engagement with their mentor, should help to uncover any misconceptions student’s form along the way and provide resource assessment strategies for the student.

Students will be creating several artifacts to demonstrate what they have learned, as well as how they plan to solve the problem they have chosen. They will also be reflecting on their learning and collaborative opportunities. To simplify the presentation process and help organize their work, I have mandated a Web tool that will house it. The Web tools I suggested were Weebly and JooMag, but there are others. Students have the option of choosing their own, and I have provided criteria to do so. The main platform is also important for the teacher. The link is handed in very early in the Project development process and frequently thereafter, and this allows the teacher to check student progress and quality of work as often as desired.
Students are also free to choose any Web tool they wish to create their artifacts. I have provided several suggestions in assignments, but the student can experiment with as many web tools as they like. I have provided a “Cool Web Tools” discussion forum for students to share their experiences with web tools they have tried and recommend them to others. I have also suggested that they use their “Reflections” section of their project as a sandbox to experiment with web tools. This encouragement should give them a “safe” place to gain exposure to several tools and help them create a diverse collection of experiences with them.

Students will also be responsible to develop their own timeline and set weekly goals to accomplish the tasks involved to accomplish it. This gives students the freedom to work at their own pace. Another important reason for establishing a timeline is to set a date for the final presentation and secure an audience. Planning for the presentation occurs later in the project process, so this final date is somewhat flexible. It is hoped that the goal setting will install a sense of responsibility and ownership over learning. The weekly reflections provide an introspective opportunity for the student and will increase metacognition and awareness of work ethic. The intent is that the combination of the two assignments will encourage students be self-reliant and create strategies to overcome issues when their goals are not met.

Timeline

I had originally planned to complete my project prior to school start up. However, once I got working on it, I realized that I underestimated the length of time it would take to address the details and overcome challenges that I faced. Also, working during the summer proved a bit more difficult than I anticipated as well. In previous years, I used the time off work to travel and reconnect with friends and family. I had several commitments in this regard that I was obligated to honor. Ironically, it was during these visits that I could reflect and discuss challenges I was having with my project and come up with
viable solutions. Stepping away periodically proved beneficial as I was able to return to work with fresh ideas and look at what I had previously done with a new perspective.

Challenges and Solutions

Most of the challenges that I faced were due to the high frequency of student choice. Students were in control over so much of their learning, I could not predict, or plan for, the path their learning would take. Students could work on any topic, produce any number of varied artifacts, work over any period of time they chose, and present their evidence of learning any way they wanted. My challenge was to create a unit flexible enough to successfully allow the myriad possibilities that were inevitably going to occur, while maintaining high standards and meeting inflexible IRP’s.

The biggest challenge I faced was in methods of assessment. It was clear that I would have to be creative to produce assessments that considered the individuality of the students and their projects. I also did not want the assessment tools to be overly complicated to use, but thorough enough to address the subject areas I had integrated. I also wanted the rubrics to be useful for any major subject area that a teacher using this unit as a model, might want to integrate.

For the project work, I determined my best choice would be to create generic rubrics. Each criteria in the rubrics addressed a subject area integrated in the unit. I was careful to use generic content language, so that the rubric could be used for any main subject area, not just the Science 10. For example, rather than referring to specific learning outcomes, I used the general term, PLO’s. Students were provided the Learning Outcomes for the subject areas in the unit, so the rubrics could be used instructionally by students as well. The generic nature of the rubrics also allows me to reuse them for the next project, providing consistency for the student.

I also needed to devise a way to encourage and demonstrate frequent engagement with their mentor, peers, and the digital community, but couldn’t know how they would communicate, or how many times this communication would occur. Students could possibly have long weekly meetings with their
ment or they could have more frequent, shorter meetings. Some students might find discussion forums really valuable and choose to engage in them quite extensively, while other students might find discussion forums on their topic too sparse to be overly valuable. I also couldn’t predict how often students would work with their peers. They did have to request feedback from their peers for their artifacts and presentations, but again, students themselves determined the number of presentations they would have. There were so many variables that I couldn’t predict, it seemed impossible to devise an evaluation method that would generically address each meeting.

