How effective is using project-based learning with junior high students to achieve improvements in their academic results and schooling experience?

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Abstract

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Education is calling for students to become more diverse and educators are experiencing students that are more diverse as well. Project-Based Learning is a strategy of student led education that encourages engagement and educational motivation, and in return increases academic grades and promotes better school behavior. With current shifts in educational trends, one would consider using Project-Based learning in all facets of education because of the potential gains. Yet, why aren't educators using this method and how effective is using project-based learning with junior high mathematic students in regards to academic results and overall schooling experience? This paper acts as a study proposal that would challenge the notion that project-based learning leads to curricular success. This paper begins with reasoning into why an educator would consider using project-based learning, and in chapter 2, research that supports and refutes project-based learning is examined. Chapter three highlights the project proposal where eight classes, four being taught with traditional teacher led instruction and four classes taught with project based learning, will be cross-examined using the same assessments. Finally, this paper reflects upon learning experiences throughout the journey of the researchers study.

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Chapter 1

"Do we seek change for the sense of change or are we trying to get better?" (Milford, 2014)

Education can be recongized as a constant revolving door of new methods or strategies to teach our future generations. In my short six years in the career, I have already noticed that some teaching concepts that were popular in the past, jump into popularity once again in spite of many teacher's disgust of more change. It can seem like change in enivetable; we change how we teach, what we teach, where we teach and who we teach. Education seems to be in constant flux. For example, we live in a generation where the change in technology is constant. With technology, educators can branch out to a wider audience of students by using digital games and interactive whiteboards, use social media to further connect to students, and use the internet for the vast amount of useful and pedagogically helpful knowledge that it can provide. Yet, some of my colleagues still cringe at the idea of implementing technology into their classroom because they have seen other novelty approaches or learning strategies fail. Instead, some of my colleagues stick to what is comfortable to them, or how they were once taught. Typically, most of these educators comfort is in teacher led instruction; this is a typical didactic approach. This style of instruction has been used for hundreds of years, from elementary to university, and can be explained as a "model and repeat" approach to learning.

My experiences during in teaching have began to make me consider, why do we seek change? Is it because as educators we get complacent and bored with repeating the same lesson year after year? Is it because educators truly strive for the best learning experience for their students? Personally, I need to constantly change how I teach to keep myself feel fresh and current; in other words, keep me from teacher boredom. However, as an educator, I also want the best learning environment for my students as well. I believe that keeping my teaching styles and

techniques fresh, current and ever-changing, helps keep students fresh and excited to learn.

Over my six years of teaching experience, primarily in upper level mathematics, I have tried many techniques to help increase student engagment and increase academic success. In some classes, I have had students write on big glass windows with dry erase markers to help promote student movement, collaboration and curricular development. In other classes, I have created math songs to help with comprehension of material, or purchased small white boards for students to use in groups so they can write out their thoughts and share with others. I like the small white board idea, as students do not feel as nervous sharing on the small whiteboard compared to feeling nervous when standing infront of a class. I have tried multiple formative assessment strategies and exit slip ideas that would force students into reflecting on how comfortable and confident they are in a section in mathematics. Some of these ideas included checking homework, completing three question formative quizzes, having students teach questions and so on. Yet, many of these strategies seemed to only work short-term, or lose their effectiveness with overuse. Also, many of these teaching strategies had me the teacher, standing infront of my class and sharing knowledge that I have gained through my experiences. This was probably because I was taught mostly with teacher led instruction, so my comfort zone of what I'm used to is using teacher led instruction.

Part of me feels disconnected with the thought that even though there is 30-40 people in a classroom, only one person holds the title of teacher. Would it not be more meaningful if there were multiple teachers in one classroom. An environment where student engagement was not forced upon by the educator, yet intrinsically found within the student. A technique, or strategy that could be used to help students academically succeed and remember what they learned instead of cramming the night before to memorize a set of rules, facts or procedures. This all

sounds quite idealistic and perfect, but could there be a teaching method that fits my educational goals?

During one of my professional development meetings at the school where I teach, my department head in mathematics suggested that we do a project with our students. My department head was suggesting the idea of fascilitating learning, where multiple students can lead, instead of one teacher educating. The project could be curricular based or something that involves mathematics for fun. I decided to create a project for my grade eight math students that asked how math could be incorporated into art. By having the students study and question art, I really had tricked them into learning curricular objectives that I would had to otherwise teach. Students had to make their own mosaics on the computer or by hand, and make use of more then one hundred mosaic pieces and more then eight different colors in their mosaic. Once students completed the art component, they had to calculate ratios, convert to percentages, create equivalent fractions and eventually calculate the worth of their beautiful mosaics with GST. I watched as students who normally had their heads down or doodling on their desk/notebook, start to enthuasistically ask questions and exceed past what they would normally output in my classes. Without prompting, students collaborated as they quickly discovered it was the process, not the solutions that mattered. Multiple conversations were being had that were all on topic, and even a few students redid their project so that they could create a mosaic that could have a higher theoretical value. I went from teacher, to fascilitator of knowledge and the students from sit and memorize to create and explore. Was creating curricular projects the key link that I was missing that would help engage students, increase both behaviour and attitudes towards learning and also increase academic success?

Soon after, I partook in a seminar about project based learning (PBL) and learned how to

properly create and implement a project according to the Buck Institute's standards. I also learned the benefits of using project based learning and the multiple competency based skills that can be learned using projects. Furthermore, I saw that PBL was matching up to many of the current educational pedgagocial shifts within the Alberta Redesign like competency based learning, student collaboration, differentiation and higher-level thinking. I was motivated to go back to my classroom and convert multiple lessons into projects that students could work on, learn and grow. In this short while, I found that project based learning was the main topic I wanted to address over my next few years of teaching and was excited to see the benefits from my students. Excited to see the whole child education that could occur because of a switch from teacher led instruction, to student led instruction. I saw my main goal as an educator to help develop critical thinking skills and problem solving capabilities, social skills and personal confidence in daily activities. To me, these goals would be my rational to why I would put extra effort and time outside the normal work day into developing projects for my students.

As I started to develop projects for my junior high mathematic students, I found that it took a good amount of time to create one project. Compared to my previous approach, I quickly discovered that this new approach was quite time intensive. For example, I would find flaws within the design of the problem and have to re-create the project. In addition, I often felt that I had to bend my circumstances to fit my intended initial problem or that the math involved was too complex for junior high students. Right from the beginning, I began to uncover one of the problems with project based learning before I ever even gave out another project. I quickly discovered that creating projects for junior high math students, where the math involved is still not as abstract, was quite a complex and time consuming process. This left me with the questions as to how I could possibly and realistically use projects for when I teach math to grade eleven or

twelve students [math 20/30], where math is more difficult and abstract? The idea of doubt began to swell and many more problems began to arise. As I handed out my first project, I began to question how well the students understood the curricular goals that they were required to meet. I also began to wonder if students were unitentionally skipping over curricular outcomes that I would have originally taught as they worked through their projects. As I scaffolded instruction and helped students with their work, I found students were gaining misconceptions by listening to incorrect strategies provided through collaborative work. Already in the first project, I felt some hesitation with continuuing on and using more projects.

I finally hit the point where I began to question, is student led instruction more beneficial then teacher led instruction? In other words, was there an overall improvement in my foundational goals as a teacher in reference to increases in problem solving and critical thinking skills, confidence, social skills, and academic success within my students? I had come full circle in a relatively short time. This problem got me thinking more specifically in terms with project based learning. How effective is using project-based learning with junior high students to achieve improvements in their academic results and schooling experience?

The reason I am building a paper around the idea of challenging the effectiveness of project based learning, is two folded. First and foremost (and as previously mentioned), I want to be the best educator that I can be for my students. Secondly, I want share my findings with other educators who are also looking for solid and concrete methods or teaching strategies to help their students. In my experience, I have found that educators are often pushed or forced to try new teaching methods on a yearly basis from administrators or department heads. Some of the new changes in teaching can cause stress and frustration, while other changes are worth the risk and can be beneficial to both educator and student. With project-based learning being a new buzz

word, I would like to help educators see the possible value of using projects as a teaching tool or shine evidence on why project based learning might not be an effective route for students. By disputing the effectiveness of projects, I'm trying to save educators time to hopefully increase efficiency within their already busy profession.

In chapter two of this paper, I will be examining academic literature to help gain a proper definition for what project-based learning truly is and what it entitles. Chapter two will also help the reader to understand how to set up and implement a project, which can be insightful for educators who plan to create their own projects. A thorough explanation of why project based learning is re-circulating and becoming a popular educational buzz word will also be explained. Research will be pointed out in regards to the positive findings and benefits of using project based learning focusing on academics, attitudes, mastery learning, the use of technology, and student motivation. Negative findings in research, more specifically, projects based learning's time constraints, teacher versus student led instruction articles, and educators over-helping will be analyzed. Furthermore, the question why are educators not using project based learning will be examined along side with the negative findings in research.

Chapter three will highlight the project proposal and offer various tools that will be used while assessing the effectiveness of PBL compared to traditional teaching. Lastly, chapter four will reflect on the experiences that I have learned upon completing this project.

Chapter 2: Literature Review

> With the child naturally social and with the skillful teacher to stimulate and guide his purposing, we can especially expect that kind of learning we call character building. The necessary reconstruction consequen t upon these considerations offers a most alluring 'project' to the teacher who but dares to purpose *(*Kilpatrick, 1918, p. 10)

Introduction

To become better, one must take a risk and dive into something unknown. As in my personal experiences, often I generate more questions then answers. However, it is in questioning, that I learn. To become a better educator, questioning the strategies, tools and techniques used can help invigorate the day-to-day processes of teaching. It is also important to understand that not every change is for the better. This is why I question the effectiveness of PBL, and look to see if the positives that surround PBL outweigh any potential negatives. If positives prevail, I would like to incorporate this strategy into my classroom to help benefit my students.

Project based learning (PBL) is teaching strategy that is regaining the spot light in the educational field. Weil (1994) addresses the fact that in order to keep teachers and students inspired in education, new methods in teaching need to be constantly adjusted to stay current. The concept of project-based learning is not new, but is gaining attention in the educational field once again. The goal of this literature review is to answer, how effective is using project-based learning with junior high students to achieve improvements in their academic results and school experience? Effectiveness will be defined as the quality of achieving a specific intended goal or secondary unintended outcome. At the beginning of this chapter, a definition of what PBL is and what educational goals PBL achieves will be discussed. Academic papers regarding the

effectiveness of PBL will be examined, along side a debate whether traditional teaching methods are just as effective. Lastly, a look at what other challenges to the effectiveness of PBL for educator use will be uncovered.

What is Project-Based Learning?

