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AN EXAMINATION OF THE EFFECTIVENESS OF PROJECT-BASED LEARNING ON STUDENT ACADEMIC ACHIEVEMENT AND TEACHER PERCEPTIONS OF PROJECT-BASED LEARNING

by

Robert Sahli

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ABSTRACT

This study examined two questions related to the effectiveness of project-based learning (PBL) instruction. First, is PBL more effective than a textbook-based instructional model, and second what are teacher perceptions related to PBL methodology? Student growth scores in the Measures of Academic Progress (MAP) assessment for reading and math, as measured within one school year, fall to spring, for students in PBL and non-PBL classes were compared. A teacher survey was conducted to measure teacher perceptions of PBL and textbook-based instructional program strengths and weaknesses. Additional data on effective instructional strategies can provide further direction for educators to continue the full implementation of the Common Core State Standards (CCSS) that call for students to gain a deeper understanding and knowledge of grade level standards. The study was located in a large urban school district in Northern California. The overall findings of this study were that the MAP assessment data reflected higher annual growth scores for reading and math in six of the eight grade levels studied. Teacher survey participant responses reflected consistent support for a textbook-based instructional program over a PBL instructional program, due in large part to the additional time teachers spent in preparing for PBL lessons.

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CHAPTER 1: INTRODUCTION

The system of public K-12 education in the United States remained relatively unchanged for most of the 20th century. Based largely on the factory model developed at the end of the 19th century during the Industrial Revolution, for the mass production of products, schools were used to educate the masses. Schools had a clear resemblance to factories where rote instruction through the use of lecture and repetition reflected the methodical tasks of factory workers. A few students excelled and were encouraged to pursue further education while most students were conditioned and trained to be efficient assembly line workers. In these systems, conformity was the goal and individualism was discouraged. The intended outcomes of these models were standardization, consistency, and efficiency (Robinson, 2012).

Research into brain development and learning in the later portion of the 20th century, combined with a technology revolution brought into existence the ability for learning to occur in a more individualized manner, while providing for more collaborative learning environments. Emergent technologies led to the development of many new opportunities for quick access to information and simple methods for collaboration to guide and enhance learning efforts, unimagined even a few years ago (National Research Council, 2000). Gates (1995) asserted that computers have allowed greater productivity and efficiency in education and will take over the traditional role of teachers as providers of information, allowing them to concentrate on interacting with individual students to help them digest, interpret, and create knowledge from the available information.

Statement of the Problem

The goal of the public educational system, based on many federal initiatives such as Goals 2000 (Congress, U.S., 1994), the No Child Left Behind Act (2001), and the most recently implemented Every Child Succeeds Act (2015), is to ensure all students achieve at high levels through effective instructional delivery methodology. One of the challenges which impedes meeting these national goals is a lack of student engagement within the learning process. A disengaged student is not likely to learn and achieve at high levels. Different instructional delivery methods such as those found in project and problem-based learning may provide for the necessary levels of student engagement to meet varying levels of achievement potential.

New national standards and the history of low performance, as measured by state and national student testing, call for a change in approach and a logical element of such change would be a new method of instructional delivery (DeSilver, 2017). Additional research on the effectiveness of alternate instructional methods in a large urban school district would contribute to understanding the most effective instructional methods. The Common Core State Standards (CCSS) assessment system, which utilizes performance tasks more so than multiple choice questions, calls for a deeper understanding of concepts and skills (Fensterwald, 2015). To meet the changing demands of the economy and workforce and better educate the students and future workers, educators must continue to experiment to find the most efficacious instructional methods to ensure a well-educated society.

Hattie (2012) identified 138 influences on student achievement in a meta-study to measure the effect size of each. In Hattie's research, an effect size of 0.4 is the average or what he called a "hinge point" and equivalent to one year's growth for one year's effort. His research found that while problem-based learning had a low effect size of 0.15, project-based learning (PBL) had a significant impact with an effect size of 0.61. Problem-based learning is what textbooks ask students to do, solve isolated problems one after the other, often in a worksheet-based format where problems are isolated from one another and where answers are calculated by the student after a session of direct instruction by the teacher. PBL is designed for teachers to lead students through a problem-solving methodology by solving a project or performance task. The teacher's role in the PBL model is to continually lead, guide, facilitate, and instruct through the completion of the project or performance task. The subtle difference in the two approaches is that one solves problems in isolation and the other accomplishes the completion of a project or task, by incorporating multiple skills and knowledge and solving multiple related and non-isolated problems. Based on Hattie's work, the PBL method had a four times greater learning impact.

Purpose of the Study

The purpose of this study was to examine the results of instructional delivery methods and to determine if a PBL method yields higher academic achievement results as compared to a traditional textbook-based method of instruction. The study compared academic growth scores of students taught through the PBL approach with those taught through a traditional textbook approach. In addition, the study explored the perceptions of teachers with regard to the effectiveness of the PBL model, in terms of meeting rigor, student engagement, and usability goals.

This researcher explored other possible inputs contributing to low student proficiency scores by looking at the teacher's ability to delivery PBL lessons, which require more engaging instruction and less presentational (lecture) instruction. One facet of instructional delivery that was examined is defined as usability. Usability is the capacity to prepare, manage, and deliver the curriculum. This study sought to understand how teacher preparation time impacts student learning and whether adequate time is available for planning. In other words, if a teacher finds inadequate time available and the lesson is less well-prepared, can the methodology of PBL itself overcome the preparation shortfall? In addition, is PBL more effective than a traditional textbook approach? The secondary question concerned the perception of teachers towards PBL and if this perception impacts their ability to deliver the PBL instruction effectively.

The researcher compared the academic growth scores based on the grade level achievement levels of students who had been immersed in a traditional textbook-driven instructional approach to students who had been immersed in a PBL instructional approach.

Significance of the Study

The results of this study provide additional evidence of which instructional delivery methodology achieves greater results in terms of academic achievement as well as the impact of teacher perceptions on PBL effectiveness. The study was conducted in a large urban public school district in Northern California. The data will be used to inform the choices of future curriculum purchases and the direction of teacher professional development training efforts.

Most of the recent research on PBL reviewed by this researcher was found to be focused on the qualitative aspects of PBL and not academic achievement data. This study provides additional quantitative data on the effectiveness of PBL. The Measures of Academic Progress (MAP) assessment was used to collect the quantitative data. Students who take a fall and spring MAP assessment within a given school year are given a MAP growth score for the year. Each year to keep on pace of working through grade level standards students are expected to meet a standard growth score. Students who do not meet normed growth scores are considered to have not made a year’s worth of academic growth for a year’s worth of time and effort. The MAP is administered to millions of students nationally each year and is considered a highly valid and reliable measurement tool.

Theoretical Framework

The PBL learning model has its root in the constructivist theory of education where students take an active role in their learning, generating meaning through experience, rather than in a passive role as found in the traditional model of textbook-based instruction. The theory posits that student performance will be positively impacted through a model of instruction that uses problem-solving as its core component. Constructivist theory is based on the works of Piaget and Dewey. In Democracy and Education, Dewey's (1916) statement on "doing" is key to understanding this theory, also known as experiential learning, "Give the pupils something to do, not something to learn; and the doing is of such a nature as to demand thinking; learning naturally results" (p. 98). This approach reflects the most standard method of learning used, prior to organized public education. This learning model is found in the apprenticeship models of trade-based economies such as carpenters, milliners, blacksmiths, bakers, and a multitude of others. Typically, these trades were taught at home or near home by a family member, relative, or close neighbor. The term "learning by doing" sums up this learning method and has been adopted by a large public university, the California Polytechnic University as its motto (Cal Poly, 2017).

Jean Piaget's theory of constructivism argues that students produce knowledge and create meaning based upon their experiences. The teacher is to facilitate a student's learning through a variety of experiences and most importantly at the student's developmental level (Baken, 2014). Piaget recognized that within different learning levels opportunities existed to allow learners to work together and help build understanding for each learner. In such learning efforts, concrete, hands-on experiences helped students create connections between new information and previous knowledge.

Research Questions

PBL offers an alternative to traditional textbook-based instruction through the methodology of more in-depth instructional units that include the integration of projects involving real-world experiences and problems, as found in the CCSS. The primary quantitative questions to be answered in this study are, was there a difference in the mathematic growth scores of students taught using PBL compared to those taught from the traditional textbook approach when measured across five grade levels (4, 5, 6, 7, 8), and was there a difference in the reading growth scores of students taught using PBL compared to those taught from the traditional textbook approach when measured across five grade levels (4, 5, 6, 7, 8)? The researcher's hypothesis was that students taught using PBL would results in greater academic achievement and PBL students would have greater math and reading growth scores than non-PBL students.

The implementation of PBL units requires more time for lesson preparation than traditional textbook-based instruction. Educators are struggling to find, or commit, the time needed for the planning of PBL units. A less than optimally planned lesson will impact the effectiveness of the lesson and subsequent student learning. The primary qualitative questions to be answered are what are teachers' perspectives on PBL? What were the teacher perspectives on PBL in terms of rigor, engagement, and usability?

Definition of Terms

Common Core State Standards (CCSS): National grade level standards that identify, by grade level, what a student should be able to understand and how they should be able to demonstrate their understanding.

Measures of Academic Progress (MAP): A nationally normed computer adaptive assessment that identifies a grade level equivalent score for students for reading and math.

RIT: Short for a Rasch Unit, an estimation of a student's instructional level and also measures student progress or growth in school.

Northwest Evaluation Association (NWEA): A non-profit organization that provides the MAP assessment.

Project-Based Learning (PBL): A teaching method in which students gain knowledge and skills by working for extended periods of time, both in small groups and individually, to investigate and respond to authentic and engaging questions and problems.

Unit of Study (UOS): A series of specific lessons, learning activities, and assessments based on grade level standards that incorporate projects and performance tasks within a skills or thematically based unit.

Zone of Proximal Development (ZPD): The difference between what a student can do without help and what he or she cannot do without help. Sometimes referred to as the learning zone.

Student Achievement: The ability of a student to master a skill that has been previously taught in the classroom as measured by a standardized assessment.

No Child Left Behind: Federal law (2002) that required states to test students in reading and math in grades 3-8 and twice in high school. Students were expected to meet or exceed state standards by 2014. Schools that did not meet expectations of predetermined growth were subject to heavy sanctions including financial loss and reorganization or dismissal of faculty and staff.

Teacher: An individual who teaches something; a person whose job it is to educate students about defined subjects.

Usability: The ease of use and learnability of a human-made object, such as a curriculum or instructional method.