I originally considered integrating a point system similar to the one used in OLTD 509. I created this document and discussed this system with my supervisor, but the integration in the Moodle platform would be a bit awkward. I was also concerned that students would engage in token collaborative sessions, just to collect the points, so this option did not seem to be the best solution.

Another option from OLTD 505, would have students demonstrate interactions with others by creating a cumulative artifact as a final assignment. This final assignment took individual interactions into account and would put the onus on the student to provide the evidence that these interactions occurred. It also “fit” the PBL philosophy of students creating artifacts to demonstrate their learning well. I could easily create rubrics for each section to evaluate the artifact, but I still needed to devise a way to encourage “frequent” collaboration with these groups.

In the goal setting, I developed questions that students had to address. Three questions that students need to address specifically directs students to plan collaboration activities each week. In the one on one sessions with the teacher, the student must discuss this weekly plan. If the student does not plan to collaborate with others, it will be obvious at these weekly meetings. It is at this time that the teacher offer feedback and encourage the student to increase collaborative activity if needed.

Students were responsible to determine their own timelines for projects. For that reason, I could not predict how many weekly goal setting assignments or reflections they would be handing in. I wanted
the goal setting to be handed in weekly prior to the one on one sessions and the reflections at the end of each week so that any concerns with productivity could be addressed as soon as possible. To make sure that students were able to hand these in every week, I created seven submission areas for both. More weeks can be easily be added if a project is longer. If the student prefers to complete the project in a shorter period of time, the left over weeks are not calculated into the student’s overall mark.

**Major Project Delivery/Implementation**

As mentioned previously, the unit is located on the BC Learning Network Website. It was “unhidden” on October 9, 2014. It is the best platform for a few reasons. The first is that although Moodle is a “freeware” LMS, a host server is required to use it. The BC Learning Network uses a reliable server which enabled me to build the unit. The other consideration was the accessibility to others. If I had created a unit using Moodle and hosted it on a server that I secured, it would not have the same wide provincial audience that BCLN does. All teachers in BC can create an account in BCLN and use the resources, including this unit, freely. Using BCLN provides the widest access to others possible. A formal request to view the unit and provide feedback was made on October, 14th, 2014 in BCLN. Included in the introduction is a short explanation of the unit as well as a link to a short feedback questionnaire. Feedback will also be requested from the OLTD cohort and instructors and from teachers I have previously worked with.
Chapter 4 – Field/Beta Testing and Findings

Beta Testing – Methods and Process

The intent of this master’s degree project was to develop an integrated online project-based unit that would satisfy the initiatives in the 2013 BC Education Plan and make it available to interested educators. The BC Education Plan highlights concepts such as personalized learning, quality learning, and student choice, as well as practices that encourage critical thinking skills, such as self-reliance, problem solving, innovation, teamwork and collaboration, and technical literacy (pg. 3-5). My research has demonstrated that a project based learning approach requires students to make several critical choices and decisions which encourages them to build strong critical thinking skills as well as a deep understanding of content. These choices also support personalized learning and provide students with a large degree of control and responsibility over their learning. The student centered approach shifts much of the decision making from the teacher to the student allowing the teacher to take on the role of mentor, supervisor, and guide (Barron, Schwartz, Vye, Moore, Pretrosino, Zech, &bransford, 1998). All lessons and instructions incorporate the project based learning philosophy as well as work within the BC Education Plan framework. I did not find any other examples of a fully online unit using the project based learning approach, so even though I endeavored to incorporate the concepts, I was curious to discover what the feedback from peers would reveal.