John Larmer, who is an editor in chief at the Buck Institute for Education, has summed up PBL's basic premise as a student led open-ended authentic project that emphasizes the growth of knowledge and core competency skills like collaboration, creativity and critical thinking (2014). Today, The Buck Institute of Education is one of the front-runners who are pushing for the use of PBL in classrooms, however it was William Kilpatrick in 1918 that first challenged the idea of using projects for learning. Kilpatrick (1918) wrote how project learning helps create motivating or "wholeheartedness" and authentic work for students to be engaged in. Since then, many other academics have added to the initial definition laid out by Kilpatrick's beginning ideas of project learning. Jones, Rasmussen and Moffitt (1997) describe project-based learning as complex tasks that are authentic, curricular based, problem solving, examination and decision-making. Solomon (2003) expands the definition by including that PBL is often interdisciplinary and involves collaboration and reflection. Grant (2002) depicts PBL, as student centered learning where learning is not a linear road of specific learner outcomes, but instead an open and flexible approach where multiple subjects can cross. Through inquiry, students are able to collaborate and develop their own learning instead of led by teacher instruction.

Since PBL is learned through inquiry, students pursue knowledge through reflecting and asking questions. In order for students to begin to ask questions, they must be intrinsically motivated in order for a reflection to occur. As mentioned by Moursund (1998), students have a voice and control over how they "shape their projects to fit their own interests and abilities (p. 4).

This allows students to create content that may be more meaningful and memorable to the student, which begins to also suggest mastery learning.

How to Set Up an Effective Project

In order for student's academic results to increase, or for mastery learning to occur, one must understand how to properly set up an effective project. As the teacher is not leading instruction, their role is transitioned into a facilitator of knowledge. Larmer and Mergendoller (2012) and Thomas (2000) wrote up a set of essential elements to follow while creating an effective project. A key when setting up any PBL activities is for facilitator to create and pose an open and authentic question or task to their students. The task needs to have some relevancy, curricular goals and openness so that students can explore multiple possibilities, solutions and end products that can exist. First, students must learn the curricular goals or significant content through the project. This means that teachers cannot teach a concept and then assign a project. This takes projects from being a dessert, to projects being focused as the main course of learning. Secondly, PBL thrives on questions that motivate learning of curricular goals. This may require an educator to hook their students into the activity by showing a video, bringing in a special guest presenter or other modes for raising inquiry. The hook would lead into the main task of PBL that is often known as the driving question. The driving question is an opened ended question that encompasses a selected topic and is supposed to provoke thought and excitement. Third, PBL involves the construction of knowledge through problem solving, designing and discovery. Allowing students to construct their own knowledge lets students collaborate, communicate, critically think and use their own strengths to continue through their project. Fourth, the teacher is hands off while the students are hands on in their learning. This means that the educator has not scripted the construction of knowledge during PBL and waiting for students

to catch up. The educator will know the start, and have a set end goal in mind, however the journey in the middle is mostly student driven in-depth inquiry.

Thomas (2000) re-iterates that PBL needs to be authentic. If students feel that their task is a soap-opera problem that can be solved in fifteen minutes, then they will not be as motivated and challenged in their learning. Larmer and Mergendoller (2012) extend past Thomas by also saying that PBL needs to have an audience such as a group of parents, other students, a special guest judge or specialist to which the final product can be displayed. Blumenfeld et. al (1991) summarizes how to complete PBL with two main components, students require a question or problem that drives the activities, and that a final product responds to the initial driving question.

Why PBL Now?

In the dawn of our new 21st century learners, the educational field has been called upon to keep up with the learners of today. Alberta Education (2010), Inspiring Action on Education has pointed out "students should be able to access instruction in a variety of settings, times and at a pace that reflects their individual needs (p. 5)." Alberta Education's vision statement is "To inspire and enable students to achieve success and fulfillment as engaged thinkers and ethical citizens with an entrepreneurial spirit within an inclusive education system (p. 7)." With many changes occurring, why is PBL being called upon to help drive the new era of learning? Recently, Alberta Education has changed their pedagogical stance from traditional teaching practices to student-centered learning. Table 1 below is a representation of traditional teaching methods compared to student-centered, and depicts the pedagogical shifts that the Alberta government is pushing educators to strive for. Traditional teaching is often perceived as teacher led, rote memorization and student recall. Traditional assessments are based off of modeled work in class that can be reciprocated by students. Student-centered teaching is student led, where the

educator is a facilitator in knowledge. Learning outcomes are more open with focus on school content, however other competencies such as collaboration, the use of technology, and problem solving skills are developed as well. Since the education is student led, this opens the door to the differentiation and individualization of instruction, along with more opportunities for higher-level thinking.

Table 1.

Traditional vs. Student-centered Pedagogy

Traditional [old]	**Student-centered [new]**
Content-based	Competency-based
Recipient	Inquirer/Creator
Topic-driven	Cross-curricular Theme
Short-term Assignments	Project-based Learning
Memorization	Higher-level Thinking
Summative Assessment	Formative Assessment
Competition	Collaboration
Single Grades	Multi-grades
One-size-fits-all	Differentiation
Print-based	Multimodal (visual, digital, print)

PBL naturally aligns itself with many of the principles associated with student-centered education. Students can create, reflect, collaborate, problem solve and share responsibility in their learning. PBL has the ability to personalize education, which would also fit into Alberta Education's goal for inclusive education.

Many academics such as McRae (2010) and Peters (2009) share the viewpoint that education needs to be transferred from the industrial model of education, to personalized learning so that the specific areas of strengths and weakness from students can be addressed and adjusted. Once adjusted, individual learning can be based off of the student's specific needs. As described by Keefe (2007), today's education is focusing on the personalization of school to the student, compared to a factory of mass education. Alberta education is looking to personalize education for each student and their intellectual abilities, otherwise known as differentiated instruction. PBL allows for differentiated instruction and for students to be unique and creative while educators facilitate specific and individualized learning.

As stated in Alberta Education (2010), Inspiring Action on Education, PBL naturally fits into their description of what a 21st century learner should be.

> Learning in the 21st century requires relevant and empowering experiences for all young Albertans. There is a need to broaden what students learn, when they learn, where they learn, how they learn, and the rate at which they progress in achieving learning outcomes. Personalized learning involves the provision of high-quality and engaging learning opportunities that meet the diverse needs of all learners, flexible timing and pacing, through a range of learning environments with learning supports and services tailored to meet their needs (p. 14).

The Good News on PBL

"Project Based Learning is so important because it involves the whole child" (Burton, 2014). When judging the effectiveness of PBL, one would have to understand that PBL reaches various learning outcomes and skill sets. Thomas (2000) dissects the learning outcomes into different fields. The first is academic achievement on standardized achievement following the

use of PBL. Followed by an evaluation of building problem solving skills, an assessment of specific skills learned, and surveys collected that asked both students and teachers to rank the effectiveness of PBL.

Academics. Most educators would look at the academic grades to suggest whether or not a new teaching method is working or not. Thomas (2000) summarizes a study conducted by New American Schools Development Corp (1997) and discovers that "…nine out of ten schools that implemented Expeditionary Learning [also known as PBL] in 1993 demonstrated significant improvement in students' test scores on standardized tests of academic achievement" (p. 10). Looking into some of the schools that follow PBL learning strategies, Nichols-Barrer (2013) compared the results of reading and mathematics scores. He noted that after three years, students moved from the 50th to 56th percentile in reading and 56th to 61st percentile in math. These results were still extended further the longer the students stayed in the program.

Schneider, Krajcik, Marx and Soloway (2002) took a classroom following PBL strategies in science and matched them up with other sample classes that had similarities with each other. The PBL science classes outperformed others who studied using traditional teacher centered teaching by 44% of test items. Simons and Klein (2007) also mirrored the same conclusions as their study showed that students who were put in PBL settings had greater academic achievement in testing scenarios than non-PBL students. Lastly, The Buck Institute of Education (2014) also showed evidence that student academics, critical thinking, problem solving skills, and collaborative skills are improved with the use of curricular projects by quoting studies by Boaler, 1997; Penuel & Means, 2000; Stepien, et al., 1993.

When looking at reasons why PBL might increase academic grades, Bartscher (1995) used a multi method approach of using teacher surveys, journal entries and check lists to

determine whether or not PBL helped increase student motivation and academics. Bartscher (1995) reported an increase in homework completion and continued to write that student's portrayed improved motivational levels, which converted into higher completion of homework and increased, quiz and test scores. An interesting note is that homework completion increased within these students as a potential by-product of PBL.

These studies were picked to represent supporting evidence that PBL effectively increases school academic results. This does not necessarily represent PBL increasing academic results in all cases. Alternative findings will be discussed with in the drawbacks of PBL section.

Attitudes. When assessing the effectiveness of PBL, academic results are a good indicator to measure success. However, PBL also can affect skill sets and attitudes that may not be measured using standardized testing. One of the major positive attributes associated with PBL is the engaging and motivating factor that encapsulates learners. Ames (1992) discovered that students who possess a motivational drive that focuses on learning and mastery of subject matter have a higher potential to stay focused with schoolwork than students who merely complete assigned work. Additionally, Blumenfeld et al., (1991), points out that PBL has variety, student choice and authentic problems that promote students interest in a topic.

One of the major problems in education is motivating and getting low-achieving students to succeed (Ames, 1992). Often these students are re-routed into lower level classes, where they are not challenged or develop mastery-learning skills. Furthermore, many of these students truly believe they are not capable of curricular intellect. Zohar and Dori (2003) helped show that when low achieving students are challenged with higher order thinking problems, they might not approach the class average expectation, however perform academically better from being engaged in their learning. Doppelt (2003) studies also showed a pattern of fewer low-achieving

students as the students progressed through continual years of project-based learning. The Academy for Educational Development (AED) looked at attendance rates and saw PBL participating schools increase attendance rates over 90 (1999). One elementary school in Cincinnati increase attendance rates from 75% to over 95% after the implementation of new programs. Not only did The Academy for Educational Development note increased attendance, but also founds reduced rates of disciplinary problems as well. Doppelt (2003) discusses that overall, low-achieving students are often low in confidence and lack academic self-image. Doppelt studied 54 low-achieving junior high students who were switched from traditional teacher led science classes to PBL science. At the beginning, many of the students lacked motivation and reported low academic results. As the three years progressed in PBL science, students reported higher interest in school and greater self-confidence in their academics. All 54 the students passed their standard matriculation examination with the help and renewed motivation for school.

Another group of students worth acknowledging in regards to PBL are students who have learning difficulties or learning barriers such as English language learners (ELL). Since many PBL activities are collaborative and communicative, it allows an ELL student to ask their teacher or working partner for clarification or definition. Most importantly, it gives an ELL student time to process the English barrier and focus on the content to be learned. Since PBL projects are open in nature, this allows ELL students to use multiple resources to help with their understanding and multiple methods to show the intended content as well. PBL challenges students to use resources and methods that may not have been presented by an educator. ELL students using PBL can look to challenge themselves to learn a language quicker, instead of avoiding embarrassment and remaining unheard.