Limitations

This study was conducted with the use of different instructional materials in different years. The curriculum materials were revised with the change in instructional methodology. Therefore, the first school year examined, 2012-2013, studied the impact of a traditional textbook-based instructional model and the second school year examined, 2015-2016 studied the PBL instructional model. Each year the total student population exposed to the instructional model and had a MAP growth score was included in the data collection. The MAP assessment was given in all years of the study to generate a MAP growth score for each student. Due to students missing either or both the fall and spring MAP assessment not every student had a growth score generated each school year. Maturation could have impacted the validity of the data but the inclusion of the same age ranges of the students each year, grades four through eight can reduce this impact.

Delimitations

The study was delimited by selecting only students who had a MAP growth score. A purposeful stratified sample was used for collecting MAP growth scores for the 2015-2016 school year by taking a subset of all students with a MAP growth score for this school year. The subset consisted of those students who have completed six or more unit of study end of unit assessments. The subset was used to verify that the student substantially participated in unit of study instruction. This was a validation concern due to the resistance of some teachers to the implementation of PBL. The schools in the study were demographically similar and were considered to be neighborhood schools. The researcher did not conduct observations of class activities so as to not disrupt the instruction.

Organization of the Study

The study recognized the problem of having to meet the different levels of academic ability of individual students within a large urban school district through the most efficacious instructional means. Two approaches were compared and analyzed. The study was based on the theoretical framework of PBL, sometimes referred to as experiential learning. The framework at its base used the works of Dewey, Piaget, and Montessori, who each wrote on the power of experience and application in the learning process.

A historical perspective was presented to describe how educational systems and methods were instituted initially in large urban areas taking societies from largely agrarian economies into the industrial age and then into the information age. The systems implemented for education in these periods and related assessments were presented. The movement towards greater school accountability and the resultant high stakes testing, as a result of a number of federal government education initiatives such as No Child Left Behind, was presented as well as the impact of such initiatives on instruction. The results of these initiatives and the movement to national educational standards, the Common Core State Standards, was discussed.

Assessment results from a large urban school district were presented. For quantitative data the assessment results were used to compare student growth scores in math and reading. The student groups experienced learning through either the PBL or the textbook-based method. To provide qualitative data on these methods, teacher perceptions of the effectiveness of the methods were analyzed for academic growth, student engagement, and overall usability in daily instruction. The data analyzation and findings provided the basis for the recommendations on the most efficacious method to meet the needs of students in obtaining mastery of content relevant to their academic needs, while adhering to the demands of national and state accountability.

Summary

Many factors influenced the success of students in the educational processes found in the public educational system. Hattie's (2012) meta-study on visible learning sought to find the most effective factors, or aspects, that provided a year's worth of gain for a year's worth of effort, which has been the minimum goal in a student's progress through the K-12 system of education. This study sought to primarily discover if one instructional format was superior to another. Was a PBL approach, with a more hands-on and actively engaging approach, more efficacious than a traditional textbook-based approach with a more teacher-directed approach? For the reason noted above concerning Hattie's work, MAP growth scores were used to measure academic progress since they also measured a full year of a student's learning by comparing the fall start-of-year assessment to the spring end-of-year assessment.

Teacher perceptions, and therefore attitudes on curriculum and instruction, may significantly impact results since teachers were at the point of content delivery and instruction. Their perceptions, of both PBL and the traditional textbook delivery models, assisted in further understanding of the most efficacious instructional models.

CHAPTER 2: REVIEW OF THE LITERATURE

This chapter includes a literature review of the constructivist learning approach, cooperative learning, and PBL. The impact of educational programs and policies initiated by state and federal agencies have a direct impact on public educational systems. These programs and policies are discussed. The researcher reviews the historical basis for informal and formal learning systems leading up to the public educational structures found today. The impact of more recent understanding of the learning process and how individuals obtain knowledge is discussed. The methodology of a mainly teacher-directed learning process, the textbook-based method, is reviewed and compared to the methodology of a more student-directed learning process, or the PBL method.

The researcher reviewed the history of education as it evolved from an individual system of life-sustaining knowledge acquisition (i.e., what was needed to literally survive in the world) to one of mass instruction for the benefit of society as much as the individual. To further develop the research basis, learning theory is discussed and its instructional delivery methodologies examined. The impact of governmental accountability on public education in the form of standardized testing and its impact on instruction is also discussed (Turnipseed & Darling-Hammond, 2015). Teacher perceptions are examined to better understand their impact on instruction and student academic achievement outcomes.

The process of learning through some form of instruction has evolved from a very personal and informal task-oriented model to a highly organized and systematized model of education for the masses (Tyack, 1974). The need for a widespread societal educational system required an examination of learning efficiencies. What tools, programs, and strategies are most efficacious to the process? To maximize learning efforts, different models of instruction have been created and utilized. Some models better met the needs of the individual student while others better meet the needs of the whole class or group. The process of learning itself needed to be studied to determine the best method for the intended outcome. One of the most pressing and conflicting issues to address in implementing any model of instruction is to determine if the method to be implemented will maximize learning for all students collectively, maximize learning for each individual learner, or maximize learning for both? Researchers, philosophers, and authors have studied learning processes and results and have wrestled with this issue, seeking to understand how learning is best achieved at both the individual and the collective levels.

Understanding the Learning Process

Webb's (2002) model of comprehension, known as Webb's Depth of Knowledge (DOK), helped to bring further understanding of how deeply students learn. DOK was a shift from the model found in work of Bloom (1956) who developed a taxonomy of learning. Bloom's work focused on the tasks to be completed in the learning process. Webb focused on the complexity of the thinking required to complete the tasks within the process. Bloom's taxonomy is linear with skills building upon one another. Educators have been using Bloom's work for years in guiding the delivery of content. The taxonomy provides strong guidance in lesson planning and the tasks student are to complete during the lesson (Forehand, 2010). Webb shifted the focus on the end product to the thinking required in a lesson's task or objective. Webb was interested in what lead to the acquisition of knowledge. The important distinction between Webb and Bloom is that Webb extended the discussion from what is to be learned to how the learning occurs. DOK categorized tasks into four levels based on the complexity of thinking required: (a) recall and reproduction, (b) skills and concepts, (c) strategic thinking, and (d) extended thinking.

An important point to note is that DOK is not necessarily developmentally sequential (Aungst, 2014). A student may achieve a task working initially from the third level, strategic thinking. Students do not always progress from recall through to extended thinking. Bloom's taxonomy is built on the premise of starting at its base, understanding, and progressing through to synthesis.

Using the graphic located in Figure 1, Francis (2016) attempted to clarify that DOK levels are not an extension of, or to be related to a taxonomy or hierarchtical model, as Bloom portrayed learning. DOK is entirely different and correlates to how extensively students are to express and share their knowledge and thinking. DOK gets at the depth of the understanding within a learning context. DOK does not express what the student is expected to do or demonstrate, but rather the situation or scenario in which students express and share their learning.

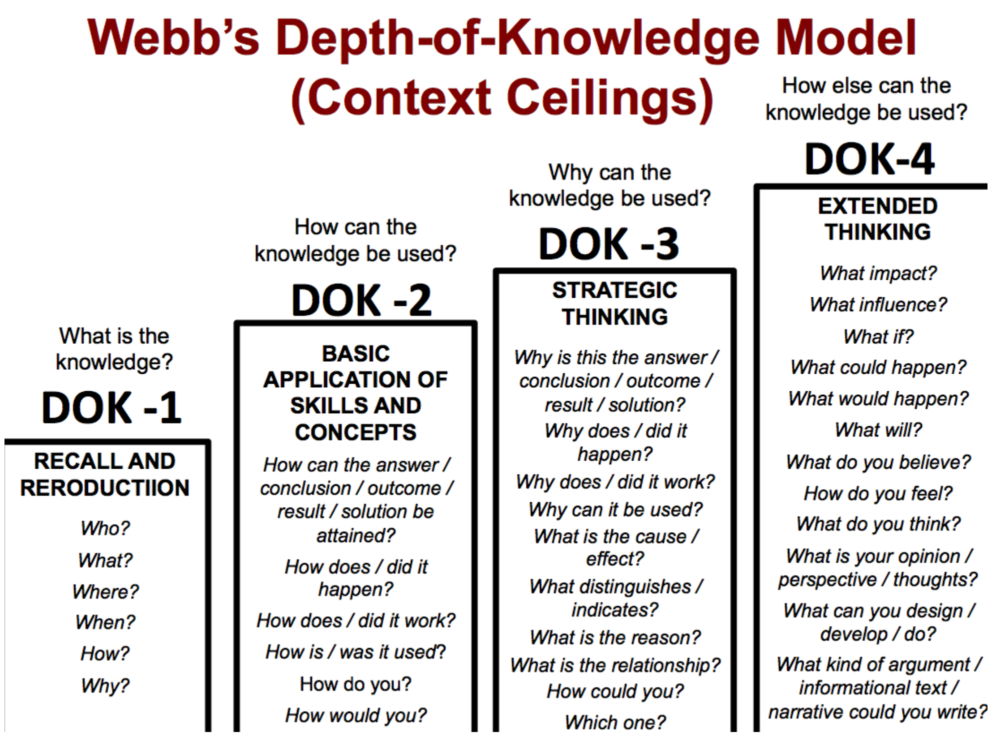

Figure 1. Webb's Depth of Knowledge (2002).

Historical Learning Models

Educational methodology and pedagogy have changed in response to the educational needs and resources of society. In the earliest educational processes, whether the learner was working towards a profession or towards obtaining a skill for a simple sentience existence of their family, the instructional methodologies were informal and found embedded within daily routine. Basic farming skills and methods a young farmer would experience, or apprenticeship skills and methods found within any of the skilled trades were learned daily. Women were largely taught life skills from their mothers, grandmothers, and aunts; these skills involved childcare and homemaking. Men were taught how to farm, hunt, or a skilled trade such as carpentry or blacksmithing. The education of the masses was conducted on an individual basis, based at home, and related to sustenance. Through the development of more and larger cities, the printing press, and increased prosperity, educational opportunities expanded in step with society. The need for a widespread and more academic and scholarly educational system arose leading to the creation of universities of higher learning and careers in businesses and science. The learning model found in these early institutions followed a lecture-based model which relied heavily on the ability to access and read printed materials. Without wide scale printing, a teacher would lecture so the students could create their own printed copy (Hanford, 2017).

> Before printing, it was very difficult to create books, and so someone would read the books to everybody who would copy them down," says Joe Redish, a professor of physics at the University of Maryland. He points out that the word "lecture" comes from the Latin word meaning "to read." (Hanford, 2017, p. 1)

Learning was reserved for the wealthy. The Industrial Revolution was the catalyst for an educational system developed for the masses, while not at a high level, at least at the level of basic literacy in reading and math. The need for a more educated populous to fill the jobs created in the Industrial Revolution resulted in widespread implementation of compulsory elementary education in the United States (Robinson, 2012) and other developed countries.