After completing the unit called Integrated Project Based Learning unit using the BC Learning Network platform (www.BCLearningNetwork.com), I requested feedback from several sources. I presented my published site for peer review from October 15th – October 31st. I requested feedback from BCLN course developers, colleagues, and posted my work to the Google + communities, PBL, PBL World, as well as the OLTD sharing space. I also tweeted my
Findings of Beta Testing

Although I felt that I used a wide net to entice potential testers to offer feedback, the results were sparse. I initially thought that using the BCLN platform to "share" my work would offer a wider audience than I could generate myself, and in retrospect, this may not have been the case. I can only assume that there was a general reluctance for BC teachers without an account in BCLN to create one to gain access to my resource. It also posed a roadblock for the few individuals that were not currently employed by a school district in BC, as school district employees are the only users that can easily create an account independently. This inadvertently excluded many of the "testers" I reached out to. The low response also caused me to question my initial choice to produce my unit using Moodle. Perhaps another LMS, such as the free version of Canvas, would have been more easily shared and been adequate for the size of my unit.

In total, I received feedback from six reviewers. Most of the respondents preferred to offer feedback using email. One responder used the feedback form that I included in the unit. This feedback form included questions about student choice, goal setting and reflection, collaboration with others, course organization and instructions, assessment, and adaptability to other subject areas. Unfortunately, the respondents that used email may not have addressed these areas.

In general, most of the reviewers were impressed with the unit layout and thought the concept was very interesting. I was very encouraged by one reviewer, as his very thorough
feedback and positive praise were invaluable and led to most of the additions in the unit. His positive comments included, “Wow. You have done a magnificent job. I love it. What a lot of work.” He also indicated that he felt that overall, I had produced “a very impressive course”. Another reviewer thought I had done “an awesome job to demonstrate how to do this and better yet, cross-curricular. Well done.” Most of the respondents felt that generally, the unit was well done and accomplished the goals that I was trying to achieve. Along with these words of praise, I also received suggestions to improve the unit.

Some of the feedback I received was in regards to student choice. Three respondents had the opinion that students would find making the required choices in the unit very difficult. However, a co-worker from the Blended program at Central Programs and Services suggested that students should struggle somewhat with choices and that overcoming this difficulty was part of the learning process. She felt that "student choice is well laid out in this unit" and the teacher guidance provided would help students through the process.

One feedback comment suggested that the unit should include "examples for students that are unfamiliar with making these educational choices". The specific example cited was the formulation of a driving question. The comment pointed out that examples were provided to help guide students to choose an appropriate topic, but there was no guidance about how to formulate a "good" research question. This was true. I had indicated to students that their initial question attempts would probably be revised, but I did not give any guidance about "how" to develop it in the first place. Considering the importance of the question, this was quite an oversight. I had just discovered a great resource produced by a master teacher about developing driving questions on Twitter and he gave me permission to use and modify his content. I produced and embedded a
google slideshow with instructions for formulating "good" questions, which should provide students with adequate instruction.

A co-worker and DL teacher, thought students were given too much choice, especially in terms of the timeline. His comment was "should the teacher (not) determine the date based on allotted time for the IRP’s? as opposed to the student choosing the time?" This respondent was concerned with running out of time before covering all the IRP's in the curriculum. However, the whole point of engaging students in creating the timeline was to allow them to work at their own pace, explore the topic as deeply as they liked, and to encourage them to take ownership and responsibility over their learning process. In short, making their educational experience student-centered. The weekly meetings could easily flush out how much work the student was planning to accomplish, and if the effort was not reflective of adequate rigor, the student could be prompted to increase his/her workload. Also, if the student chose to devote an extensive length of time working on this particular topic, additional IRP's from other units in Science 10 could easily be added, as the theme lends itself to this incorporation. This supports my suggestion that the main subject area must be one that the teacher is very familiar with. A teacher with an in depth knowledge of the IRP's would be able to suggest a broadening, or narrowing of the IRP's based on the timeline the student created. It is also important to note that the initial timelines students create are tentative and will be adjusted as they progress. The timeline will become firmer closer to the end of the project so that the student can prepare for the final presentation.

The other major area of feedback was about students locating their own experts. The four responders that addressed this issue were concerned that students would lack the experience to locate reputable mentors on their own. My co-worker said that students "may need more guidance during this time to truly collaborate with others". This concern was echoed by others.
One reviewer suggested that finding an expert "might be difficult if they have never done this before. You might give an example or two" to provide guidance. I have addressed these concerns in a couple of ways.