Meyer, Turner, and Spencer (1997) isolated two groups in their study, challenge seekers and challenge avoiders. They found that students who embraced the challenge seekers role flourished with PBL, while challenge avoiders were not confident and often used minimal processing strategies but still faired better than traditional teaching centered education students. One might make the assumption that the challenge avoiders would be the students who were considered to be low-achieving students. Surprisingly, Meyer, Turner and Spencer (1997) found that many of the challenge avoiders tend to be students who are considered textbook smart and at first struggled with the idea of not being spoon-fed knowledge. Many of the challenge seekers and avoiders collaborated and communicated with each other as they developed their knowledge. From experience, some parents do not like high and low level students collaborating as they feel it deters from the learning experience. Cheng, Lam and Chan (2008) discovered that collaborative groups raised the efficacy of lower achieving students without diminishing the abilities of higher achieving students. Students who work together are better at resolving problems and understanding multiple perspectives (Cheng, Lam & Chan, 2008). Furthermore, some of the skills learned while grouping both challenge seekers and avoiders are patience, empathy, management, and teamwork. These are skills that may not reflect in academic grades, but are critical in daily living and can help increase the ability for mastery learning.

Mastery learning. One of Alberta Educations goals is for students to excel in mastery learning. Part of mastery learning is increasing critical thinking skills by using higher level thinking, as well as increasing problem solving skills within students. Shepherd (1998) used a nine-week study to determine whether PBL helps with critical thinking skills. At the end of his study, he noticed that the PBL group exceeded the experimental group on a test of critical thinking skills or The Cornell Critical Thinking Test. Since PBL allows the use of multiple

methods to find, create or show a student's knowledge, students are more apt to master their learning. PBL offers the use of technology as a tool for students and gives students voice and choice in how they represent their knowledge. Furthermore, PBL helps develop creativity and innovation within our students as they must analyze, plan and construct their own concepts of what a curricular specific learner outcome might look like. Boaler (1997) conducted a study that tested junior high students in a national mathematics exam that highlighted both procedural and conceptual questions. Procedural questions are often rote memorization; while conceptual questions are more in-depth and involve critical thinking skills. Students taught with PBL outperformed traditionally taught students both in the procedural and conceptual questions. Interestingly, when Boaler surveyed, students from the PBL school he found that students saw math as more meaningful, flexible and useful. When Boaler interviewed traditionally taught students, the students saw math as inert and unimportant. PBL helps students to see a purpose in learning, and allows students to create their own appreciation of subjects being studied.

With the use of PBL, students are able to develop critical thinking skills to help with maturing processes as a student. Bell (2010) found that PBL helps students become independent learners. Independent learners involve learning effective planning and organization skills, an increase in collaboration and social skills, and intrinsic motivation for learning. These traits are often sought after by employers and are much more attractive in the work force. Horan, Lavaroni and Beldon (1996) looked at critical thinking skills that involved formulation, prediction, producing, assessing, and reflecting, and observed an interesting revelation in reference to high ability students and low ability students. The high ability students were recorded completing critical thinking skills more then 50% then the low ability students. However, the low ability students had increased their critical thinking approximately 446% compared to when taught

using traditional teaching methods. This means that the higher ability students were still being challenged, while the low-end students were developing skills at a faster rate. Part of the reason that PBL affects critical thinking skills is because students are able to construct information and reflect it outwards by using a personal project. When comparing PBL to traditional teaching methods, students advance their own understanding of a driving question of a specific topic with PBL, compared to a lecture that is to be reciprocated on what a teacher modeled. Reciprocated steps can be easily forgotten and lead to students falling behind in their grade level.

A common frustration that teachers experience is re-teaching a concept that has already been covered in previous courses. A prime example is re-teaching addition and subtraction of fractions throughout grades seven to grade twelve. The frustration stems from students not retaining content as they progress from grade to grade. Kvam (2000) performed a study between two courses and found that participants who were taught using PBL strategies performed better immediately after the course was finished, and also eight months after the course was finished compared to students who were taught by using traditional teaching methods. Kvam's study is one example that suggests that PBL helps increase the retention of knowledge in students. Since many courses build on previous knowledge, it is beneficial for students to be able to retain course curriculum for future expansion.

Technology. Many new school initiatives, like Alberta Education (2010), Inspiring Action on Education, has pointed out the need for students to develop technological skills and abilities. Kleiman (2001) recognized that over a decade ago, introducing computers into the classroom helped teaching by enhancing "student autonomy, more collaborative work both face to face and online, more global connections, richer learning resources than traditional textbooks,

and more inquiry, interdisciplinary, and project-based learning" (p. 3-4). Project based learning allows students the opportunity to use technology as a support to their learning.

With the use of technology, students can interact with others online, and educators can interact with guest presenters that would never have made a presentation in person. Using technology, like Skype, allows both educators and students a chance to ask notable specialists questions that can both hook student's interest or help lead inquiry based lessons. Using the Internet during projects, students can look for information by reading websites and blogs or watching videos. Having multiple perspectives or ways of explaining a concept and twenty-four hour access to information allows students to inquire when they have questions or are ready to learn. There are many online learning communities such as Edmodo that connect educators, parents and students together. Blumenfeld et al. (1991) adds to the discussion that technology can make to student development and learning. These researchers find that technology can enhance interest and motivation, provide access to massive amounts of information, allow active representations, structure process with tactical and strategic support, diagnose and correct errors instantaneously, and manage complexity and aiding in production.

As mentioned by Harris, Mishra and Koehler (2009), incorporating technology properly into projects has the ability of mixing together technological knowledge, content knowledge and pedagogical knowledge together to create technological pedagogical content knowledge. Harris, Mishra and Koehler (2009) further their discussion by explaining how each piece of technology made available creates different effects on human's ability to think or solve. By allowing student choice, in how they present, create, research and inquire, educators give students the power of knowledge and control of student learning which truly exercises their thoughts and knowledge.

Exercising the brain. Giving students the opportunity to research, inquire and presenting requires them to physically move around as well. Moving forward with effective techniques for students in school, Dr. Dieter Breithecker's keynote presentation, "Brains in motion, bodies in motion," (personal communication, October 17, 2014) discussed his studies in which he found for students to learn, they must move. Whether this means moving around a classroom or having a yoga ball like seat, students need movement to stimulate the brain. In his lecture, Dr. Breithecker mentioned that using project-based learning allows students to move, collaborate and gives students a chance to get out of their desk. Movement while thinking stimulates engaged thought, and prolonged critical thinking moments. Prolonged critical thinking can bring extreme satisfaction into learning.

The Joy of learning. As students progress through education, it feels like there are fewer students who thoroughly enjoy learning. One could make this assumption by looking at the sheer amount of educational articles written about increasing student motivation or improving behavior. PBL, as referred to by Doppelt (2003) found that students self image and behavior improved as there enthusiasm increased in class. Since PBL drives on student motivation, Doppelt felt that PBL helped reduce behavioral problems. PBL offers students a chance to use technology, create and truly be innovative in their presentation or collection of knowledge. In return, this engagement brings back a passion to learning. Barab et al. (2005) writes "Given that children's play spaces have been constrained from several square miles to, in some cases, a mere electronic screen and moreover, given the potential consequences of this shift in children's activities, it is imperative that they be provided with the means for safe and productive play" (p. 104). As mentioned by Bartscher (1995), Ames (1992), Boaler (1997), project based learning draws in student's interest and lets them play with learning.

In summary, PBL has high hopes for increasing student academics and behavioral issues. Students who inquire about issues that are authentic and relevant can increase their motivation, which brings prolonged critical engagement and fun back into learning. PBL helps with many learner profiles by allowing students to have a voice through outlets like technology, or extra time to process a concept. With many positives of PBL presented, why are not more educators using PBL in their classrooms? In the next section, the drawbacks of PBL will be examined.

With So Much Good, Can There Be Bad?

As there are studies that show supportive claims for using project-based learning (Hmelo-Silver, 2004), there are others that can highlight PBL not working as well. Although, it was slightly harder to find papers written against PBL, the limited evidence that did exist showed that time devoted to PBL could outweigh the actual benefits, educators often did the work for students instead of exploration, direct instruction produced better results, and problem solving skills are not enhanced with PBL. In the next section, these problematic issues will be discussed.

Time constraints. Kirschner, Sweller and Clark (2006) write, "Any instructional procedure that ignores the structures that constitute human cognitive architecture is not likely to be effective. Minimally guided instruction appears to proceed with no reference to the characteristics of working memory, long-term memory, or the intricate relations between them. The result is a series of recommendations that most educators find almost impossible to implement and many experienced educators are reluctant to implement…"(p. 76). Depending on the subject and/or topic, PBL is not always the ideal way of instruction for many educators. If students have no prior knowledge to a topic, and an educator is expecting students to be engaged, the development of learning may not occur. Often, creating authentic projects, for example in math, would involve enormous amounts of time and concepts that well exceed the difficulty of a

course or learning objectives. Keegan and Turner (2001) feel that too much time is needed to devote to PBL and that the time devoted is not efficient in the returns or final product. Since the amount of time is a concern with PBL, Keegan and Turner (2001) argue that the overall quality of learning and product suffers. Thus, PBL is an argument of quantity over quality where students are limited with the constraint of time that impedes their progress in their project and learning.

Let me do it for you. Aulls (2002) examined teachers as they performed PBL. In his field notes, he noticed that teachers began scaffolding instruction as students got confused or lost their progression in PBL. Aulls (2002) field notes included that teachers spent a great deal of time scaffolding instruction, modeling procedures, pointing out key information for the students, summarizing information and having students take notes. Aulls describes a teacher posing a problem, and solving the problem for their students. This does not present true problem solving capabilities, and does not promote the skills PBL supposedly builds. According to evidence built by Blumenfeld and Meece (1988), students do not particular respond well to high-level tasks by using increased amounts of learning strategies. Furthermore, many students shut down to the idea of high-level tasks. As noted from before, challenge avoiders would not flourish in the realm of PBL. Brown and Campione (1994) reported that students learning with inquiry based methods (PBL) often became shut down in their learning and frustrated. In addition, students developed many misconceptions that remained uncorrected, as the students doing the research could have uses faulty sources. Even though educators facilitate throughout the project to check for student understanding, errors in learning went un-noticed because of the vast amount of steps involved in each individual project and the amount of students in a class.

Direct instruction is simply better. In a meta-analysis by Albanese and Mitchell (1993), testing between traditional and PBL teaching found PBL producing lower achievement on exams, and longer studying time for students. If students find that they are constantly taking a longer route to learn, they eventually will lose focus and as a result, produce lower grades. In a similar study, Berkson (1993) mirrored the same results as Albanese and Mitchell by documenting no significant increases or benefits gained by PBL students compared to traditional taught students. Many studies have been conducted [Moreno (2004), Schauble (1990), Chall (2000)], that concluded that students gained a stronger understanding of curriculum through teacher led instruction compared to discovery based learning like PBL. In these studies, it was often noted that PBL would be used as instructional time to help students lost in the process. In Klahr and Nigam's (2004) study, they found that "with respect to the focal skill of designing unconfounded experiments in simple contexts, these results replicate other studies in which Direct Instruction was clearly superior to [PBL] Discovery Learning in children…" (p. 6).