The need to educate the masses resulted in a system of education that largely followed the industrial model of manufacturing. A system that, for efficiency reasons, created an assembly line type format in which students were funneled through the process of education in batch lots, or classes, through a series of uniform courses within a given timeframe to produce, in the end, a uniformly educated populous. For this system to be effective, conformity was required in both curriculum and pedagogy. The only room for individualism was in the outcome of the assessments of learning in which individuals would be ranked according to a uniform grading scale and then based upon the results, sorted into skilled, non-skilled, and professional career pathways (Robinson, 2012). The most efficient method of instruction was the teacher-lecture model and the utilization of a uniform grade level based textbook. This educational learning model utilized an authoritarian teacher, similar to the factory supervisor, to lead students in rote memorization for learning.

The factory model of education with a uniform textbook-based curriculum was effective for its purposes in the early half of the 20th century. The Soviet launch of Sputnik in 1957 brought fears to the United States of being surpassed as the world leader and superpower in all areas including education (Kaestle & Smith 1982). A shift was required in public education to place a heavy focus and emphasis on math and science education.

Governmental Reports

The landmark report, *A Nation at Risk* (United States National Commission on Excellence in Education, 1983), caused deep concern for many that the fears of the Sputnik era may have been warranted and that the United States had lost its world leadership role in the area of education and that the United States educational system was not meeting the needs of the nation. One major recommendation of the report was a return to the basics, interpreted as a return to the emphasis on basic reading, writing, and mathematics skills and curriculum, through a textbook-based program of instruction in a uniform manner of delivery.

The No Child Left Behind (NCLB) Act of 2002 also called for a return to the basics with a heavy emphasis on reading and math performance. As a result, most school districts implemented a heavily scripted textbook-based curriculum in these content areas. Annual state multiple choice assessments were developed and implemented to identify the performance level of each student, school, and district. These assessments were labeled "high stakes tests" since they were used to label schools as failing and implement mandated restrictions and penalties on these schools under the premise that the schools required even further restrictions and guidance from an outside authority. The ever-increasing academic achievement targets of NCLB resulted in a majority of schools being labeled as failing or underperforming, which ultimately led to the demise of the NCLB program and mandates. The capacity for all schools and students to meet or exceed standards was unattainable in an educational system focused primarily on two performance levels, math and reading. NCLB sought to ensure that 100% of students would be 100% proficient in math and reading standards, an honorable but unrealistic goal.

The net effectiveness of what had become the traditional educational model, the textbook-based curriculum delivered by a teacher in a direct instructional model, has resulted in a mix of results in academic performance. The efficiency of such a model for educating the masses is evident, but the ability to engage all students is not. For a learning environment to be effective, it is required that students become engaged in the lesson and when a student's personal interests are piqued, the engagement is greater, leading to deeper learning (Bell, 2010).

In an effort to meet students' interests, several methods of instruction have been developed and studied. John Dewey's (1916) work focused on experiential learning, at times referred to as learning by doing. Dewey's work led to a number of similar approaches referred to as either problem or project-based learning. Dewey believed teachers should not be in the classroom simply as instructors but should be the facilitators of learning. Working at the same time in the field of psychology, Jean Piaget's work on the cognitive development of children also supported the premise that experiential-based educational opportunities were most beneficial to the students as well as society (Singer & Revenson, 1997). Dewey strongly believed learning should be interdisciplinary since the world around us was built upon multiple actions and interactions. In light of his recognition as an important educational philosopher and pragmatist, his theories have been, at times, poorly understood and applied haphazardly (Niedermeyer, 2014).

The dissection of content into separate curricular areas was bemoaned by Dewey (1916) who pointed out that there was a clear intermingling of content in real-world examples. Dewey used gardening as an example of a subject that should be taught both for preparing future gardeners and simply as of a way of passing time for pleasure. Gardening offers an approach to knowledge that is far reaching. When presented in an educationally controlled environment, the chemistry of soil and the role of light, air, and moisture can be introduced in a vital way. Dewey believed as students matured, they would make connections between problems of interest to them, pursued simply for the sake of discovery, and independent of their original interest to problems in general. Physics as a discipline, for example, grew out of the use of tools as simple machines.

Another constructivist model of learning, although originally designed for "phrenasthenic" or "special needs" children, was created by Maria Montessori (1949), during the same time Dewey and Piaget were writing and studying about learning environments. The Montessori philosophy spawned its own small movement, resulting in Montessori specific schools. Dewey posited that constructivist learning should be embedded in all schools and not segregated into a separate learning environment.

In an examination of the effects of the Montessori Method, in terms of preparing children for primary education, Kayili and Ari (2011) found a statistically significant difference between six-year-old students immersed in the Montessori Method and a control group that was not. The same study also found the Montessori Method was effective in improving student behavior and concentration. The findings match other studies of the Montessori Method. Kayih and Ari also found the method improved language skills and resulted in more children becoming successful in acquiring the concept of numbers.

Jean Piaget laid the foundation for the constructivist approach to education in which students build on what they know by asking questions, investigating, interacting with others, and reflecting on these experiences. Waite-Stupiansky (2017) further described how Piaget stressed that knowledge and experience is constantly being "assimilated" or filtered through pre-existing concepts. This process begins in the infancy stage of human development. Stated differently, new knowledge is first interpreted by existing knowledge and then connected to existing knowledge. The underlying assumption of constructivism is possibly most clearly expressed by

Ausubel (1968): “The most important factor influencing learning is what the learner already knows”.

Vygotsky believed the most important role of the teacher was the creation of a social environment, or culture, in which the teacher would mediate the learning process through the use of appropriate tools and symbolic systems, while participating as a participant-observer to help students with the construction of new knowledge (Eun, 2010). Vygotsky also expressed that learning only took place when students were working within their Zone of Proximal Development (ZPD). The ZPD is the area between a learner’s independent working ability and that requiring guidance and assistance from a competent adult or peer.

Jerome Bruner is also considered a founding father of constructivist learning. Takaya (2008) defined four essential themes of Bruner’s work: (a) teaching and learning should focus on mastery, (b) the learner’s readiness to learn must be considered, (c) emphasis should be placed on developing a student’s analytical skills, (d) the learner’s interests should be considered and encouraged. Takaya further analyzed Bruner’s work in which he expanded the thinking and research on the importance of the culture in learning. Four instructional impacts were noted in Bruner’s later work, including cultural motivation, or peer influence, echoing Vygotsky.

An important consideration in the constructivist approach, which often includes group work, is the potential and real conflict between the needs of the group and the individual. Osborne (1997) argued that tensions between individual and group needs and desires make classroom explorations and the subsequent conversations progressive and creative. The role of the teacher is in balancing the competing individual and group needs dilemma. At times a teacher may sacrifice subject matter for enhanced behavioral control, in order to minimize any conflict detrimental to the learning. Osborne argues that for optimal learning in the constructivist classroom the teacher is to manage, and at times, foster conflict.

Several pedagogical implications of constructivist learning are discussed by Ernest (1996). The implications Ernest presents are: the teacher's sensitivity to the learner's prior knowledge, the students' use of cognitive conflict techniques, assumption of responsibility through self-regulation, connections to previous learning, multiple representations, development of goals, and an understanding of the social context of learning. Sensitivity to students' knowledge includes using students' previous conceptions and understanding to build and expand knowledge. Cognitive conflict techniques allow students to troubleshoot their own thinking and develop meaning. Self-regulation allows students to think about their thinking and become responsible for their learning. The use of multiple representations of knowledge offers more avenues to connect to students' prior understanding. The awareness of students' goals relates to the difference between teacher and student goals, including the need for students to understand intended goals. Social contexts for knowledge occur in various social settings. An example is the use of informal (street) knowledge versus formal (school) knowledge.

Cooperative Learning

PBL lessons and activities are commonly conducted in groups, under the premise of a cooperative learning pedagogy, with pairs, triads, or larger groups of students working collaboratively to both learn and solve, or complete, the project at hand (Wrigley, 1998). PBL can be completed by individuals as well, but this is less commonly the case. Given the tendency of PBL collaborative grouping, it is important to discuss cooperative learning or "group work." Working in a group can consist of actions from the full range of a cooperative nature, to one of great conflict. Managing the group task, dynamic, and roles, is crucial in a successful learning activity. Students cannot simply be grouped together and expected to work in an effective and cooperative manner. Marzano, Pickering and Pollock (2001) reported in their study on cooperative learning that when groups are effectively structured, student achievement gains of 28% were demonstrated. A clear caution was made that grouping students of low ability in homogeneous groups can have a negative effect. Creating groups of students with various abilities, strengths, and skills tends to raise the levels of all when the highest performing students in the group push all members, similar to a high tide raising all boats in a harbor.

Several reasons for the benefits of cooperative learning were presented by Felder and Brent (2007). An active learning cooperative lesson is simply more interesting. Group work helps students to remain active and engaged. When left on their own on individual projects, weaker students are more likely to give up, or "hit the wall." Fellow group members can encourage these students to push onward. Efforts to help, clarify, and summarize concepts to group peers further strengthens the understanding of all members.

Teachers' reflections on the implementation of cooperative learning, as reported by Gillies and Boyle (2010), indicate positive experiences for themselves and their students. Some positive improvements noted in student work were: more risk taking, more work completed at a higher level and in less time, and the class was a happier place. One significant challenge reported was the management of student socialization. Additional time was needed in lesson preparation but the benefits exceeded this challenge.

Cooperative learning methods have shown enhanced student achievement and attitudes toward learning (Slavin, 1983). However, cooperative groups can result in reliance on other group members, decreasing independent thinking and personal responsibility (Corno & Mandinach, 1983). The effectiveness of the method depends on the way groups are composed and the methods of student accountability used (Slavin, 1983). When working in a cooperative group, students must monitor their own understanding, compare the viewpoints of others to their own, and ask clear questions. Teachers must guide students through this process to realize the effectiveness of this method.

Gillies (2003) conducted an overview of five different studies and found that in successful cooperative learning classrooms teachers followed an intentional process of structuring the cooperative group work. The intentionality of establishing the cooperative learning classroom allows children to derive the benefits attributed to this pedagogical practice. Conducting a similar review of the research, Slavin (2014) summarized five key practices necessary for teachers to successfully implement cooperative learning: (a) form interdependent teams, (b) set group goals, (c) ensure individual accountability, (d) teach communication and problem solving skills, and (e) integrate cooperative learning with other structures. When these five practices are established, Slavin concluded that students would be successful in meeting learning objectives.