Initially, I had assumed that teachers would realize that this task, and others that students would need guidance completing, would be discussed in the weekly group meetings. I certainly had that idea in my mind, but realized that I did not provided any guidance in this regard to teachers. To address this, I created a teacher resource folder with suggestions of weekly group meeting topics and the first Power point presentation. In the first weekly meeting, guidance for finding a mentor is on the agenda and corresponding slides on the presentation address this topic. The Power point presentation can be modified to suit the teacher's specific teaching style and choices. Specific lessons are provided for the first 3 weeks and general questions/collaboration opportunities after that.

I also created and embedded a slideshow demonstrating how to do an initial search of the topic to search for potential mentors by finding contact names and agencies that could offer potential mentor candidates. This slideshow has results from two example searches and suggested content for the mentor request email. This, coupled with the teacher guided group session, should help students secure a reputable mentor.

Two respondents expressed concern about students navigating the unit. One queried whether "people going to be able to figure this out easily enough?" and suggested "a checklist of sorts" to help solve the problem. A co-worker, suggested a checklist as well "so that prior to reading this I am reading with purpose". I had initially included a navigation video in the introduction of the course, but felt that the informational video about the PBL approach was
more important. The checklist was a good replacement and very easy to create and embed in the unit. I also included navigation instructions in the first meeting Power point so that it is clear to students how they should be working within the unit.

One respondent wondered whether students should engage in "public" discussion forums. The concern was that students "could end up with non-scientific (conspiracy theory) information which may consume time". To address this, I have included discussion forums as one of the topics in the second group meeting. Additionally, the purpose of engaging in discussion forums is stated in the assignment. It states that the student goal is to "gain information and discover the differing points of view and perhaps the reasons that individuals have them." The students are not to rely on discussion forums as their main source of information. Developing research skills and guidance from their mentors will provide the strong knowledge foundation. Once students are informed about their topics, they will be better equipped to critically assess the validity of discussion posts in forums. Cultivating this skill is ultimately worth any time and effort the student devotes to it. Students cannot determine an effective solution if the opinion of others is disregarded. Also, in the one on one meetings, the student and teacher discuss the results of the student's experiences to ensure that students are not basing their solutions on unreliable information. If the student cannot finding quality discussion forums to participate in, the mentor or teacher can suggest reliable ones as well.

Two respondents thought that the instructions were too wordy from a student's perspective and they feared students would "quit reading" before understanding all of the elements of the assignment. I struggled with this concern. My dilemma was that the content would not only provide information to students about a particular lesson, but would inform the teacher as well. One colleague understood this concept and realized that "teachers, may have to
adjust the wording level for their own students/audience at that time”. This comment echoes my thoughts. I would expect, and encourage, any teachers interested in using this unit to modify it to suit their needs.

Only one respondent that addressed goal setting and reflection, as she was the only one that used the feedback form in the unit. Although she could see value in both aspects in terms of helping students recognize how they learn and teach them how to organize their work, her concern was that “if students, haven't bought into the idea of project based learning yet, it might be difficult for them to see the usefulness in these areas.” It has been my experience using a project based learning approach, that these two aspects are critical to student success. Projects are large and without breaking down tasks to make them obtainable by goal setting, students could easily get overwhelmed. This weekly activity also ensures productivity. Students are faced with a myriad distractions, especially when on a computer, so having tasks laid out for the week will help to make them accountable and encourage responsibility. The reflection component will help them identify and critique their own progress. Reflection is also important to encourage students to take responsibility and help them feel ownership over their learning.