Problem solving skills. Lastly, PBL claims that it helps develop logic and reasoning skills. In a paper written by Arocha and Patel (1995), they discovered that PBL students could perform backward directed reasoning, however struggled at forward directed reasoning. Just as there are many supporters of PBL, there are many critics of PBL that claim that there are no true steps forward with academic grades, and that valuable teaching time would be better used by teacher led instruction.

In summary, the time needed to devote to the creation, exploration and reflection have many educators turned off of PBL. For educators, it is also difficult to see students struggle and consistently get incorrect results, which causes many educators to help students a little more then they should. This sense of cheating, nullifies the true purpose of using PBL as a learning

strategy. It is important to not only consider the affects on students, however the affect on educators as well. In the next section, a closer look will be done to see some of the challenges educators face while implementing PBL.

Challenges of Implementing and Using PBL – Why Are Educators Not Using PBL?

With so much evidence supporting the use of project based learning, why isn't every educator using it? Part of asking whether project based learning is effective with junior high students is also understanding the effectiveness and usefulness that teachers find with project learning as well. The Buck Institute for Education compiled a list of reasons why teachers claimed project based learning was difficult to use. Some educators found that projects were time-consuming and felt that class time could have been used for further questions, summative and formative assessments. Many teachers felt that they could not control the flow of information. After asking a driving question, which can be general, narrowing the students down to particular learning objectives can be difficult. It is hard to scaffold to each specific student when one does not necessarily know what step they are at. This coincides with the difficulty in finding a balance between helping a student and given them independence and control of their learning. Since students do get independence, some PBL classes can feel loud and disorderly, which to some, is not a good learning environment.

Part of a good learning environment can be using multiple methods or tools to initiate learning. One of the benefits of using PBL is the use of technology, however as Barab et al. (2000), mentions that it can be a monetary and time sharing challenge to integrate technology into schools. If many classes are using PBL as a learning method, finding time in computer labs might be difficult as booking computer labs are often by whoever signs up first. Further, Marx et al., (1997) found that many teachers struggled to incorporate practical new technology and

design authentic assessments for students. Barab et al., (2005) continues to explain that the Internet provides much information, but at the end of the day is only a tool and can only be as good as we make it to be. It is important to maintain focus on the key learner outcomes, as learning is the main goal, not using a new software program.

Another key element of PBL is the ability to engage and motivate student learning. Bartscher (1995) writes that as students progressed through school grades [grade ten was her highest case study level], student motivation was not as effective, which meant that the projects needed to be adjusted to be more relevant or challenging. Creating authentic and engaging projects can be severely difficult as student's progress through school. Another challenge in implementing effective PBL as stated by Ladewski, et al., (1991), is figuring how much freedom to give students to explore, while still making sure to cover all curricular learning outcomes. Furthermore, how much support should be given to students without providing the correct answer in order to empower student learning? Students learn in PBL by creating mistakes, and often teachers need to let mistakes happen in order for students to learn. Since letting mistakes happen is an important process, it is hard to move onto another step or topic with a group of students because they might all be at various stages in learning. There are many gray areas like grading projects, student autonomy, amount of time and help given, which challenge both students and educators during PBL.

Assessment of PBL can lead to potential mark discrepancy. Creating a rubric that would be fair to all students can pose as a challenge, as students return various modes of presentations or multiple different possible solutions. Creating a fair rubric might make some educators question the validity of a mark in terms of content comprehension. Often, a summative quiz or test would be used to confirm the PBL project mark to compare discrepancy. However, doing a

summative assessment nullifies the importance of a project, as students are often more concerned with studying for a test. PBL has its inconveniences and drawbacks like any other teaching method; whether the positives outweigh the negatives is an important discussion when considering the effectiveness of using PBL to increase the overall school experience.

There are many challenges that teachers are faced with when trying to implement PBL. Creating authentic content that is relevant and challenging for students can be difficult and time consuming. Adding technology to specific learner outcomes can often lead to focusing on the tool, instead of the product. Lastly, assessing PBL projects can lead to discrepancy and inequality in marking. Overall, PBL if done properly can be an extremely rewarding method of teaching, however, PBL must be practiced until it is made perfect. Practice can be difficult, and time consuming which can turn many educators off of the idea of project based learning and back into their comfort zone of teacher led instruction.

Conclusion

Project-based learning is student centered, inquiry based education. It promotes core competencies such as collaboration, reflection, critical thinking skills and creativity. In studies, it has shown to increase academic marks, improve behavior, develop stronger homework work ethic, increase student interest and motivation and help retain content knowledge longer then traditional teacher centered techniques. PBL has had evidence supporting the use of it with students who are low and high achieving, and English language learners. Hmelo –Silver (2004) sums up the strength and worries of PBL by saying "certain aspects of the PBL model should be be tailored to the developmental level of the learners…there may be a place for direct instruction on a just-in-time basis. In other words, as students are grappling with a problem and confronted with the need for particular kinds of knowledge, a lecture at the right time may be beneficial" (p.

26-261). A strength that lies with PBL is how students are the constructors of knowledge, which can be done in a multitude of methods, and the strong motivating factor PBL can possess. Other critics are concerned with the effectiveness of PBL in regards to academics results being slim to none, hard to effectively implement, and a time waster. Overall, project-based learning provides an opportunity for students and educators to step out of what is normal and comfortable, and into something exciting and unknown.

In the oncoming chapter, the design of the proposed study will be explained. Assessment tools that will help assess the study will be shared and critiques of the researching team will be explored.

Chapter 3

Studies done from Project based learning have shown great success within creativity, motivation and problem solving abilities, but also have shown negative impacts on student academics, and an increased perplexity as subjects become more abstract (Scaffa & Wooster, 2004). Even with many studies completed, PBL is still questioned on whether it is a valid learning approach. More specifically, PBL is challenged on whether it is successful within all school subjects and grade levels. In the next chapter, a project proposal for a study to find whether junior high mathematics can be more successfully taught using PBL compared to teacher led instruction will be explored. Mathematics is traditionally a model and repeat subject, yet how well can students perform when the modeling aspect is removed and problem solving and collaboration moves in? In order to achieve this study, data sources and collection techniques will be analyzed, along with reliability and validity of the sampling techniques. Eight classes will be used in this study, where four student groups will learn through PBL and the other four student groups will learn through teacher led instruction. A multiple choice and written response pre-assessment, end of chapter summative assessment, and mastery learning post assessment will be used to analyze students learning. Video taped classes, interviews with students and teachers, and questionnaires will be used to get further details during the study. In chapter four a concluding reflection will bridge together the papers work on the effectiveness of PBL in schools.

The Proposed Methodology

PBL is an extremely intriguing approach to learning. One cannot help but think that a study done on project-based learning is in fact project-based learning itself. In order to seek the benefits or downfalls of PBL within a school scenario, multiple students or classes would have to

be tested simultaneously. For this studies purposes, Junior High mathematics classes would be used to help conduct the study. Both PBL and teacher led instruction focus on the student discovery of educational understanding. However, both PBL and teacher led instruction have completely different methods in how students go about in obtaining comprehension of a particular curricular topic. Student comprehension can be measured in many different ways, however for this studies purpose, a series of multiple choice, short answer and written response tests would be used to measure the success of a teacher style. Ideally, multiple classes would be used to increase the variance amongst the students and control for the external validity of findings. I would propose to use eight junior high-grade 9 classes of 30 students each to study the effects of using PBL compared to traditional learning.

To know where someone is going, we must understand where they start. An assessment of prior knowledge would be completed with all students. This multiple choice and short answer exam would assess student's previous knowledge of content that would lead into the new chapter. For example, surface area is taught in the grade 8 curriculum and grade 9 curriculums. An assessment would be completed to see how much of the basics from grade 8 are comprehended and where certain misconceptions are happening within their work. The formative assessment could test the basic use of area formulas, or challenge students with a more complicated problem solving composite object question with multiple shapes that are put together. A pre-assessment would start to give a picture to the researchers of what skills, comprehension levels or misconceptions that students may already have of a particular topic. Since many classrooms don't necessary have "perfect learners," taking note of special learners such as students with learning difficulties, or language difficulties might provide helpful or hypothesis generating data for future studies. Initial statistics of students with learning

disabilities such as students on individualized learning programs or personalized learning programs, students who classify as English Language Learners, student's historical grades would all be analyzed and recorded. Since the researching team will be using school classes that are already in session, not every class in the study will have the same amount of language learners or students with learning difficulties. Since there are varying amounts of these students, some of the data might be skewed, however not taking account of these special learners may lose valuable data that could be used for future studies.

Once the assessment of prior knowledge and student background checks were completed, a researcher would separately sit down with an instructor of both groups (teacher led instruction and PBL instruction), to make sure that the same curricular goals were being tested. A specified chapter would be picked beforehand, for example Chapter 4 Surface Area, and checklists would be created in order for instructors to develop curricular appropriate lessons. Furthermore, the researching team would record notes that explain whether the instructor is using PBL or teacher led instruction and how the instructor plans on presenting the curricular goals during their lesson. Video recordings of both classes being taught would be recorded and used to highlight any significant findings that could be questioned and elaborated on as the study progressed. Once a chapter is completed, a test date would be picked that would be fair to both sets of study groups. This way, one class does not get two weeks compared to one month on one topic. A standardized multiple choice, short answer and written response exam would be administered to all groups to see if curricular goals were comprehended. Results would be analyzed and categorized by looking at mean scores and comparing the success rate of students that passed and failed, excelled with honors or showed improvements from their school awarded average mark. A follow up videotaped semi-formal meeting would be conducted with randomly selected students

from specific subgroups (such as students with disabilities, English language learners, failing students, and students with honors). If the student decides to participate in the meeting, students would be asked to share their experiences in the process of learning in regards to what they felt throughout the chapter being learned.

A short exit slip checkbox questionnaire would be handed out for students to complete in order to further evaluate personal reflections on the style of teaching they were exposed to. The questionnaire would allow researchers to ask certain qualitative questions based on the experiences that the students had as they progressed through the chapter. Getting the opinion of students is important as they can help suggest what worked or didn't work and why something did or didn't work for their learning. In order to check critical thinking and problem solving, a task would be given to all students that would involve the curricular goals they learned, however displayed in a new and unfamiliar way. One class would be dedicated to this task, where students would need to create a solution for the new problem. Lastly, a summative assessment with multiple choice, short answer and written response would be administered a few months later, to see if one style of teaching led to an increase in information recall then the other. Testing students a few months later on the same content could help assess whether or not students had mastery learning in a curricular outcome. In short, the study will test students prerequisite knowledge before the chapter begins, see how the students feel as they progress through the chapter by conducting interviews and handing in questionnaires, examine how the knowledge learned can be applied to a new scenario via a task based assignment, test how students perform after they complete the chapter by writing a summative test and lastly, if the students can remember what they have learned by having the students write a follow up exam two months later.