Connecting Knowledge

After twenty-five years of teaching medical students, Dennick (2016) reflected on the constructivist approach used in medical school internships and residencies. He asserted that in the constructivist model the brain naturally attempts to extract meaning from the world and interprets new experience through existing knowledge. The process of building and elaborating upon this new knowledge is identical to the scientific method. In his research he identifies "student's theories of learning." Students bring their own mental constructs or "theories" to explain phenomena they encounter. A medical student brings years of personal experience with heat, light, gravity, solids, liquids, gases, plants, animals, and people. In an attempt to make sense of the world, the student's brain attempts to make connections even before any scientific teaching in medicine is encountered. Dennick goes on to cite several neuroscience studies that demonstrate considerable evidence that our perceptions of reality are constructions. We do not perceive reality as it actually is, rather we perceive a construct of reality based on a probabilistic model created by the brain, based upon given inputs from our visual, auditory, and other senses, and filtered through our understanding and prior knowledge.

Crockett, Jukes, and Churches (2011) wrote about how a minister of education from a respected country lamented that his country had produced many highly educated useless people. The academically successful educational system found in this country had produced people who had obtained a high level of knowledge but lacked what may be termed as "street smarts." Street smarts can be defined as having higher level thinking skills and competencies to solve real-life problems in real time. This definition of "street smart" is what would be the result of learning in and from a problem-based constructivist learning model. The acquired knowledge is only of high value if it can be applied to constructs and challenges that need to be resolved in life. Crockett (2011) further developed a series of fluencies needed in the present time to become street smart. He describes these as 21st century fluencies and they include: solution, creativity, collaboration, media and informational fluency. Having the totality of these fluencies is the construct of a global digital citizen.

There are conflicts between the short-term and long-term academic needs and goals in education. There are short-term needs for students, and therefore schools, to perform well on standardized exams used to measure both student and school performance. In contrast, there are long-term goals of educating students to be well equipped to work collaboratively, apply knowledge to solve problems, and to become lifelong learners contributing to betterment of society. These long-term goals are more difficult to address quickly. Gash (2015) stated the central issue in meeting these competing interests is to develop a new way of thinking that requires more flexibility in the traditional approaches to teaching and learning. He stated that a major reason it is difficult for educational systems to change and adapt is because teaching and learning are so fundamental, and seemingly beyond change, where historically the teacher is the expert who imparts knowledge and the learner listens and remembers. One important change needed is for an emphasis on the learner as problem solver and not solely one who remembers. A second change has to do with views of curriculum and whether the focus is on the cognitive processing of learning or the knowledge to be learned.

Project-Based Learning Foundation

Against the theoretical background of Dewey and Montessori, PBL emerged more than a half century ago as a practical teaching strategy (Boss, 2011). Students are challenged in the PBL model to solve problems that mimic real life. PBL puts the student in charge of the learning by asking and answering questions, rather than responding to the questions of a teacher or textbook. PBL can be applied across all disciplines and emphasizes active student-directed learning. The relevance of applying problems to real-world contexts plays a strong role in engaging students and providing a greater motivational factor in student learning. Gultekin (2005) reported evidence that PBL helps students to become better thinkers, researchers, and utilize higher order thinking skills. Heitin (2012) reported that PBL is a strategy that is helping at-risk students remain engaged in their learning and stay in and complete school. Students who participated in PBL also exhibited better scores on Advanced Placement tests (Parker et al., 2013).

The departure from conventional modes of teaching required teachers to be willing and able to conceptualize their role in learning. A PBL approach required a shift from a provider of information to a facilitator of learning (Park, Rogers, et al., 2010). PBL placed demands on both the teacher and the student (Boss, 2011). Additional professional development was necessary for teachers to understand their role and the research into cognitive development using PBL. Boss concluded that PBL would best promote the skills needed to prepare students and honor the requirement to meet state standards.

Although PBL can present challenges of time management and logistics, careful planning and collaboration can help to overcome them. The PBL approach resulted in greater student engagement and motivation (Robinson, 2012). The ability to use the PBL approach regularly is achievable. There is more work required with PBL than is required through the use of a textbook-based approach, but the research demonstrates the benefits outweigh the cost of additional time and resources.

PBL incorporates many facets of learning as displayed in Figure 2. PBL is organized around an open-ended driving question, intended to create a need to know essential skill or question that creates a context and reason to learn, requiring inquiry to learn and create. When used properly, inquiry leads students to develop critical thinking, problem solving, collaboration, and communication skills. PBL teaches students to work as a team yet allows for student voice and choice to increase student engagement. Simultaneously, PBL teaches students to work independently and take responsibility and incorporates feedback and revision, to ultimately provide results presented publicly.

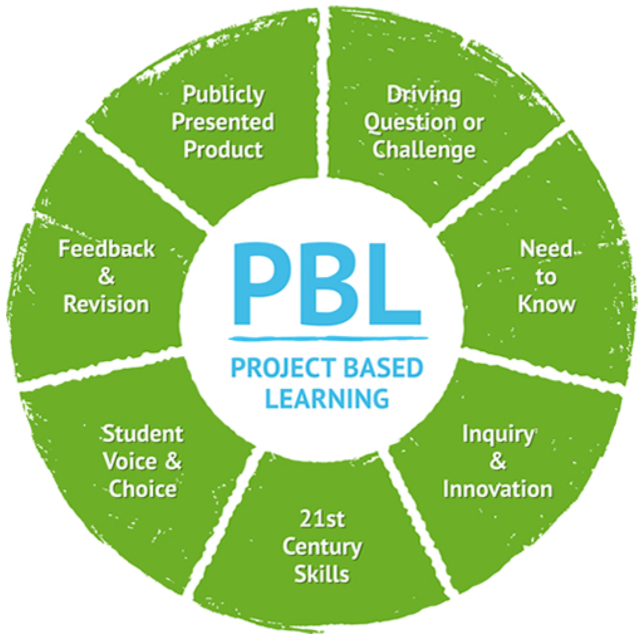

Figure 2. Project Based Learning (Zulama, 2017).

Crockett, Jukes, and Churches (2011) studied two groups of social studies students, one group was taught using traditional methods and the other taught using project-based approaches. The end of the year state-mandated test results from both groups' results were surprising to the researchers. Both groups scored at similar levels of achievement. One year later, without warning, the two groups were given the exact same test. The group taught through traditional methods had retained 15% of the content from the previous year. The group taught using the PBL methods had retained over 70% of the content, demonstrating a significantly deeper understanding and the transference of knowledge to long-term memory.

The traditional textbook-driven instructional design provides a teacher-centered approach where information flows largely from the teacher to the student, where the teacher is highly engaged while moving, writing, explaining, erasing, and questioning. The student is largely a passive recipient of information. In this model, the talking that occurs in the classroom is largely that of the teacher. As students get older, there is a tendency towards even more teacher talk and presentation. Hattie's (2002) research into visible learning found that somewhere between 70% and 80% of class time is dominated by teacher talk. This phenomenon isn't new and has actually shown an increase over time. Tsegaye and Davidson (2014) found teachers speaking 84% of the time. Cross and Nagle (1969) found teachers spoke 75% of the time. They cite research from 1912 that reported teachers talking 65% of the time. If listening, as opposed to active engagement, was a highly effective way of learning, test scores should increase as teacher talking increases. Research has shown the opposite to be true, both in terms of engagement in learning, as well as in higher assessment results. Yair (2000) measured a 20 point higher level of engagement when students were taught in hands-on labs as opposed to lecture. Riskowski, Todd, Wee, Dark, and Harbor (2009) measured a 20 point higher assessment score on a science assessment for those taught in a hands-on lab.

The traditional classroom provides many opportunities for students to hide in plain sight, to pretend to be engaged and learning through simply appearing to attend to the spoken word, nodding in agreement, and completing whatever worksheet is presented with accuracy and precision, or not. Rollins (2017) calls this the implicit deal: "You leave me alone, and I'll do the same." An active classroom environment, dominated by student engaging tasks, makes the hiding places nonexistent.

Instruction that is broken into shorter time frames has also been measured to increase learning. The traditional teacher-centered and often lecture-based model requires a student to remain focused on one thing, the teacher's voice, for an extended period. Hartley and Davies (1978) found that student recall of the content dropped significantly the more time a teacher spoke. Students could recall 70% of the first 10 minutes of a presentation, but only 20% from the last 10 minutes. This research calls for students to be engaged in activities that are varied, interactive, and engaging, which is the intent and design of PBL. The study also demonstrates that the listening portion of direct instruction must be brief, with a very thoughtful presentation ensuring the most important information is delivered in a brief initial teacher directed (spoken) time frame. If listening to someone talk was the most effective way to learn, our students would be soaring academically, which they are not (Rollins, 2017).

PBL has been studied as a method to both promote student learning and to motivate students to learn (Blumenfeld et al., 1991). These researchers argue that PBL does both when critical factors are addressed. Teachers must have strong pedagogical skills to design projects and problems. PBL is successful when teachers make the content of the projects interesting and include opportunities for student choice. Teachers must not provide too much of the solution, or guidance to the solution, which takes the challenge of the task. Of no less importance is the teachers' interest, motivation, and confidence in creating engaging projects. To achieve success the projects must emphasize learning is not simply a process of obtaining information, but that it is an active process of knowledge construction. Successful implementation of PBL includes scaffolded instruction, assessment which is often less structured and time consuming, instruction that does not oversimplify, and a classroom climate that promotes inquiry, risk taking, and a mastery orientation.

The central activities of a project must include the construction of knowledge and new understanding by the students (Bereiter & Scardamalia, 2000). PBL activities must include adequate difficulty a lesson that does not end up at some predetermined outcome and include student autonomy and responsibility. Traditional lab experiments do not fit these parameters and while these may include real or synthetic problems, are not PBL activities.

Experiments using mice, living in an enriched environment, have shown that this stimulates neurogenesis and results in increased synaptic connectivity (Kempermann, Kuhn, & Gage, 1997). This data suggests that learning is a physiologically constructive process in the brain, enhanced by active learning. The physical structure of the brain provides a neuroscientific rationale for cognition, implying that certain pedagogical methods, such as active rather than passive learning, should be encouraged.

Davies (2007) identified another benefit of the PBL model was a reduction in the teacher-to-pupil ratio through the use of pairings and grouping of students. A classroom of 30 pupils can be reduced to groups of 15, or 10, or fewer. The main advantage of this is to increase the feedback provided to students, both by the teacher, as well as the student peers. Hattie (2009) has identified feedback of student work as one of the most effective methods to improve learning, with an effect size of 0.75.

A common complaint of teachers has been that students are not paying attention. Wolfe (2010) explains in her book *Brain Matters* that students' brains are always paying attention, to something. The brain is constantly attending to a person's surroundings to determine and focus on what seems important, needs attention, and filters out what is valued as less important. The brain needs to find relevance in the activity to attend to it with a greater and longer focus. With this in mind, teachers should engage students in a writing or math activity by making the activity a banking activity, or a game, where the academic content is made relevant through the use of a project or problem the student is interested and, minimally, familiar with to engage the student's brains.