The other important aspect of these two components is that in any given group, students may be at various stages of their project, and most likely be working on different topics. Both of these areas help the teacher keep informed about each student’s progress and highlight difficulties. This weekly feedback will help the teacher identify the unique strengths and weaknesses of each learner. This will enable the teacher to provide targeted assistance and promote a truly personalized learning environment.
Two respondents offered feedback in regards to assessment. One thought that students would not be able to develop meaningful criteria in the assessment/feedback forms they create for peer assessment and presentation audience members. He indicated that they may be as brief as “did you like my project”. His feedback confirmed that this unit would be very difficult, if not impossible, to implement in a 100% DL setting with no interaction with the teacher. I am not sure if this was his overall misunderstanding, but to clarify, this unit is designed using a blended model and must be used as such. The weekly group meetings are provided to address these sort of topics and to provide a little more clarification for the teacher, I included the lesson topic in the week three group meeting lesson suggestion. My colleague suggested a “co-constructed criteria with the students, so they see and understand exactly what is expected of them.” Again, this could be addressed at the appropriate group session or the one on one sessions with the teacher.

The field testing phase of this project produced some really interesting insights and I received some excellent suggestions to improve this unit. Although I did not get as many respondents as I had hoped, I learned a lot about how others might perceive the unit and took steps to improve it where I could. I found the range of opinion interesting in terms of some areas having too much information and others not providing enough guidance. This really highlighted the need for balance in these areas and I leaned toward increasing guidance, rather than cutting instructions. If any teachers are interested in using the unit, the content can easily be modified if they prefer less information. I am very grateful to the reviewers that took the time to look over this unit and am impressed with the depth of feedback and insight they provided. Their contributions have served to improve the quality of this unit and its usefulness to others.
Chapter 5 – Conclusions and Recommendations

Conclusions

To prepare graduates for an increasingly technological environment and changing workforce demands, educational practices must change. Once today’s students enter the workforce, it will be expected that they are technologically literate and possess 21st Century skills, such as critical thinking, problem solving, communication and collaborative skills (The Conference Board of Canada, 2014). To acknowledge these changes, the British Columbia Ministry of Education has produced a draft copy of the 2013 BC Education Plan. The Plan’s fundamental directive is a shift in pedagogy to create learner centered classrooms where students are encouraged to develop 21st Century skills (BC Education Plan, p. 3 - 5). Specific concepts highlighted in the 2013 BC Education Plan are personalized learning, quality learning, student choice, and practices that encourage critical thinking such as problem solving, innovation, teamwork, collaboration, and technical literacy. The teacher role, and thus the pedagogical approach, must change in order for this plan to be successful. The BC Education Plan currently lacks exemplars at the secondary level to help teachers implement the plan.

The intent of my project was to create an online learner-centered unit, utilizing the project based learning approach. Studies have demonstrated clearly that a project based learning approach encourages students to develop 21st Century skills such as critical and creative thinking, problem solving, collaboration, and time management (Frank & Barzilai, 2004; Savery, 2006; Thomas, 2000), while encouraging self-reliance and self-discipline (Doppelt, 2003; Grant, 2005; Frank & Barzilai, 2004). The creation of the unit would demonstrate that an online, subject integrated, project based learning approach could be used as a method to implement initiatives in the 2013 BC Education Plan.
I created an online unit using the learning management system, Moodle, located on the BC Learning Network. I chose the theme of "Human Impact on the Environment" and students develop their driving questions based on that theme. The theme was chosen based on the Science 10 Life Sciences unit and students meet the learning outcomes in Science 10, English Language Arts and Applied Digital Communications as they work to find the best solution to their driving question and prepare for a final presentation. The basic organization of this unit follows the Project based learning approach where students develop a research question, research the topic, then choose or develop the best solution. In all Project based learning programs, students create artifacts to demonstrate their learning. To further encourage technical literacy in this unit, students will use a variety Web 2.0 tools to create those artifacts.