Research Design

Since there are many students that are being subjected to this study, it is important to consider the vast amount of learning experiences that can happen. Each student can be thought of as an independent variable, as there are thousands of factors that can contribute to a student learning; such as whether they ate breakfast or not, having problems with peers, a students home-life, involvement in extra-curricular activities, or going through daily teenage problems like puberty. Since this is the case, this study has the potential to be hypothesis generating and hypothesis testing, because of the many outcomes that each student can portray. Each student's success or failure can lead to many more studies. Looking at the big idea of this paper, the goal of this study is to test the effectiveness of using PBL teaching strategies compared to traditional teacher led instruction. In this regard, the paper will be following a research design of hypothesis testing, as we will assume that PBL has positive effects on children. As previously stated, this study will have elements of exploratory research as the study will help generate new ideas on why PBL does or does not work, and will raise new questions on what age levels or subject areas project-based learning should or should not be used in.

Throughout the study, a mixed research design will be followed. Quantitative measures such as standardized exams will be used to accurately retrieve prior knowledge results, summative information once the educator taught using their allocated teacher strategy, and a check on mastery learning a few months later for information recall. This data will be analyzed using regression analysis to see if there are any correlations between the data. Since learning has many factors involved with it, qualitative data will be collected in the forms of open-ended exit slip questionnaires and video recorded meetings. Some of the benefits of PBL do not translate over to academic marks, such as improvements in confidence, motivation or problem solving

skills (Mitchell, Canavan, & Smith, 2009), which can be hard to examine by looking at exam scores. When trying to capture the effectiveness of a teaching strategy like PBL, it is important to catch as many benefits or downfalls as the researcher can notice. This is why a mixed research design was chosen, so that the study can be all encompassing.

Data sources

Using a mixed research design process requires collecting both qualitative and quantitative data. For qualitative primary research data, sources will be taken from individual teacher interviews, small focus student group interviews, researcher observation, and open-ended exit slip questionnaires. The individual teacher interviews and small focus student groups of 8-12 students would be video-recorded and transcripts of conversations would be made. For the most part, any meeting that would be arranged would be mostly structured with pre-determined questions. Some questions asked could include; what did you find challenging throughout the unit, what is something that you enjoyed about how you were taught this unit, did you feel motivated to learn with how you were taught? Keeping a part of the meeting unstructured allows for flexibility in the questions asked. This is important to keep in mind, as part of the purpose of the study is hypothesis generating. Field notes would be created while teachers taught and personal observations would be recorded.

For quantitative primary research data, formative and summative assessments that contain multiple choice, short answer and written response would be used to evaluate the intended goal of the study. These would be administered at the beginning of the study, at the end of a unit, and a few months after the unit has been completed. While observing an educator teaching the lesson or from video recorded classes, mechanical observations will be recorded, like “How many times is there a question directed toward an instructor?” This means that some

of the observations will be structured with specific outcomes to be observed. Short and closed ended quantitative questionnaires or checklists would be given to both teachers used in the study and students in order to help align the aims of the study. Pictures and short videos would be taken of any projects created by students that displayed their learning. Secondary resources such as historical grades, years at the school, or previous accounts to learning would be taken into consideration. Many of these data requirements for records would either be printed off a school system, or completed in a short answer questionnaire. Since the study would test the effects of a control group and a group subjected to PBL, one might suggest the use of an experimental approach. Since there are too many variables that can affect the control group and test groups individually or simultaneously, this study will stay away from using an experimental approach. Instead, the study will draw upon the data collected and draw conclusions based on the evidence collected from each subset of data.

Examples of the formative assessments, exit slips, summative assessment, group interview questions and task-based project are included later in the chapter and at the end of this chapter. The summative assessment was created using ExamView Test Generator, along with Pearson's Math Makes Sense 9 program. Special permission would have to be granted in order to publish the pre, post and summative assessment that would be used in the study.

Sampling techniques

Since the research design involves both quantitative and qualitative data, separate sampling techniques must be used to frame the data. The population being studied is the eight classes of approximately thirty students each, and the instructors that were involved in giving the lessons as well. In the quantitative sampling approach, a census of all students willing to participate would be included (all students whose parents signed and given permission to be included in the study).

Since all the students participating would be completing exit slip questionnaires and writing standardized assessments, direct element sampling would be conducted in order to represent the entire population. The sample size in the study would be dependent on the number of teachers willing to participate, and ideally multiple environments or schools would be involved. Ideally with classes' sizes at 30 students, and using eight classes, 240 students would be involved in the quantitative sampling. If only one school could participate in the study, 4 classes of 30 students, or 120 students would be the planned sample size. The participating teachers would be more involved in the qualitative portion of the research and not be as involved in the quantitative data.

When dealing with the qualitative data, a purposive sampling lens will used as a researcher deciphers data. As the study shifts to the focus groups that were created by using a stratified random sampling technique, a maximum variation-sampling lens would be used by the researchers to see all angles of the meetings and information collected. As classes are being taught and field notes are being written, a critical case sampling lens would be used as a filter in order to question the successes or failures that the group or teacher is experiencing. Lastly, since the sample frame is a particularly small representation, a total population sampling strategy would be involved for parts of the study, such as questionnaire exit slips, checklist responses, standardized exam results, or videotaped lessons. A mixture of random stratified and entire population sampling would be chosen for the study to bring out the best results from the data. Since the study is working with a smaller population, an entire population would be studied to see how classes that were taught with PBL compared to classes who were taught with teaching led instruction. Furthermore, random stratified sampling would be used to make sure that all the student groups such as, students with honors, failing marks, learning difficulties or English language learners are fairly represented in the study.

Data collection techniques

To begin collecting data for our study, historical records of student's grades and years of schooling attending the same school will be collected prior to the study starting. Sending home student permission forms will be needed in order for records to be used and accessed by researchers, getting allowance for students to participate in a study, and allowance for students to be videotaped and interviewed. An example letter for parental consent would appear like in figure 1 below.

Figure 1.

Parental Consent Letter

Dear Guardian,

We are conducting a study out of The University of Victoria that tests to see whether project-based learning, a method of learning that involves using projects instead of teacher-centered education, is effective and valuable to children's education. If given consent, by signing below and returning to the school, you allow our research team access to your child's historical and current grades.

Your child will follow normal curricular lessons that are taught by their normal mathematical teachers. Students will be chosen at random to participate in small group meetings that will take approximately 30 minutes or one lunch hour. Some of the classes and meetings may be videotaped to help researchers collect additional data upon reviewing. Any information collected will be considered highly confidential and no body other then the research team will see any of the data. Any information recorded will be destroyed upon the completion of the study.

If there are any questions, please call 780-555-4433 and we would be happy to answer any questions or concerns that you may have.

I _____ give consent for my child to be part of the project
Parent Consent Signature
Based learning study that is being conducted by The University of Victoria

In order for the study to occur within school grounds, district permission would also be asked in order for the study to be approved within the district. Special arrangements would have

to be made for any students whose parents would not want their child to be part of the study. Meetings would be scheduled with teachers who are partaking in the study, two to three times a week. Ideally, the meetings would happen after school or during lunch hours and would consist of individual and group conversations. Most of the meetings would be semi-structured, so that an intended goal could be met. Having meetings semi-structured allows for flexibility and new insight through in-depth led conversation, but also honors both the researcher and teachers time.

An introductory meeting would be held with each teacher and a calendar of days taught would be organized so that the researchers could be present and prepared. During the introductory meeting, expectations of each teacher would be discussed in regards to teaching by the selected style. A teacher who instructs using teacher led instruction and a teacher who instructs using PBL will be arranged. Teachers are to keep journals, which can be filled out daily to map their thoughts and express any comments, frustrations or successes throughout their days. Journals will be collected towards the end of the study, and the teacher's experiences and comments will be summarized and used for qualitative research. The following template, figure 2, would be used for daily instructor reflections.

Figure 2.

Daily Written Researching Team Reflections

Daily Reflections Date:_____ Lesson Number:_____
What was the curricular goal that you were meeting today?
Was there anything that stood out during today's lesson?
Was there any student that stood out or captured your attention? Why?
What activity or part of your lesson did you find the most difficult today?
Did you feel that students were engaged with your lesson?

What would you change during today's lesson?

Is there something you would keep the same or try to do more of from today's lesson?

Any other comments?

Collecting initial student data will be completed by using an assessment of prior knowledge of the chapter selected by researchers. The assessment will consist of 15 multiple choice, 3 short answer and 2 written response answers. A key will be created to mark the multiple choice and short answer questions, while a rubric will be created to mark the written response questions. All results will be recorded and used as a benchmark of starting point for student's knowledge of a topic.

Using the teaching calendar created at the beginning of the study, researchers would videotape each lesson that is taught. Observations from the video would be recorded, and instances of specific findings such as questions asked would be recorded. Both educators who are participating in the study would be given the same amount of time to teach their chapter using their corresponding teaching methods. While instructing, field notes would be created to capture elements or scenarios that might not be noticed on film. A guiding list, as seen in figure 4, would be used to help with the creation of any field notes produced. The journal component is a written reflection based off of visual observations that are taking place. Information such as, time of day (class block), date, mood of class, or other contributing factors would be noted.

Small questionnaire exit slips would be handed out to students at the end of each class. The exit slips would cover three main criteria using a scale from 1 to 5 for overall engagement, understanding of content, and overall use or effectiveness of class time. Exit slips would be collected daily to begin to give students a voice in the study. An example of the exit slip can be

found in figure 5.

Figure 4.

Field Notes Exemplar

Researching Team's Field Notes Field Notes: Observer: _____ Date: _____ Class Observed: _____	
Journal Class time:_____ Environmental factors (ex. Hot and sunny outside or cold classroom etc.)? School Factors (ex. Friday last block, early Monday morning, sick students or field trip etc.) Inferences Amount of Questions asked today	Side Notes

Figure 5.

Exit Slip Example

Please rank your experience in class today [1 is low, 5 is high]
How engaged did you feel during today's lesson? _____
How confident do you feel with today's lesson? _____
How well do you think you used your class time today? _____

Prior to the student's summative chapter assessment, students will be challenged with a new problem-solving task that involves the curricular goals they have been learning about, yet rephrased into an unfamiliar way. For example, instead of giving the dimensions for students to calculate surface area of a triangular prism, students will be given a specific surface area for a triangular prism, and required to work backwards to find possible dimensions. This task can be found in figure 6.

After completing the critical thinking/problem-solving task, a standardized chapter exam consisting of 15 multiple choice, 3 short answer and 2 written response questions would be distributed and administered to all students. A separate exam would be created for any students who need modified or adapted assessments. The summative assessment with answer key would be distributed for all teachers, so that standardized marking could be done. Furthermore, the researching team would verify marks by simple random sampling in order to maintain validity within marking.

Figure 6.

Student Led Surface Area Project

Chapter 4 Surface Area Project

Names: _____

Part A

Your Goal is to create a 3D object that has a specific surface area!

Overall for Part A, you must create three shapes. You will also have to provide a written explanation/reflection on why your shape is a specific surface area. SHOW YOUR WORK!