Listening as a skill is valued by future employers of students, but it is not the most valuable. Devoting a majority of classroom time to activities, in which students are passive listeners, is inefficient. More time should be allocated to developing the knowledge and skills employers highly value, including collaboration, problem solving, and leadership. DeLeon and Borchers (1998) surveyed large manufacturing companies and found that the most important skill desired of employees was being an effective team member, at 90%, followed by problem-solving, at 73%. Proficiency in reading, writing, and math was further down on the list. While basic skills are desired and required, it is apparent these are considered more common in applicants and therefore, less valuable. The highest rated qualities are those not content specific and are those taught less often in schools, but the most desired by employers. These skills are not learned through a textbook-driven teacher-centered format where the students are passive recipients of knowledge. A PBL approach, where students are active learners, develops skills employers identify as of having high value.

Classroom structure affects student learning and motivation as well. Ames (1992) examined classroom structure and PBL task construction's impact on students. Students' engagement and interest increased when tasks had varied topics of interest and those that offered personal choice, or control, had social connections and interactions, and were challenging. Students' perceptions of academic control, whether real or imagined, was an important factor in their effort and learning. When students are deeply engaged in a topic or task, many classroom management issues lessen. As Lambros (2002) reported students engaged in PBL became more responsible and turned in higher quality work when engaged in meaningful projects. Another study found that projects also provided motivation to continue or persevere. Balfanz (2007) studied the dropout problem and noted that when students enter high school significantly below grade level, if given short-term projects and experiential learning tasks, short-term successes in these projects can motivate students to remain in school. Traditionally these students would have to pursue a yearlong succession of coursework in pursuit of a passing grade. When most of a year progresses with them barely passing, or worse, they lose motivation and drop out.

Teacher Perceptions

When some educators hear of PBL, they feel that the process is not preparing students for college, as they believe collegiate learning is still largely lecture-based. It must be noted that there is room for lecture in PBL. Listening and note taking are important skills that students should master prior to leaving high school, but these skills can be built into a project. A growing number of college courses are becoming more experiential-based, as reported by Perry's (2013) study of courses at highly regarded universities such as Harvard and Stanford.

Under the pressure of high-stakes testing and accountability, in the last 10 to 15 years, many teachers have felt limited in their choices about curriculum and instruction. The testing pressures in many schools brought about a return to traditional teacher-directed instruction, in many cases the teacher was far from a director of instruction and was more of a servant of the publisher's program (O'Donnell, 2008). The mantra of "fidelity to the curriculum" became widely used, as though in some way the curriculum was perfect and great care must be taken not to break it during the delivery. This was clearly not the case, as evident by the fact that in California in the 2002 textbook adoption only two publishers where deemed acceptable by State Board of Education edict. These two programs were the Open Court and Houghton Mifflin basal reading series. All districts used one or the other program, both programs were lauded and lamented. In the end, with the 2008 textbook adoption, it was clear neither program had the clear advantage in getting students to read and comprehend at grade level. It was clear due to the fact that in 2008 the State of California approved nine reading programs for district purchase and implementation. Seven years of Open Court and Houghton Mifflin had not delivered improved test scores on a large scale and most of the state's students were still underperforming in English Language Arts.

A large percentage of current teachers experienced the era of "fidelity to the curriculum" and its lock on creativity, disregard for experience, and emphasis on one size fits all instruction and multiple choice assessments. For these teachers, PBL can bring the fear of a loss of classroom control and behavior and prescribed minute by minute lessons already planned. For veteran teachers, PBL often brings comments such as: "This is how I used to teach!" Although often not the appropriate level of rigor, many teachers prefer to plan their lessons based on the skills and needs of their class, rather than to simply "deliver instruction" or endure a long march through a textbook. A recent study of teacher perceptions on PBL found that teachers felt more satisfied with their teaching methods and results when using PBL (Finkelstein, Hanson, Huang, Hirschman, & Huang, 2010).

Rigorous Curriculum Design for Project-Based Learning

In response to the implementation of the Common Core State Standards, the school district in this study chose to adopt a curriculum development process titled Rigorous Curriculum Design (RCD) developed by Ainsworth (2011). The RCD process starts by building the foundation of a grade level curriculum through a prioritization of the standards to be addressed and the development of a pacing guide, also known as a scope and sequence. Instructional units are then designed consisting of a collection of learning experiences to create what are called units of study. Ainsworth (2011) believes the following:

> The need for a cohesive and comprehensive curriculum that intentionally connects standards, instruction, and assessment has never been more needed than it is today. For educators to meet the challenging learning needs of students, comprehend all the

> standards, prepare for a variety of formative and summative assessments, demonstrate proficiency on high-stakes state tests, they must have a clear roadmap to follow throughout the school year. Rigorous Curriculum Design presents a carefully sequenced hands-on model that curriculum designers and educators in every school system can follow to create a progression of units of study that keeps standards, instruction, and assessment tightly focused and connected. (p. xix)

To develop a full grade level by grade level curriculum for both reading and mathematics, grade level teams of teachers were convened. Each team consisted of three to six members. Each teacher was recommended by a site administrator as an exceptional teacher. The teachers were provided a professional development on the RCD process and attributes. All grade level teams met at the same time in the same location, which was designed for them to make informed decisions based upon a kindergarten through high school articulated course of study. Each grade level team had to fully understand what skills were needed to be addressed in the grades prior to their grade level work, and also what subsequent grade level teams were expecting them to have addressed in their grade level work. Too frequently teachers work in isolation, either in their own classrooms or in their own grade level teams. The RCD process followed in the district was intended to reduce isolationism and to build collaboration among teacher teams and develop a full articulation of grade level skills and concepts.

In total, nearly 200 teachers worked on the RCD units of study over an initial two-year period. Subsequently, a refinement process was completed that took into account lessons learned in the implementation of the units in the classrooms. Some units were bolstered and expanded with others trimmed or consolidated to better address standards, learning styles, relevance, and access to resources. The units all have a unit organizer designed to be a pseudo teacher’s guide as would typically be found in a textbook program. The organizer includes a unit overview section, similar to an abstract, an instructional sequence, known as a pacing guide in the textbook model, an organizer for the student performance tasks, and a resource appendix to supplement the lessons based on teacher and student needs and interests.

The RCD process is structured in a manner that addresses the curricular needs of meeting the prioritized standards and objectives through a logically sequenced manner using appropriate instructional delivery methodologies and appropriately placed formative and summative assessments. RCD has at its core Engaging Learning Experiences (Ainsworth, 2011). These experiences consist of large and small projects. The experiences are to incorporate the following attributes:

(a) Authentic
(b) Relevant to life situations and contexts
(c) Interdisciplinary
(d) Use embedded informational technologies
(e) Highly motivational, not routine
(f) Mentally stimulating
(g) Include both collaborative and individual work
(h) Incorporate: reasoning, application, analysis, synthesis, creativity, self-assessment, and reflection

When considering these attributes, it is evident these are the key components of PBL. The graphic below, the Gold Standard of PBL, published by the Buck Institute (Larmer, Mergendoller, & Boss, 2015), identifies seven elements that encapsulate PBL. The attributes of

RCD and the elements of PBL match, overlap, and intertwine completely, making the RCD units of study a collection of PBL units.

Figure 3. Essential Project Design Elements (BIE, 2015).

Summary

This chapter presented a historical review of learning and education. Beginning with a review of informal education in an agrarian environment, where learning occurred in homes, farms, and small workshops, experienced in daily living activities, to an apprenticeship model both formal and informal. The evolution of the learning model and educational framework brought about by the Industrial Age was also described and explored in terms of the impact made upon the formal structure of education. Later in the chapter, the impact of the technology revolution and information age's effect on education was discussed and how the foundation was laid for a return to more of an apprenticeship model where learning is enhanced most when it is presented within a contextual learning framework, or a project and problem-based model.

Researchers and theorists' work looking into effective learning strategies was examined. The conclusions of Piaget, Webb, Bloom, and Montessori were presented. Their work examined student learning and they sought to determine the most effective learning methods, commonly referred to as the constructivist model. Constructivism, or learning by doing, creating meaning from these investigations, has led to terms now commonly referred to as project-based or problem-based learning.

This chapter also presented the evolution of formalized learning and state-run school systems and with it the pressure for improved student performance and accountability, now termed standardized testing. Calls for increased student performance were presented, including the reports and programs titled A Nation at Risk, No Child Left Behind, and The Every Student Succeeds Act. The response to these programs was discussed, both the standardized textbook driven model of a teacher lecturer, and the constructivist or project-based model.

Recent changes to instructional technology and the impact the information revolution has made on education was presented. The changing needs of the economy and the workforce drives a need for creativity and problem-solving, bringing slow but steady changes to the learning environment, which are more in-line with these needs.

CHAPTER 3: METHODOLOGY

This study examined the effectiveness of PBL on student achievement and teacher perceptions of PBL. The study was conducted in an urban public school district. An explanatory sequential mixed methods design was used; quantitative data was collected and analyzed first, followed by collection and analysis of qualitative data. In this study of the PBL model of instruction, the author utilized a two-group design that compared student reading and math growth scores from fall to spring within a single school year. The study included assessment results from students in grades 4th through 8th from multiple sites, all of whom experienced instruction under a textbook-based model in 2012-2013 and through the use of the district's units of study as their PBL curriculum in 2015-2016. Comparison control group data consists of archival data from 2012-2013 classrooms that measured the MAP growth scores for reading and math.

There were two main quantitative research questions and one qualitative question addressed in this study:

1. Was there a difference in the mathematic growth scores of students taught using PBL compared to those taught from the traditional textbook approach when measured across five grade levels (4, 5, 6, 7, 8)?
2. Was there a difference in the reading growth scores of students taught using PBL compared to those taught from the traditional textbook approach when measured across five grade levels (4, 5, 6, 7, 8)?
3. What are teachers' perspectives on PBL? What were the teacher perspectives on the effectiveness of PBL in terms meeting the rigor and depth of the content standards, engagement of the students in the lessons and activities, and usability of the curriculum?

To answer the quantitative research questions, the MAP assessment was used to test the theory that PBL would positively influence the academic achievement growth scores for students in the district. Student academic growth scores were used to measure growth between the fall and spring MAP administrations. A comparison between a school year when students received instruction through a textbook-based delivery model and a school year of PBL-based instruction was made.

Teacher surveys provided data to answer the qualitative questions related to teacher perceptions of the two instructional delivery methods. The surveys were analyzed and coded to help determine the impact of the two instructional models from the teachers' experience.