Once I completed the unit, I requested peer review from several sources. I posted it to my OLTD cohort twice, once in the Google + community as well as in our Facebook group. I also posted to several other Google + communities and Twitter hashtags with a Project based learning focus. I felt responders from these groups would be particularly valuable as they would be able to offer suggestions from a position of experience. I also used the BCLN network and emailed teachers and administrators personally. I included a feedback questionnaire in the unit which focussed on the outcomes I was attempting to achieve, such as student choice, critical thinking, collaboration, self-reliance, and responsibility. However, most of the reviewers with the exception of one, preferred to offer feedback using email, so I had little control over the direction or content included in reviewer feedback. Although I did reach out to teachers with PBL experience, only two of the six responders to the unit had past experience or in depth knowledge of the Project based learning approach.
Although none of the reviewers stated it specifically, I inferred from some comments that a few were confused about the teacher role. The concern that students would not be able to complete some tasks without quite a bit of difficulty, or at all, led me to believe that perhaps they were unclear of what the teacher was supposed to be doing. Shannon Ward, who has experience using the PBL method, suggested in many of her feedback comments that teacher guidance would be required for several tasks. This is true and research shows that guidance from the teacher is critical in PBL to help students navigate through the decision making process, especially initially, so that students can develop self-confidence in this area (Bell, 2010; Grant, 2005; Melin et al., 2009). However, the majority of responders lacked PBL experience. Considering that Barron et al. (1998) suggest that difficulty making the shift in teacher role is one of the major hurdles to the successful implementation of project based learning programs, the oversight to provide direction for the teacher was significant. I had not addressed this area adequately and incorrectly assumed that the teacher would see where students would need guidance and accommodate that need in the weekly group sessions. To address this oversight, I added suggested lessons for the weekly group meetings, including the first power point presentation. I felt that detailed guidance for the first weekly meeting and then a basic outline after that, would suffice. Once teachers understood their role, it would be more obvious to them where their particular students were having difficulties.

I appreciated the suggestions from an OLTD instructor to add exemplars where students were expected to perform tasks that they may not be familiar with, especially in the areas of question development and finding a mentor. I thought this advice was practical and valuable. Krajcik et al. (1994) support one of the responder's concerns about student ability to perform unfamiliar tasks, especially in the development of a good question. They suggest that the ability
to create good driving questions comes from experience and many students unfamiliar with the PBL method will lack this experience. The area of question development reiterates the importance of teachers adopting the role of guide to provide adequate scaffolding to ensure that students develop questions that are intellectually worthwhile, challenging to the student, and have sufficient depth to sustain inquiry over an extended period of time (Blumenfeld et al. 1991; Krajcik et al., 1994; Thomas, 2000). To ensure that this scaffolding takes place, both question development and finding a mentor topics have been included in the first weekly group meeting. Even so, students might still grapple with decisions and tasks on their own at some point. Examples and detailed instructions would help to guide them through these tasks when they were working on their own. The addition of embedded slideshows that demonstrate step by step processes for question development and finding a mentor in the appropriate lessons improves the overall usefulness of the unit and should be helpful to students. I would further suggest that the teacher record the weekly meetings and provide links in the unit to provide additional support. These additions will make these tasks more manageable for students.

I was hoping for more feedback about the objectives I was trying to meet by creating the unit. One responder provided some feedback in these areas and suggested that with teacher guidance, students would become self-reliant and responsible learners. She also thought that the choices students made would encourage them to take ownership and that the collaborative opportunities would be successful as long as teacher guidance was provided. I did not receive any feedback to indicate whether my reviewers thought that students would improve their critical thinking skills such as problem solving, innovation, teamwork, and technical literacy by participating in the unit. I can only assume that because I have used a Project based learning
approach, and that research clearly demonstrates that these skills are improved by using this method, that participation in the unit will achieve these goals.

One drawback of the unit that was pointed out in the testing phase of the unit is in terms of audience. I attempted to prepare the unit to be used by students, but at the same time, act as a guide for teachers. Because of this, some of the feedback indicated that lessons were too wordy from a student’s perspective. However, the excessive information for some lessons was necessary to provide adequate information for the teacher. Although creating a duplicate for each lesson, one for the student, and one for the teacher would be a solution, given the length of time it took to produce the unit, I did not implement this solution at this time. Another solution to the problem brings up the second perceived drawback.