The three shapes you must create are [you will be only creating one of each shape]:

1. Rectangular Prism B) Triangular Prism C) Cylinder

The three specific surface areas can be used on any of the above shapes [each surface area can only be used once]:

$182cm^2$	$264cm^2$	$236cm^2$

Part B

You must create one ***composite shape*** that has the specific surface area:

Remember to include NEAT AND DETAILED WRITTEN WORK with each 3D shape that you create!

That means we should see 4 separate worked out surface areas with labeled diagrams!

The 4-week school calendar, table 1, would give an idea of the time and data collection date. One must remember that depending on the school schedule, classes are not seen every day. The example below will highlight a class that is seen on Monday, Wednesday and Friday. On every day that a lesson is taught, field notes would be written.

Table 1.

Calendar of Data Collection Dates and Classes Taught

Monday	Tuesday	Wednesday	Thursday	Friday
Pre-Assessment		Lesson 4.1 Exit Slip		Lesson 4.2 Entry Slip Exit Slip
Lesson 4.3 Entry Slip Exit Slip	Lunch Focus Group	Quiz Assessment from sections 4.1-4.3	After school Focus Group	Lesson 4.4 Exit Slip Lunch Focus Group
Lesson 4.5 Entry Slip Exit Slip	Lunch Focus Group	Lesson 4.6 Entry Slip Exit Slip	After school Focus Group	Task-Based Assignment Lunch Focus Group
Review for Summative Assessment Exit Slip	Lunch Focus Group	Summative Assessment	After school Focus Group	Lunch Focus Group
Lunch Focus Group	Lunch Focus Group	Lunch Focus Group	After school Focus Group	Two Months later-Post assessment

After completing the assessment, researchers would assemble students into groupings of, students with honors, students with marks between 60-80 percent, students below 60 percent, and English language learners. From each of these groups, a total of 12 students will be selected to the focus group. The group will consist of 2 language learners, 3 honor students, 3 failing students and 4 students between 60-80 percent who will be chosen at random. Three focus groups will be created in order to get a variation of answers. Three different groups would be interviewed at school during lunch hours and asked the same questions as the previous groups. Meetings would be videotaped and a script would be generated. Individual teacher interviews and group teacher interviews would be conducted to discuss any findings, surprises, frustrations,

successes, or general comments. An example of one focus group's questions can be seen in figure 7.

Figure 7.

Example of a Group Interview List of Questions

Interview Questions

Thank you for taking your time to participate in our study. My name is Paul Horpyniuk with the University of Victoria and today we will be asking you some questions regarding how you learned during the last couple math classes. The purpose of the questions is to get a better understanding of how students learn and to see if certain teaching strategies are more effective than others. The researching team is interested to hear your experiences over the last unit covered in math, and listen to any improvements or things that could have been done better.

There is no right or wrong answers as we go through our interview today, so please make sure you share your opinion as it matters to us. Please make sure that we are open to everyone's opinion and feel free to speak honestly in our safe environment.

Today's interview will be videotaped in order for us to review information and comments that are said. Comments will remain confidential throughout the entirety of our study and once our data is obtained, any recordings will be destroyed. Before we begin, are there any questions that we can answer?

1. Which style of teaching did you experience; project-based learning, or teacher led instruction?
2. What is your first impressions how you were taught the unit?
3. What did you find challenging throughout the unit?
4. What is something that you enjoyed about how you were taught this unit?
5. Did you see an increase in confidence as you wrote the formative to summative assessments? Please explain.
6. Did you feel motivated to learn through the specified teaching style? Why?
7. How long did you spend on studying or completing homework on average per night for this unit?
8. If you were the teacher, what things would you have done differently throughout the unit? Kept the same?
9. On a scale from 1-5 with 1 being not comfortable and 5 being very comfortable, how comfortable do you feel with the content you learned during the unit?
10. When you think back, is there something you would like to share about your experiences that have not been mentioned?

After two months, researchers would return to the classes participating in the study and

administer a standardized exam consisting of 15 multiple choice, 3 short answer and 2 written response questions. Results would be collected, analyzed and recorded.

Weaknesses with data collection

Leading the collection of data will have some of its hardships. Trusting students to be fully responsive and honest can be a daunting task. Allocating time towards recording classes, creating transcripts and field notes, creating assessments and questionnaires, creating permission forms, conducting focus group meetings with students and teachers, and scheduling time with participating teachers will be hard to juggle. Another weakness I have as a researcher is I have never conducted a qualitative interview before or properly done quantitative analysis. This will require extra time devoted towards researching the proper questions to ask and understanding how to properly break down taken in data. Making sure that the study maintains both validity and reliability will be an utmost concern because of my lack of experience in the field. To help accommodate for my lack of experience in the field, I would look for experience field researchers that would be interested and be willing to be part of the research team. Furthermore, constant contact will be held with other field academic experts in order to keep the validity and reliability of the study. One of my strengths as a researcher is to understand the overall flow of a scenario. In my field notes, I will be able to make strong inferences on situations that educationally work, or do not. I also have strong content knowledge of educational practices, curriculums, and teaching strategies. Since I am comfortable with public speaking, leading focus groups or having communication with other participants will not be an issue.

Issues of reliability and validity

Since PBL in theory educates the whole child, incorporating evidence of purely academic, emotional, skill based or confidence-based success would be a disservice to project-based

learning. In this regard, both qualitative and quantitative data were used to collect the statistics and experiences of the study. Quantitative data would be collected in order to measure any mark discrepancies between the student's original mark, and new chapter awarded mark. Qualitative data would be collected in order to hear the experiences and suggestions that both students and educators had throughout the study.

While collecting qualitative data, the study will focus on keeping the data credible, transferable, dependable and confirmable by maintaining the code set forth by Shenton (2004). To maintain credibility, data will be collected on multiple days over a month span. Frequent debriefing sessions will be set with teachers of the study in order to maintain the expectations set for each teacher. Random sampling will be used for selecting willing participants who would like to participate in any focus groups or interviews. Encouraging honesty within the participants will be promoted, so that evidence is not skewed. Since multiple sources of data will be collected, triangulating the data will help encourage credibility in the study. Detailed descriptions of findings and processes will be written and documented. A detailed reflective commentary will be added and any findings will be examined against previous research findings. To maintain transferability, full descriptions of impinging factors will be included, along with details such as number of participants, school settings and location, and demographics of the school and classes being used. If other researchers are interested in replicating the study, a detailed research design will be included with the number and length of data collection sections, the time period in which the data was collected and a detailed and thorough description of any processes used. As previously mentioned, the triangulation of data sources should promote the dependability of the study. A reflective evaluation of the study would be written that would also provide the reader with the researcher's biases and weaknesses as a researcher.

To ensure that the quantitative data is reliable and valid, detailed explanations of measurements, scores, and instruments used would be provided throughout the write up of the research design. In order to maintain reliability, standardized assessments will be used for all classes with a specified time limit. All assessments are to be done in class to eliminate the chance of students taking home assessments and getting extra help. Similar lessons will be presented to all students who are within a specific group. Differences in how a teacher presents, or maybe uses specific verbal explanations will be noted and recorded. The study will remain valid, as only curricular grade appropriate topics will be tested. All assessments will be pre-tested and follow proper examination protocol such as the amount of easy, moderate and difficult questions, along with the amount of conceptual, procedural and problem solving questions asked. Standardized rubrics will be used to ensure that marking of any assessments will to try to eliminate any potential biases amongst markers.

When working with both students and teachers, we cannot fully expect a valid result to occur to every student every time, as there are many factors not accounted for in this study such as hours of sleep and eating patterns. Some factors that could affect the reliability and validity of the study include the time of class during day, previous class before attending study, was food eaten for lunch or breakfast, seating arrangements, attendance, bullying issues, problems at home, problems school, etc. Trying to eliminate all of these factors would render the study useless, as these are daily interferences that any teacher would face. Removing these factors would not make the study life-like, therefore not helping educators in daily practice.

Definitions of key terms, concepts and variables

Throughout the study and paper, certain key words will be used to explain phenomena that are occurring while students learn. One of the highlights of using PBL is it is supposed to

develop critical thinking skills. Critical thinking as defined by Halpern [1999], "refers to the use of cognitive skills or strategies that increase the probability of a desirable outcome. Critical thinking is purposeful, reasoned, and goal-directed. It is the kind of thinking involved in solving problems, formulating inferences, calculating likelihoods, and making decisions." In order to measure critical thinking skills, a critical thinking rubric will be used during class observations and during the individual task based assessment. Students within classes will be given a critical thinking ranking number and these statistics will be compared to the other classes in the study.

Project-based learning has the reputation to increase academic results (Branch, 2015) and also improve a student's schooling experience (Collier, 2012). Schooling experience has many attributes attached to it, such as individual confidence, learning attitudes, dealing with peer pressure and an increase in social skill competencies (Filcik, Bosch, Pederson, & Haugen, 2012). PBL constantly uses communication and collaboration to help increase skills that impact the overall experience of a student's journey through school (Smith, Duncan & Cook, 2013). Schooling experience can be hard to express by simply using numbers, therefore both qualitative and quantitative measures would be used to collect data. Qualitative data would be collected during open ended questionnaires and focus groups to describe the schooling experiences and include the emotions that would be lost if it were only represented by a number. Quantitative data of schooling experiences would be collected while using closed-ended questionnaires and compiling results between the different classes.

Academic success is another key term that is relative to who is saying it. A 90% student getting 80% on an assessment can feel like a fail, while 80% on an assessment for a student who averages 50% is excellent. In the study, academic success will be viewed in two different ways. It is important to look at the class averages to see if they compare or differ from each other.

Secondly, it is important to look at the mark discrepancies between an individual student's average and a new project or test awarded mark. Looking at an individual level can help show evidence of individual mastery learning or individual mass confusion. Looking at multiple individual cases can help create generalizations for the whole class.

While students study using PBL, a big component of their studies are performing problem-solving activities. Carbonell (1985), defines problem solving as "transferring knowledge from past problem solving episodes to new problems that share significant aspects with corresponding past experiences – and using the transferred knowledge to construct solutions to the new problems." (p. 3). Problem solving will be measured in two specific areas. First, the standardized test of prior knowledge, summative chapter test, and mastery learning test will all have problem solving questions built into the assessments. A researcher could break down the success rate between the conceptual, procedural and problem solving based questions in the tests. Secondly, in the critical thinking skills task that students are assigned, researchers can use rubrics to assess whether students use correct, justified solutions to their answer their task.

Data analysis and interpretation

Data, which will be collected throughout the study, will be of two forms, qualitative and quantitative. Collecting qualitative data will be done through questionnaires and videotaped group interviews that will be transcribed into scripts. Once collected, themes or overarching big ideas will be focused upon and recorded. Entry and exit slip sheets both serve as a check for student understanding, and gives the students a voice into their engagement and confidence within a lesson. Any curricular questions can be marked and recorded for accuracy and used formatively for a comparison to the final summative mark. This could quantify their journey in learning a mathematical concept or show evidence of weaknesses in teaching. A signal that can

show evidence of weakness in teaching can occur when multiple student's score lower compared to their ongoing summative final mark. This is also true when multiple students do not attempt work because of the lack of understanding.