Participants

The participants of the study that were used as a comparison group included middle grades students who received instruction in the traditional textbook method during the 2013-2014 school year and the teachers who taught them. The experimental group of participants included the middle grades students who received instruction in the PBL method in the 2015-2016 school year and the teachers who taught them. The students and teachers were from over 20 K-8 elementary schools in the district. The middle grades included grades 4th through 8th. The district demographic data is reflected in the study's participant pool, which consisted of students who were 83% free and reduced lunch and 34% English Learners, with a balance of males and females. The district is 64% Hispanic, 11% African American, 13% Asian/Pacific Islander, and 8% Caucasian (DataQuest, 2017). Teachers in the study had a minimum of three years of teaching experience in the district to ensure they had taught at least one year using the traditional textbook method prior to the 2013-2014 school year and could then compare the two instructional model delivery experiences.

Sampling Procedures

This study included a quantitative investigation of the effects of PBL instruction in comparison to traditional textbook-based instructional methods. Assessment data from multiple sites included middle grade classes implementing the district's units of study as their PBL curriculum. For control group comparison data purposes, archival data was utilized from the 2013-2014 MAP assessments. For the two-group study, the first group experienced textbook-based instruction and the second group experienced PBL instruction as the independent variables. The PBL group was the comparison group. The dependent variable was the MAP growth scores obtained at the end of the textbook-based year and the end of the PBL year.

Students took three MAP assessments within a school year: one in the fall, one in the winter, and one in the spring. Only the fall and spring scores were used to calculate the student growth scores. The MAP assessments were taken on a computer and were untimed but typically were concluded within two 90-minute sessions, one session for math and one session for reading. The results were transferred from the assessment publisher's database to the district's student data assessment program, Illuminate Education (IE). MAP results were then archived in the IE assessment database, which is used to store all student assessment data taken throughout the year, including both in-district and external assessments. The IE reporting tool was used to extract MAP scores and calculate student growth scores by comparing fall and spring assessment data for each student. The growth scores of students from the years identified above were used to compare the two instructional models.

The teachers surveyed were invited to participate in an online format utilizing a Google form. To gain a sufficient number of respondents from a representative sample 12 sites were selected from a randomly generated list using a feature for randomization found in Excel. Only elementary schools were included since the data collected did not include any data for students in high school. Teachers who participated did so anonymously which was intentional to increase participation and also to increase honesty in their responses.

Instrumentation

The district in this study initially implemented the NWEA MAP computer adaptive test in 2005 to measure students' academic growth. The district has been using the MAP exam as a local measure to help inform instructional needs.

The MAP assessment is a nationally normed exam of the NWEA. NWEA measures and reports the validity and reliability of its assessments based on the results of millions of MAP assessments taken each year. Teachers in the study administered the MAP assessments at all district schools. For purposes of this study, the fall MAP assessments were utilized and compared to spring MAP assessments, providing a growth score for each school year within the study timeline.

Using the results of the MAP assessment, a comparison was made to see if more students met growth targets after using the traditional textbook method of instruction in 2012-2013 or if more students met growth targets after the implementation of the PBL units of study in 2015-2016 (see Figure 4 and Figure 5). Growth targets were determined for each student, depending on the student's score in relation to that student's grade level national norm. During the 2012-2013 school year, students were taught using the textbook-based curriculum developed and published by a large educational corporation. The textbook-based curriculum was in its fifth year of implementation. During the 2015-2016 school year, students were taught using the project-based units of study curriculum developed under the Rigorous Curriculum Design model

(Ainsworth, 2011) and written by district teacher teams. The PBL units were in their second year of implementation.

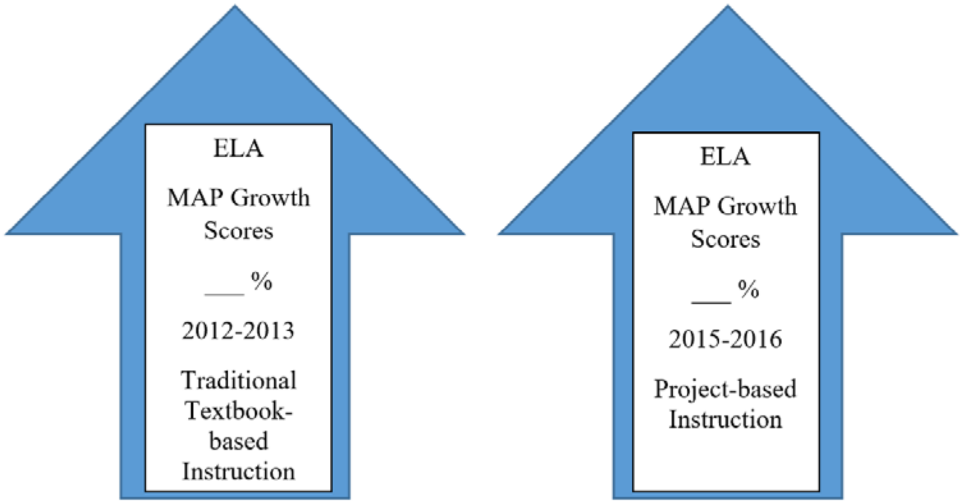

Figure 4. Comparison of NWEA Growth Scores in Reading. Sahli 2017

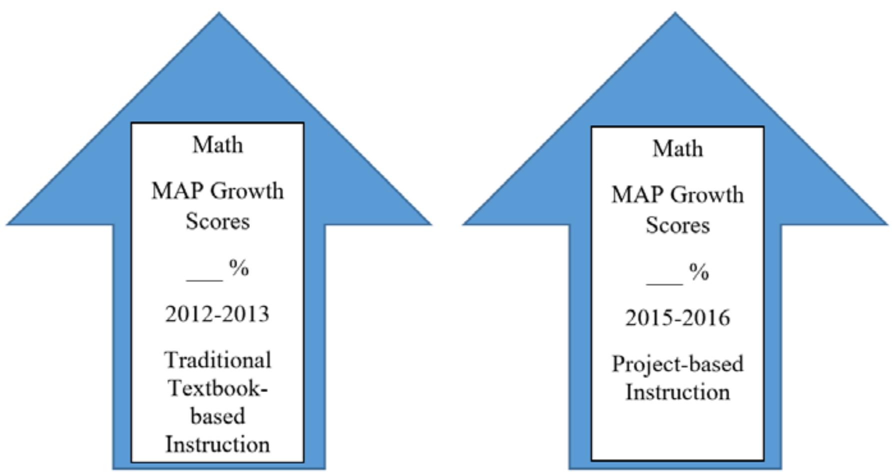

Figure 5. Comparison of NWEA Growth Scores in Math. Sahli 2017

Upon completion of each MAP testing event, student assessment data results were collected and the results were electronically transferred from the NWEA servers to the district's IE database. IE allows district users to view and customize multiple reports of the data. The growth scores from the 2012-2013 school year measured growth during the use of a traditional textbook-based model of instruction. The growth scores from the 2015-2016 school year measured growth during the use of a PBL model of instruction.

Scores for students who had not completed five or more PBL units of study end of unit assessments were excluded from the calculations of the district-wide averages of each grade level. This filter was applied to ensure that student scores from classrooms where a teacher was not adhering fully to the shift to PBL implementation and may still have been following a textbook-based instructional model were removed from the data sample to mitigate any impact from non-PBL using classrooms.

A teacher survey was used to measure teacher perceptions of the instructional models. The surveys were collected without names to maintain anonymity and to increase the honesty of responses. The teacher survey was administered to teachers to collect data on their perceptions and experiences in the implementation of both textbook-based and PBL-based instructional models. The three categories of instructional impact reported were: effectiveness in meeting the rigor and depth of the content standards, the usability of the curriculum, and the engagement of the students in the lessons and activities. The teacher survey asked teachers to rank their responses on a five-point scale, where a score of five is strongly in favor of using a PBL and a score of one is strongly favor using a traditional textbook-based learning model. Using the five-point scale, an average response of a three indicated no preference for the textbook or PBL method. There were five questions addressing the instructional impact of each of the three categories and one open-ended question.

Textbook-Based Model	PBL Model
1) Rigor for Meeting Academic Standards	1) Rigor for Meeting Academic Standards
2) Usability	2) Usability
3) Student Engagement	3) Student Engagement

Figure 6. Teacher Survey of a Comparison of Instructional Model. Sahli 2017

To determine the effectiveness in meeting instructional rigor, the questions pertained to the ability of PBL units to address the standards in a way for students to achieve mastery and also in way to bring a deeper level of understanding as identified in Webb's work on DOK (Webb, 2002). The aspect of usability was questioned to determine how well the PBL units are able to be fully delivered. The traditional textbook-based model of instruction provides a teacher's edition that is highly scripted, and the teacher preparation time is minimal for implementation of the lessons and units. PBL does not provide such a scripted teacher's edition and relies more on the teacher's professional ability to use the PBL unit overview and the standards, scope and sequence guides, to generate lesson plans more adapted to each classes' needs and the teachers' teaching strengths. The level of student engagement in the PBL model was assessed through teacher perception and experience with the delivery of the PBL lessons, including whether the units allowed for creativity and flexibility and whether the units allowed for thematic content integrations to further engage students' interest.

Any effort to replicate this study can be completed provided there is a PBL curriculum in use and there are standard assessment instruments available, such as the MAP. Access to the data and reports can be replicated provided there is some student assessment data collection program available, such as the IE. Several similar student data programs are being used in most school systems, which would allow for the replication of such reports. The replication of the teacher surveys can be conducted digitally with an electronic form or manually with a printed survey.

Reliability

Data were collected through surveys. The teacher surveys provided a more in-depth understanding of the engagement and motivation of teachers in delivering PBL instruction and also their perceptions of PBL on the effects on student achievement, which cannot be found in standardized test results. A total of 64 teachers were surveyed. The surveys were post-only, following the completion of the implementation of the PBL instructional delivery model.

The reliability of the MAP assessment is very high. Studies have consistently yielded statistically valid correlations between multiple test events (Northwest Evaluation Association, 2011). The MAP assessments are conducted nationally in thousands of schools.

Validity

The validity of the teacher surveys was maximized by maintaining the participants' anonymity and asking questions more than once using a parallel phrasing format. To minimize any unforeseen bias in the question responses, the open-ended responses were also submitted anonymously. The teachers in the survey volunteered to participate and data collected were archived by a number assigned at the time of survey submission.

Data Collection

The data collected consisted of the reading and math growth scores of students taking the MAP assessments. The assessments were taken on computer and the data were stored in the IE database. MAP scores from the fall and spring testing sessions were used to obtain the students' growth scores for the school year. The growth score for each student was determined by the fall

MAP assessment and the spring assessment. MAP growth scores vary. The further from the grade level norm a student is, the greater potential for a higher growth score. This study looked to see how many students made significant growth within the school year. The school district extracts the data from the MAP database and inputs it into IE, which is used to sort and filter the data as needed. MAP results can be analyzed using several customized reports.