The unit should be used by teachers with some knowledge of Moodle and PBL. A teacher with Moodle experience could easily modify the lessons to address the above concern of wordiness. The adaptation to an alternate main subject area is possible as well, but it would require more work on the teacher’s part. Although the Collaboration, Goal Setting, and Reflection areas could be very quickly modified, the Project section would require substantial alterations. This level of modification may involve knowledge of Moodle beyond a beginner level.

I would further suggest that it would be very difficult for a teacher to modify or use the unit without first becoming familiar with the Project based learning methodology. The areas where students are given choices, and the lack of subject specific content is intentional, and teachers unfamiliar with the PBL pedagogical approach may view these areas as holes in need of filling. This refers once again to the shift in teacher role required to implement a PBL unit.
Barron et al. (1998) suggest that teachers struggle with this shift when they feel that students may not be "covering" content adequately. Rather than guiding the individual students to reach the learning outcomes, the easier method is to provide students with the driving question and associated content in the lesson. Alterations in this manner would diminish the effectiveness of the unit as taking away choices and providing content would deprive students of the opportunity to engage in a student centered educational experience and reduce their ability to improve critical thinking skills and become self-reliant learners.

Another drawback is that the unit is located on the BC Learning Network. Although many teachers in BC have free access to this network, the unit is limited to a small population of teachers that might be interested in the online Project based method. I was initially confident that the unit would be easily provided to a wide audience, but realized in the testing phase, that few teachers currently have active accounts. When I began the project, using the BCLN was a solution to my lack of access to a Moodle shell. Using the BC Learning Network did give me access, but limited the sharing capability. I do believe that using an LMS like Moodle is very valuable, but am unable to offer the unit to as wide an audience as I would like at this time because of it.

The most significant drawback is that I cannot offer any direct evidence that students will develop 21st century skills by engaging in this unit. It is designed using a Project based learning approach, and research demonstrates that PBL supports the acquisition of 21st century skills. However, the unit has not been tested with participants. Theoretically, if the unit is used as designed, students should achieve the expected outcomes. However, the results in terms of student performance is yet to be determined.
Recommendations

The usefulness of this unit to other teachers is dependent on whether or not they can easily access it. The unit is currently available to all teachers employed in the school system in BC. However, those teachers must have, or create an account in BCLN to view the unit to determine if it is of interest, or not. The testing phase of this project demonstrated that there may be a reluctance to do this. Also, even if teachers were interested in looking at a PBL example unit, they would not know that the unit is available in the BCLN site unless someone specifically informed them. The unit is not available to out of province teachers either. They could have been added as a reviewer at my request, but typically, the BCLN site is for BC teachers only. To improve accessibility issues, the unit should be downloaded to an unrestricted server.

Additionally, if a teacher were interested in using the unit, it is most likely that modifications would be required to suit the teacher subject area and teaching style. To complete the revisions, it is recommended that the teacher has, at minimum, a working knowledge of Moodle. The teacher should also be familiar with PBL practices and philosophy to maintain the intent of the unit and keep the PBL methodology. The desire to add content, or simplify the management of the class by usurping control of student projects would result in lost learning opportunities and growth for students.

The last recommendation is in the area of effectiveness. I have relied on research and past experience using a Project based learning methodology in a face to face setting to create this unit. I have not found a fully online example that uses PBL to compare my unit to and this unit has never been used in an online setting. In theory, the unit should encourage students to
develop 21st century skills, but evidence of this is not available. I would recommend further testing of the unit to determine whether the predicted outcomes are realized.

In conclusion, producing an online integrated unit using the Project based learning approach was a challenge. It was a constant struggle to find a balance between providing too much information and not enough guidance. Maintaining the integrity of the Project based learning philosophy, while creating an example unit for the audience of both teacher and student was tricky and I realize now that two sets of instructions for each lesson would have been much better. I regret that the opportunity to "test" this unit with student users to determine its effectiveness. I feel that the project is not complete without this evidence. However, because of my past experience teaching using a Project based pedagogy, I am confident that this unit adheres to the methodology.
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