Having students participate in focus groups, helps encourage the hypothesis-generating portion of the study. With student suggestion and conversation, their experiences can be transcribed into a script and then broken down into overall subcategories or themes. Looking at commonalities within themes can potentially help with the study as it progresses. For example, if multiple students share the complaint that not enough modeling of questions is being done, or not enough time is given for a task, this can be tweaked during the study. Also during the focus group meetings, researchers an get more emotional responses compared to a ranking number from 1-5 on a survey. This means that responses could be more personalized and truthful because a personal opinion is being explored compared to when a student writes a survey.

While looking at quantitative data such as pre, post and summative assessments, and the task-based assignment, data will be recorded and converted into means to see if any progression or changes are noted through the experimental phases and classes. Taking a look at the means over the course of the project should hopefully shed light on whether students grasp curricular content faster, or more efficiently with one teaching strategy over the other. Similarly, contrasting the summative marks compared to the post-summative test, will hopefully build evidence towards mastery learning in reference to one of the teaching strategies. If information is able to stick into a student's head, and they can correctly recall how to use a tool or method, then some mastery learning is evident. Once data has been collected, graphs will be created in order to visually display the difference in data collected.

Ethical considerations

Since this study involves students who are under the age of 18, and individuals who may not want their names to be published in a study, confidentiality issues will be put into place. It is still important to be able to link whose responses were given during the study as classifying the data will help understand who was able to learn from a certain teaching styles. Understanding how certain subgroups in a classroom, such as students with honors, failing grades, English language learners, or learning difficulties, will benefit the study by comparing results to other groups. Data will be collected from students, and participating teachers. Data responses will be given during questionnaires, videotaped classes, field notes, focus group meetings, interview notes, standardized exams and pictures of projects. Any pictures taken that have people's faces will be blurred so that they remain anonymous. Participant's names will not be used during the reporting stage of the study and will remain anonymous. Maintaining privacy will be strongly cautioned throughout the entire study. No information will be used for other purposes besides the aims of the study. The consent form will also explain the reasoning for collecting data, and reporting on it will be for academic purposes. Information will only be discussed with members of the research team. Once the information is collected, recorded and analyzed, all data will be destroyed.

Informed consent

Before the start of the study, an informed consent form will be given to all participants of the study. Parental approval will be necessary for all participants under the age of 18 to participate in the study. Students will only be able to be actively involved in the study with a return of a signed consent form from their parents. In the consent form, participants will be able to see how the data collected will be used for the intentions of the study. The consent form will

state policies regarding the privacy and confidentiality of their participation, with specific intentions of using their collected data for academic research. Only members of the research team will have access to data that has identifying information.

Pre-testing the Pilot Study

Any questionnaires, exit slips, written response, multiple choice or other assessments will be tested before hand to make sure that they are fair and follow curricular goals. Testing to make sure that summative assessments follow proper testing protocol such as one-third procedural, one-third conceptual and one-third problem solving would be focused on. Creating summative assessments that also followed three-fourths easy to moderate and one-fourth difficult questions would be used in order to discover the strength of a student's understanding in a topic. Interview questions will be prepared beforehand and experimented with other researchers in order to reach clarity and avoid wordiness or confusion. Any interview schedules created will be examined by the research team to make sure that no bookings are overlapped. Any proposed lessons will be examined beforehand in order to make sure that they are abiding by PBL standards or traditional teacher led instruction. Project questions will be tested so they are grade specific and follow curricular standards.

The suggested pilot study will hopefully shed light on the effectiveness of using PBL, and see whether it has different results compared to teacher led instruction. In the following chapter, a reflection on the journey of this project will be examined, highlighting the learning experiences that I encountered and how they will mold my future as an educator.

Chapter 4

It is amazing that as you understand more, you realize you actually understand less. Over the process of writing my project on project-based learning, I have magnified the amount of questions that I originally started with. Initially, I was curious to see what effects PBL would have on junior-high math classes, but quickly, I started asking myself; is PBL more useful in subject specific areas, can PBL be used in more abstract courses like higher level mathematics, what is the right amount of PBL for a class, or what would satisfaction levels of junior and senior high teachers look like if we tracked the teachers creating and implementing PBL? The more I discovered about PBL, the more I even questioned its usefulness. I guess I needed to see it in effect in order to believe its potential; seeing is believing.

As I worked throughout the project and master's program, I began to also realize that I was earning valuable experiences that redefined my beliefs, actions and thoughts regarding education and my role as an educational professional. In the next few paragraphs, I will elaborate on my learning curve on education and speak on some of the grey areas of education that I would like to explore further.

The factor that stood out the most as I worked through my master's program is how essential it is to make learning motivating and authentic for students. In my own practice as a math educator, I would struggle with students, asking them to start their homework or try and work on an in class example. A daily question that I can still hear from my students is, "when will I ever need this in the future?" At first take, I would come up with explanations such as, "you don't know what the future has in store for you" or "how will you ever get smarter?" Upon further reflection, I now realize that it is not the student's fault if they are forced to memorize something that has no interest to them. It is now my challenge as an educator, not to teach the laws of mathematics, but instead help show students how math is applicable to them. By doing

this, I am forced as an educator to create authentic and motivating lessons that will inspire students instead of boring them. Not only does creating more enjoyable lessons help keep students engaged, it also keeps the educator engaged as well. With all of this being said, there are still many challenges in creating daily authentic and motivating lessons. In reality, there are time restraints, difficulty with abstract concepts, and students learning at different rates, not to mention that the educator creating the material would like to also devote part of their life to things outside of work as well. Regardless of the complications, creating an environment that students want to be a part of is the main key to student learning.

In order to make lessons motivating, an educator needs to understand the learners in their classroom. This means creating a relationship with them and understanding what helps each individual in the classroom. Taking the time to individualize a lesson to each student can be time devoting; however being aware that one size does not fit all can help student's progression in learning by meeting their individual needs. Through the master's program, I saw that the famed "learning styles" was not fully accurate, however, using multiple educational strategies keeps students away from repetitive practice and keeps students engaged in learning. Individualizing a lesson can come in many forms and can help multiple students even if they are not the intended audience. For example, when individualizing for an English language learner, creating a word wall, providing written notes or including pictorial representations for terminology is something that could be of benefit for our language learners. However, by allowing all students access to these same resources and strategies might prove beneficial to other students in the classroom as well. Furthermore, it can be a mistake to think of differentiating instruction only for students who are struggling. It is also imperative that instruction is individualized for those who excel in a subject to help propel their learning experiences. Again, this helps keep all students academically

accountable, motivated and engaged in their own learning. During my individualization and differentiation course, I found that the biggest part of individualizing is realizing that the strategies that I use to teach are not the best for everyone. This requires an open mind and constantly changing and critiquing practices each and every school year.

Even by creating engaging lessons or differentiating instruction, students can still not develop as I hope and wish they would. Over the master's program, I have had a chance to give a lot of thought into the good and bad of our current educational system. Our goal as educators is to strive for mastery learning within our students, however, what happens when our junior high or high school students don't excel? We continue on. It wouldn't make sense as a piano instructor to continue to another level and increase difficulty when a student doesn't know where the notes are on a piano. Why would a skydiver instructor allow their students to jump solo when they showed that they faulted at the tandem jumps? In fact, they wouldn't. So why is it that in school education, when a student receives 60% on a quiz or test, we continue to push forward? My firsthand experience is that the students who receive lower marks and continue in schooling years only get more frustrated, confused and anxious. Not many students who understand a concept question why it is important to learn, yet those who struggle, often dismiss knowledge as unimportant. I understand that mass education is a tricky topic that a whole thesis could be devoted too, yet, there must be a better system that keeps students in check throughout their learning. The masters experience has helped me think of ways that I could help catch students when they academically falter, however, I am still not satisfied with the cracks that are growing in my students learning.

With some of my students who are grade levels below in mathematics, I have been able to set up an academic support group, where volunteer calculus students come and give 1 on 2

supports to our struggling math students. This is just one of the ways that I am trying to help catch students who need help. The master's program has also shed light on various other techniques that can help students as well. During our technology course, we were introduced into multiple gizmos, websites, and tools that could help connect, expand and diversify teaching. Many of the teaching tools that were demoed during presentations, I currently use today. I find that students like the idea of a flipped classroom, where they can learn, re-watch and practice when they are ready. To help support his, I have created an online website that gives my students extra practice and resources to videos that help foster their learning. During class, I try and diversify my instruction by using various projects found on Pinterest, or get immediate formative assessment by using a cell phone based app called Kahoot. As a last example, I have found that students can connect with me from outside of school using Twitter, Edmodo or other social media sites. This way if students have questions and I have a few minutes to spare, I can answer questions on the spot, help hold study question and answer periods or if I don't have time, get back to them the next day. With technology evolving as it is, I believe it is valuable to make every effort possible to connect with our learners, in and outside of the classroom.

Along with the use and expansion of technology within the classroom, educators have seen a shift in educational development as well. Part of the master's program extensively focused on the 21st century learning and the curricular redesign that follows as well. These changes look at developing student learning that can become more student led, competency based, higher-level cognitive abilities such as problem solving, and collaborative opportunities for the students. This practice is built around the notion of engaged learners, ethical citizens and entrepreneurial spirit. Timing between the curricular redesign and me proposing a project on PBL couldn't have been better, as PBL highlights the main transitions of the redesign. PBL is competency based,

collaborative in nature, problem solving, higher order thinking, differentiated instruction, student led and cross-curricular. As my colleagues were learning about the new transitions, through my studies, I felt like I could have been presenting the new information. Furthermore, because of my studies of the curricular redesign, I have been able to apply the new philosophies into my teaching practice, which has helped nurture my abilities as an educator. Being on the forefront of such transitions has helped promote my interests as becoming a mastery level teacher, which is a goal I strive for each year.

One of the final thoughts that I would like to touch on in regards to my experiences throughout the master's program and my changing of educational ideologies is my thoughts towards the final goal of education. Before my studies in the program, I thought of my teaching occupation as a job where I was supposed to instruct students to learn the specific learning outcomes in mathematics and occasionally have some fun while doing it. Over the course of two years, I have had a personal redesign in my philosophy of education. I believe that now I am investing time into developing tools such as the use of mathematics in my students. I focus on the socialization and well-being of each child, whether it is physically, emotionally or spiritually. I look to challenge, not assess. Whenever possible, I encourage students to work collaboratively as in the real world, solutions are often shared from friends, family or the Internet and not discovered from trial and error by yourself. So when I get parents that come and discuss a student's grade, and ask why it is only an 80%, I take the opportunity once again to reflect on the final goal of education. We are looking after our future. In a few years, having 72% or 80% in grade 9 junior high mathematics won't make a difference, however, the work ethic, patience, communication skills and passion will. These are the elements that I now focus on, and why I believe that creating relationships amongst students is one of the most important factors that an

educator can do.