Teacher surveys were taken online. The surveys were tallied utilizing a Google form and the data were downloaded into an Excel spreadsheet and also input into SPSS. The surveys measured teacher perceptions and favorability to either the PBL or traditional textbook-based instructional model. A five-point scale was utilized with a score of three as neutral, or not preferable to either method, a score of one as preferable to textbook instruction, and a score of five as favorable to PBL instruction.

Data Analysis

Quantitative data were collected from the MAP assessment results, filtered for students with MAP growth scores. To determine PBL participation, the 2015-2015 data were filtered for students who completed six or more unit of study end-of-unit assessments. The independent variables of PBL instruction and traditional textbook-based instruction were compared. The dependent variable was the student MAP growth score. The independent *t*-test was used to assess whether the means of the two groups were statistically different. Cohen's *d* was used to determine effect size. The Levene's test was used to test for equality of variances. SPSS was used to conduct a one-way ANOVA. The ANOVA was used as a second analysis of the data to determine whether the two independent variables demonstrated a significant difference between student MAP growth scores of students taught through the use of a traditional textbook-based model in 2012-2013, with students taught through the use of a PBL model in 2015-2016. Descriptive statistics were used to analyze the mean and standard deviation data.

A multiple analysis was conducted across five grade levels (4, 5, 6, 7, 8). The same data set was utilized in multiple calculations and a priori Bonferroni correction was utilized to adjust the alpha value. The Bonferroni Correction adjusts the *p*-value, since the reading and math growth outcomes were compared across the five different grade levels. The critical *t* value for both math and reading was .05/5 = .01. To conduct the priori Bonferroni correction, the *p*-value was divided by the number of comparisons made. In this case there were five grades, therefore the *p*-value of 0.05 was divided by 5 to yield a *p*-value of 0.01. The Bonferroni Correction helped to reduce the chance of obtaining false-positive results (type 1 errors) when multiple tests were performed on the single set of data.

Group sample size can affect the outcome of the comparison test, therefore it was important to look at the magnitude of the effect size. Effect size measures the sizes of associations or the sizes of differences. Cohen's *d* indicated the difference between two groups' means divided by the average of their standard deviations and was used to accompany the reporting of *t*-test and ANOVA results. An effect size (negative or positive) of $d = 0.2$ is a small effect, $d = 0.5$ is a moderate effect size, and $d = 0.8$ or greater is considered a large effect size. If two groups' means do not differ by greater than $d = 0.2$ standard deviations then the difference is trivial, even if it is statistically significant.

Levene's test was used to verify whether or not the homogeneity of variance assumption was equal or not equal. The high degree of within-group variance indicated by the large standard deviations in both math and reading contributed to Levene's Test for Equality of Variances, yielding a significant result ($p < .01$) for four of the five grade levels tested in math, and two of the five grade levels tested in reading. Also contributing to the unequal variances in PBL versus non-PBL groups, at certain grade levels, was the difference in population sizes (see Table 1). The significant result (p <.05) from Levene's Test indicates a violation of the assumption of homogeneity, precluding the use of traditional ANOVA to compare student groups; however, alternate methods were employed to generate valid comparisons. For grade levels where the Levene's Test yielded a significant result, equal variances were not assumed for the *t*-test, and corrections were made, including a reduction of the degrees of freedom that allowed for a usable *t*-statistic. Even though statistical significance was found, the magnitude of the significance needed to be determined by measuring effect size using Cohen's *d* as noted above.

The Welch's ANOVA takes into account the unequal sample sizes and heterogeneity of variance, providing another view of how the data from the two groups compared (see Table 4 and Table 5). Fisher's ANOVA assumes that all groups have equal variances and use of the Fisher's ANOVA could provide inaccurate results. Since the Levene's test determined that group variances were unequal, in order to verify the analysis, a one-way Welch's ANOVA was conducted on student growth by PBL exposure and by grade level. The Bonferroni and Tukey post hoc tests were not available for data analysis since both require three or more comparison groups. The results of the *t*-test and Fisher's ANOVA provided confirmation of the results of statistical significance.

Teacher survey data were analyzed to determine teacher preference or no preference for their use of PBL or a traditional textbook-based model of instruction. The survey asked teachers to rank their responses on a five point Likert scale, were a rank of five was strongly in favor of PBL learning model and a rank of one was strongly in favor a traditional textbook-based learning model. Using the five point scale, a response of a three would indicate a neutral or no preference to either method.

Ethical Issues

Students were not directly contacted. Archival student data were used and all students in the study were immersed in PBL instruction, thus none were either deprived of, or advantaged by, a control treatment. The researcher was employed by the participating school district. However, the researcher's relationship with teacher participants was not one of a direct supervisory role and would not impact their work. Confidentiality was maintained through the collection of teacher surveys submitted online, both voluntarily and anonymously. Teacher survey participants were provided an informed consent form that provided a simple description of the research. The researcher's district and university Institutional Review Board criteria were met.

Summary

This study was conducted to examine the effectiveness of PBL on student academic achievement and teacher perceptions of PBL. The goal of the researcher was to identify effective instructional strategies that would improve the annual academic growth of students in a large urban school system. MAP growth scores for reading and math were compared between a year of traditional textbook-based instruction and a year of PBL instruction. A Likert scaled survey was used to obtain teacher perceptions on the effectiveness of PBL and textbook-based instruction in three domains: student achievement, academic rigor, and student engagement. An open-ended question in each of the three domains was used to collect feedback in place of an interview. The intended goal was that the anonymity of the online responses would provide more open and honest responses than a face-to-face interview would provide. All data were collected and analyzed during 2017.

CHAPTER 4: RESULTS

The purpose of this study was to determine the effectiveness of PBL on the academic achievement of students and teacher perceptions of and preference for the PBL instructional method. This chapter discusses the results of the study through an analysis of quantitative academic data collected from MAP assessments and qualitative teacher survey response data.

Data Collection

Two sets of data were collected. The quantitative data, which consisted of NWEA MAP assessment growth scores for students, was collected from archival data in the IE student assessment database system during the fall of 2017. The MAP assessments from which this data originated were administered in the school year 2012-2013, as well as the school year 2015-2016. The MAP growth scores were collected for all students in grades four through eight who completed both the fall and spring MAP assessments and therefore, had a MAP growth score generated for them during the 2012-2013 school year, which represents 80% of the students in the identified grades. Map growth scores were collected for students in grades four through eight during the 2015-2016 school year who also had completed six PBL units of study end-of unit assessments, which represents 30% of the identified population. The qualifier of six units of study assessments was included to validate their full participation in PBL instruction. The participant demographics in both of the school years for data collection reflects the overall district demographics which consists of 60% Hispanic, 15% Asian, 10% African American, 9% White, and 6% other groups.

The student participation rate from the 2012-2013 school year was consistent with what was expected (80%), since most students completed the fall and spring MAP assessments and participated in a textbook-based instructional learning model. However, a lower-than-expected participation rate was found in the 2015-2016 school year. It was anticipated that a 50% or higher participation rate would have been realized. The completion of rate of six units of study end-of-unit assessments, validating their participation in PBL for 2015-2016, was found to be 30%. Several possible reasons contributed to this shortfall as outlined later in this chapter.

Quantitative Data Analysis of MAP Growth Scores for Reading and Math

To determine if there was a difference in academic achievement levels between students exposed to PBL versus those with a traditional textbook, a quantitative analysis of student growth scores on NWEA MAP assessments was conducted for reading and math. The NWEA MAP assessments, administered to students in the beginning, middle, and end of the school year, report individual student results on a continuous scale. The calculation for a student growth score in both reading and math was determined by subtracting a student's fall score from his or her spring score on the NWEA MAP assessments.

NWEA MAP is administered in thousands of schools across the country, and the test developers compiled normative data for all test takers. Based on this actual data, individual student growth targets were established. The student growth target for reading and math comprises the scale score that students starting at a similar level tend to improve on their individual MAP score from the fall to the spring. To determine differences in achievement, PBL versus non-PBL students were compared regarding their average fall-to-spring growth scores using the independent samples *t*-test.

The student population participating in NWEA MAP testing for both the PBL and non-PBL groups reflected district norms and had a high degree of ethnic diversity in all grades tested. In total, 11,751 non-PBL and 5,693 PBL students had fall-to-spring MAP growth scores in reading and/or math and were included in analyses. In both groups, between 61% and 70% of students were Hispanic and between 74% and 85% were economically disadvantaged by grade level. Table 1 indicates that the percentage of each demographic group studied varied only a few percentage points. Consistency was high between all groups.

Table 1
Demographic Characteristics of Non-PBL and PBL Student Groups

Grade Level Group	N	Amer. Indian / Alaskan Native	Asian	Black or African Amer.	Filipino	Hispanic	Native Hawaiian or Other Pacific Islander	Two or More Ethnicities	White	Econ. Disadv.
Grade 4										
Non-PBL	2470	3%	9%	9%	5%	66%	1%	1%	6%	83%
PBL	1516	2%	9%	6%	5%	69%	1%	2%	6%	80%
Grade 5										
Non-PBL	2396	3%	10%	10%	5%	63%	1%	1%	7%	84%
PBL	994	2%	8%	9%	3%	70%	0%	1%	6%	76%
Grade 6										
Non-PBL	2473	3%	10%	10%	5%	64%	1%	1%	6%	86%
PBL	1615	3%	11%	8%	5%	66%	0%	2%	5%	78%
Grade 7										
Non-PBL	2223	4%	11%	10%	5%	62%	1%	1%	6%	86%
PBL	931	3%	7%	8%	6%	68%	1%	2%	6%	78%
Grade 8										
Non-PBL	2189	4%	11%	10%	6%	61%	1%	1%	6%	81%
PBL	637	3%	5%	6%	8%	68%	1%	1%	7%	75%

The greatest variance in ethic group representation in grade four was 3% for both African Americans and Hispanic groups, with 6% represented in the PBL group and 9% in the non-PBL group and 69% represented in the PBL group and 66% in the non-PBL group, respectively. The greatest variance in ethic group representation in grade five was 7% for Hispanics, with 70%

represented in the PBL group and 63% in the non-PBL group. The greatest variance in ethic group representation in grade six was 2% for both African Americans and Hispanic, with 8% represented in the PBL group and 10% in the non-PBL group and 66% represented in the PBL group and 64% in the non-PBL group, respectively. The greatest variance in ethic group representation in grade seven was 6% for Hispanics, with 68% represented in the PBL group and 62% in the non-PBL group. The greatest variance in ethic group representation in grade eight was 7% for Hispanics, with 68% represented in the PBL group and 61% in the non-PBL group. The greatest variance in any grade level for the economically disadvantaged group representation was 8% in grades five, six, and seven.