As stated in the past few paragraphs, I have been blessed with the opportunity to learn many valuable skills and lessons that I will incorporate in my daily educational beliefs and practices. Looking into the future, I am excited to use these newfound beliefs and skills to the best of my ability. The following paragraphs will highlight how I anticipate my experiences within my graduate studies to influence my professional career for personal, school and district levels.

First and foremost, I was surprised that my graduate studies granted me one of my most valuable learning experiences, which is the gaining of self-confidence. Before, I could be put in front of 3000 students and hold a discussion or make a speech, yet placing me in front of 5 colleagues while presenting had me sweating bullets. Through collaboration, whole class group discussions, and practicing presentations in front of the cohort, I have been able to start and overcome my uneasiness of presenting in front of colleagues. I have already found noticeable gains in confidence and the ability to articulate my thoughts during staff meetings, learning committees or other professional groups such as the Greater Edmonton and Area Teacher Conventions Association, which I am a member of. Being comfortable in front of my peers is something I deem very important and is a life skill that I want to continue to practice as I move forward with my role at Louis St. Laurent and with Edmonton Catholic School board. Having the confidence to share my thoughts and recommendations will help me professionally as I continue to educate.

As I picture my life plan, in the next few years I hope to become the next math department head at my school, followed by becoming a vice principal and eventually school principal. This, in large part, is because of my graduate experiences. I found that throughout my

group projects and presentations, I thoroughly enjoyed taking on a leadership role and accepting any challenges that arose. Looking back, I feel that part of my success when it comes to group projects or playing team sports such as basketball, has been because of my communication and collaboration skills. I feel that I naturally fall into leadership roles when I see a void or something that needs to be addressed. While I love teaching, I would like to expand my knowledge and skill sets by adding more onto my plate, such as becoming a department head and learning the responsibilities that come along with the position. I believe that the more I do and learn, the more it will help me in any given scenario. My experiences from teaching high school have helped mold me while I teach junior high. Similarly, teaching junior high in return has taught me other lessons that I'm excited to practice once I teach high school again next year. Thinking along the same lines, I am curious to see how I can improve by taking on more responsibility and leadership roles in the near future.

Part of accepting leadership roles is becoming the visionary model for your colleagues. When I think of my current principal, he successfully initiated multiple transitions within the school. Whether it is the development of skills such as learning PBL, 21st century transitions, technology developments, or changing educational beliefs and values by introducing educational teacher circles, or the redevelopment/reconstruction of our entire school. I can't say that I ever was a fashionable trendsetter or led my friends in new technologies, however the idea of finding motivated people to try and push for better educational practices is very exciting for me. A stimulating aspect of being in the master's cohort was learning from the people that were in the group. Being one of the youngest members in the cohort, I was able to listen to multiple principals, department heads, consultants or experienced teachers who helped give me valuable advice of what education is truly about and how to achieve desired goals. Along with this great

wealth of knowledge, as a master's group, we were introduced to current trends and ideas that are evolving or re-evolving within education. I was able to listen and see what elements are necessary to see success and what potential drawbacks could occur. Undergoing all of this, I feel that if I was to try and start a certain initiative on my own or with a group of colleagues that I have some experience that I can fall back on. With education constantly changing, understanding how to accept change and viewing it, as an opportunity is something that I now look forward too.

As I speak on how education is constantly changing, through my experiences with my graduate studies, I have also seen how much I have enjoyed returning to the classroom to learn new things. By learning more, it increased my desire to teach me. In my under graduate studies, when I received an A- I would be in my glory, however, when I received that same grade in my graduate studies I was mad and dejected. As a result, when I taught, I feel that I put more effort and passion into my teaching, which was a direct result of caring more for my own education. In a sense, as I took a step forward, so did my level of commitment, and capabilities of being an educator. Even through the complaints and procrastinations of completing a graduate course assignment, I truly believe that I will miss learning in a class setting. I definitely think that returning to the classroom has helped mature the person I am becoming. Our principal always reminds us that it is important to model the behaviors we expect from our students. When students see that you are committed to being a life-long learner, I feel they buy into whatever you're saying that much more.

Part of being a life-long learner includes listening to others and working with groups of individuals to reach a goal. My graduate studies has helped showed me that education should not be considered as a lonely island, but instead, a busy city metropolis. Collaborating with multiple teachers seems like work at first, but there are many valuable entities such as learning new

teaching strategies, sharing assessments or gaining resources that can help improve ones practice. While conversing with other cohort members, I gained insight and knowledge that I previously never thought of myself. Working with others also gives me a chance to bounce ideas off of others and see how they feel about the topic at hand. I have gained an appreciation and value of collaboration from my graduate studies, and now I look for collaborative opportunities within my school and district to help better my teaching practices.

In order to be able to teach to ones fullest, I believe that everything inside and outside of school needs to be somewhat balanced. I am not one who likes to be stressed. My graduate experience has helped me learn how to manage multiple things at once. Over the course of two years of the program, I have planned a wedding, coached four month long basketball seasons, been part of various learning groups, council member of GETCA for teacher's convention, built a house, taught full course loads, and completed a masters program amongst others things as well. Being able to complete everything at once has helped me value my free time, make me more efficient in my daily operations, and truly appreciate each day that I get. Learning to manage and deal with pressure and stress is one of the most important lessons that I gained from my studies. If I can do all that I did and still want more, I know that I'm ready to move forward into greater and better things once again. I am very fortunate to be in the position I am today, and owe it greatly to a loving family, supportive fiancé, fantastic professors and a group of cohort learners that pushed for excellence.

In conclusion, the last two years have been a thrilling and exceptionally rewarding experience. If I were to point other educators or researchers looking to engage further on what I have studied, I would suggest to look and see if PBL is more effective to use in certain subjects. Maybe PBL is better suited for Social and English, compared to Physical Education and Math?

Secondly, I would be interested to see if a potential increase in motivation creates academic dividends on low performing students? Lastly, tracking how satisfied teachers are who have to create, implement, and assess using PBL over a course of a few months could prove to be an interesting study. I will end my chapter with the same thought that I began with; it is amazing that as you understand more, you realize you actually understand less.

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Appendix A

Entry Slip
Complete the following questions to the best of your ability. You will be given 8 minutes to finish. Please write out your answers in a neat and organized fashion!

1. Find the surface area of the following triangular prism whose dimensions are

   Height 10cm, length 12cm and width 14cm

2. Find the surface area of a rectangular prim whose dimensions are

   Length 6cm, height 9cm and width 10cm

3. A cube has a side length of 6cm. Calculate its surface area.

Appendix B

Exit Slip! Section 4.4 Name:_____

What are three key terms that you learned from this lesson? Provide a written and pictorial explanation.

How comfortable do you feel with today's lesson? Please check of your answer (1 uh oh! – 5 genius)

1_____ 2_____ 3_____ 4_____ 5_____

Is there a question you didn't ask today or were wondering? If so, please write below

What is the surface area of the following rectangular prism? Length 8m, height 7m, width 5m

Exit Slip! Section 4.4 Name:_____

What are three key terms that you learned from this lesson? Provide a written and pictorial explanation.

How comfortable do you feel with today's lesson? Please check of your answer (1 uh oh! – 5 genius)

1_____ 2_____ 3_____ 4_____ 5_____

Is there a question you didn't ask today or were wondering? If so, please write below

What is the surface area of the following rectangular prism? Length 8m, height 7m, width 5m

Appendix C

Interview Questions

Thank you for taking your time to participate in our study. My name is Paul Horpyniuk with the University of Victoria and today we will be asking you some questions regarding how you learned during the last couple math classes. The purpose of the questions is to get a better understanding of how students learn and to see if certain teaching strategies are more effective than others. The researching team is interested to hear your experiences over the last unit covered in math, and listen to any improvements or things that could have been done better.

There is no right or wrong answers as we go through our interview today, so please make sure you share your opinion as it matters to us. Please make sure that we are open to everyone's opinion and feel free to speak honestly in our safe environment.

Today's interview will be videotaped in order for us to review information and comments that are said. Comments will remain confidential throughout the entirety of our study and once our data is obtained, any recordings will be destroyed. Before we begin, are there any questions that we can answer?

1. Which style of teaching did you experience; project-based learning, or teacher led instruction?
2. What is your first impressions how you were taught the unit?
3. What did you find challenging throughout the unit?
4. What is something that you enjoyed about how you were taught this unit?
5. Did you see an increase in confidence as you wrote the formative to summative assessments? Please explain.
6. Did you feel motivated to learn through the specified teaching style? Why?
7. How long did you spend on studying or completing homework on average per night for this unit?
8. If you were the teacher, what things would you have done differently throughout the unit? Kept the same?
9. On a scale from 1-5 with 1 being not comfortable and 5 being very comfortable, how comfortable do you feel with the content you learned during the unit?
10. When you think back, is there something you would like to share about your experiences that have not been mentioned?

Appendix D

Dear Guardian,

We are conducting a study out of The University of Victoria that tests to see whether project-based learning, a method of learning that involves using projects instead of teacher-centered education, is effective and valuable to children's education. If given consent, by signing below and returning to the school, you allow our research team access to your child's historical and current grades.

Your child will follow normal curricular lessons that are taught by their normal mathematical teachers. Students will be chosen at random to participate in small group meetings that will take approximately 30 minutes or one lunch hour. Some of the classes and meetings may be videotaped to help researchers collect additional data upon reviewing. Any information collected will be considered highly confidential and no body other then the research team will see any of the data. Any information recorded will be destroyed upon the completion of the study.

If there are any questions, please call 780-555-4433 and we would be happy to answer any questions or concerns that you may have.

I _____ give consent for my child to be part of the project
Parent Consent Signature
Based learning study that is being conducted by The University of Victoria

Appendix E

Daily Reflections Date:_____

Lesson Number:_____

What was the curricular goal that you were meeting today?

Was there anything that stood out during today's lesson?

Was there any student that stood out or captured your attention? Why?

What activity or part of your lesson did you find the most difficult today?

Did you feel that students were engaged with your lesson?

What would you change during todays lesson?

Is there something you would keep the same or try to do more of from todays lesson?

Appendix F

Chapter 4 Surface Area Project

Names: _____

Part A

Your Goal is to create a 3D object that has a specific surface area!

Overall for Part A, you must create three shapes. You will also have to provide a written explanation/reflection on why your shape is a specific surface area. SHOW YOUR WORK!

The three shapes you must create are [you will be only creating one of each shape]:

A) Rectangular Prism B) Triangular Prism C) Cylinder

The three specific surface areas can be used on any of the above shapes [each surface area can only be used once]:

$182cm^2$	$264cm^2$	$236cm^2$

Part B

You must create one ***composite shape*** that has the specific surface area:

Remember to include NEAT AND DETAILED WRITTEN WORK with each 3D shape that you create!

That means we should see 4 separate worked out surface areas with labelled diagrams!

Appendix F

Field Notes: Observer:_____

Date:_____

Class Observed:_____

Journal	Side Notes
Class time:_____ Environmental factors (ex. Hot and sunny outside or cold classroom etc.)? School Factors (ex. Friday last block, early Monday morning, sick students or field trip etc.) Inferences Amount of Questions asked today	