Table 2 and Table 8 present mean growth scores by grade level for PBL and non-PBL students taking the fall and spring NWEA MAP assessments in math and reading, respectively. The tables show summary data for all grade levels. Grade level specific tables were presented after the math and reading summary tables. As shown in Table 2 and Table 8, within each student group (PBL and non-PBL), the mean student score decreased by grade level. For example, the average growth score in math for PBL students decreased from 9.90 among fourth grade students to 4.81 among eighth grade students. Growth scores for non-PBL students in math, PBL students in reading, and non-PBL students in reading followed a similar pattern.

Table 2

Mean Fall-to-Spring Student Growth Scores on NWEA MAP Math Assessment Summary

	Non-PBL		PBL						
	M	*SD*	*M*	*SD*	*Mean Difference*	*t*	*Df*	*sig.*	*Effect Size*
Grade 4	8.85	8.68	9.90	7.77	1.04	3.64*	2529.46	<.01	.127
Grade 5	7.73	8.71	8.88	8.19	1.15	3.19*	1142.46	<.01	.136
Grade 6	6.86	8.57	7.65	8.59	0.78	2.71	3829	<.01	.092
Grade 7	5.97	8.55	4.80	6.67	-1.17	-3.72*	1426	<.01	-.153
Grade 8	4.42	8.39	4.81	6.90	0.38	0.95*	555.58	.34	.051

**Result of Levene's Test for Equality of Variances is significant (p<0.05); equal variances not assumed*

Math MAP Growth Results

The independent samples *t*-test was performed comparing the fall-to-spring growth for students within each grade level and subject (see Table 2 and Table 3). As predicted, at many grade levels, students engaged in PBL in 2015-16 demonstrated greater academic growth than their counterparts from 2012-13, who received textbook-based instruction. Results of the *t*-test indicate that at grades four, five, and six, PBL was associated with greater growth in math compared to non-PBL students t (2529) = 3.64, p <.01; t (1142) = 3.19, p <.01; and t (3829) = 2.71, p <.01, respectively. In the reading assessment, PBL was associated with greater growth among students at grades four, five, six, and eight t (2471) = 6.03, p <.01; t (3226) = 2.7, p <.01; t (3746) = 5.79, p <.01; and t (636) = 3.14, p <.01, respectively.

For math MAP assessments, the mean difference between PBL and non-PBL student growth ranged between *M* = 1.17 and M = 1.15 across all grades. This indicated a small effect when compared to the standard deviations from the math growth means for each group, which ranged from *M* = 6.67 to *M* = 8.71 across all grade levels tested. Reading growth showed a similarly small effect with mean growth differences between PBL and non-PBL students ranging between *M* = 0.65 and *M* = 1.91 as compared to standard deviations from reading growth means that ranged from *M* = 8.03 to *M* = 9.74.

Cohen's *d* was used to determine effect size for MAP math assessments for all grade levels four through eight, and all effects were small ranging from *d* = -0.136 to *d* = 0.153. Cohen's *d* was used to determine effect size for MAP reading assessments for all grade levels four through eight, and all effects were small ranging from *d* = -0.210 to *d* = -0.073. The *t*-test and effect size address two difference issues (significance = probability; effect size = magnitude). The results show that while the *t*-test demonstrates statistical significance the magnitude of the effect was small.

An independent samples *t*-test was conducted to compare academic growth scores in grade four math for PBL and non-PBL students. There was a significant difference between the grade four academic growth scores of PBL students (*M* = 9.90, *SD* = 7.77) and non-PBL students (*M* = 8.85, *SD* = 8.68); t (2529) = 3.64, $p < 0.01$. These results suggest that PBL instruction does have a greater effect on academic scores than non-PBL instruction (see Table 3). Specifically, results suggest that when grade four students receive PBL instruction they have greater academic growth scores in math.

Table 3

Mean Fall-to-Spring Student Growth Scores on NWEA MAP Math Assessment Grade Four

	Non-PBL		PBL					
	M	*SD*	*M*	*SD*	*Mean Difference.*	*t*	*df*	*sig.*
Grade 4	8.85	8.68	9.90	7.77	1.04	3.64*	2529.46	<.01

**Result of Levene's Test for Equality of Variances is significant (p <0.05); equal variances not assumed*

An independent samples *t*-test was conducted to compare academic growth scores in grade five math for PBL and non-PBL students. There was a significant difference between the grade five academic growth scores of PBL students (*M* = 8.88, *SD* = 8.19) and non-PBL students (*M* = 7.73, *SD* = 8.71); *t* (1142) = 3.19, *p* <0.01. These results suggest that PBL instruction does have a greater effect on academic scores than non-PBL instruction (see Table 4). Specifically, results suggest that when grade five students receive PBL instruction they have greater academic growth scores in math.

Table 4

Mean Fall-to-Spring Student Growth Scores on NWEA MAP Math Assessment Grade Five

	Non-PBL		PBL					
	M	*SD*	*M*	*SD*	*Mean Difference.*	*t*	*df*	*sig.*
Grade 5	7.73	8.71	8.88	8.19	1.15	3.19*	1142.46	<.01

**Result of Levene's Test for Equality of Variances is significant (p <0.05); equal variances not assumed*

An independent samples *t*-test was conducted to compare academic growth scores in grade six math for PBL and non-PBL students. There was a significant difference between the grade six academic growth scores of PBL students (*M* = 7.65, *SD* = 8.59) and non-PBL students (*M* = 6.86, *SD* = 8.57); *t* (3829) = 2.71, *p* <0.01. These results suggest that PBL instruction does have a greater effect on academic scores than non-PBL instruction (see Table 5). Specifically, results suggest that when grade six students receive PBL instruction they have greater academic growth scores in math.

Table 5

Mean Fall-to-Spring Student Growth Scores on NWEA MAP Math Assessment Grade Six

	Non-PBL		PBL					
	M	*SD*	*M*	*SD*	*Mean Difference.*	*t*	*df*	*sig.*
Grade 6	6.86	8.57	7.65	8.59	0.78	2.71	3829	<.01

**Result of Levene's Test for Equality of Variances is significant (p <0.05); equal variances not assumed*

An independent samples *t*-test was conducted to compare academic growth scores in grade seven math for PBL and non-PBL students. There was no significant difference between the grade seven academic growth scores of PBL students (*M*=4.80, *SD*= 6.67) and non-PBL students (*M*=5.97, *SD*=8.55); *t* (1426) = -3.72, p<0.01. These results suggest that PBL instruction does not have a greater effect on academic scores than non-PBL instruction (see Table 6). Specifically, results suggest that when grade seven students receive PBL instruction they do not have greater academic growth scores in math.

Table 6

Mean Fall-to-Spring Student Growth Scores on NWEA MAP Math Assessment Grade Seven

	Non-PBL		PBL					
	M	*SD*	*M*	*SD*	*Mean Difference.*	*t*	*df*	*sig.*
Grade 7	5.97	8.55	4.80	6.67	-1.17	-3.72*	1426	<.01

**Result of Levene's Test for Equality of Variances is significant (p <0.05); equal variances not assumed*

An independent samples *t*-test was conducted to compare academic growth scores in grade eight math for PBL and non-PBL students. There was no significant difference between the grade eight academic growth scores of PBL students (*M* = 4.81, *SD* = 6.90) and non-PBL students (*M* = 4.42, *SD* = 6.90); *t* (555) = .95, *p* = 0.34. These results suggest that PBL instruction does not have a greater effect on academic scores than non-PBL instruction (see Table 7). Specifically, results suggest that when grade eight students receive PBL instruction they do not have greater academic growth scores in math.

Table 7

Mean Fall-to-Spring Student Growth Scores on NWEA MAP Math Assessment Grade Eight

	Non-PBL		PBL					
	M	*SD*	*M*	*SD*	*Mean Difference.*	*t*	*df*	*sig.*
Grade 8	4.42	8.39	4.81	6.90	0.38	0.95*	555.58	.34

**Result of Levene's Test for Equality of Variances is significant (p <0.05); equal variances not assumed*

Reading MAP Growth Results.

An independent samples t-test was performed comparing the fall-spring growth for students within each grade level in reading (see Table 8). At many grade levels the students engaged in PBL in 2015-16 demonstrated greater academic growth than their counterparts from 2012-13 who received textbook-based instruction. Results of *t*-test indicate that in the reading assessment, PBL was associated with greater growth among students at grades four, five, six and eight.

Table 8

Mean Fall-to-Spring Student Growth Scores on NWEA MAP Reading Assessment Summary

	Non-PBL		PBL						
	M	*SD*	*M*	*SD*	*Mean Difference*	*t*	*df*	*sig.*	*Effect size*
Grade 4	6.64	9.46	8.55	8.68	1.91	6.03*	2470.88	<.01	.210
Grade 5	5.47	9.30	6.49	9.74	1.02	2.70	3226	<.01	.107
Grade 6	5.47	9.03	7.32	9.67	1.85	5.79	3746	<.01	.198
Grade 7	4.39	9.31	5.04	8.44	0.65	1.34	2655	.18	.073
Grade 8	3.50	8.87	4.86	8.03	1.36	3.14*	635.55	<.01	.161

**Result of Levene's Test for Equality of Variances is significant (p <0.05); equal variances not assumed*

An independent samples *t*-test was conducted to compare academic growth scores in reading for PBL and non-PBL students. There was a significant difference between the grade four academic growth scores of PBL students (*M* = 8.55, *SD* = 8.68) and non-PBL students (*M* = 6.64, *SD* = 9.46); *t* (2470) = 6.03, *p* <0.01. These results suggest that PBL instruction does have a greater effect on academic scores than non-PBL instruction (see Table 9). Specifically, results suggest that when grade four students receive PBL instruction they have greater academic growth scores in reading.

Table 9

Mean Fall-to-Spring Student Growth Scores on NWEA MAP Reading Assessment Grade Four

	Non-PBL		PBL					
	M	*SD*	*M*	*SD*	*Mean Difference*	*t*	*df*	*sig.*
Grade 4	6.64	9.46	8.55	8.68	1.91	6.03*	2470	<.01

**Result of Levene's Test for Equality of Variances is significant (p <0.05); equal variances not assumed*

An independent samples *t*-test was conducted to compare academic growth scores in reading for PBL and non-PBL students. There was a significant difference between the grade five academic growth scores of PBL students (*M* = 6.49, *SD* = 9.74) and non-PBL students (*M* = 5.47, *SD* = 9.30); *t*(3226) = 2.70, *p*<0.01. These results suggest that PBL instruction does have a greater effect on academic scores than non-PBL instruction (see Table 10. Specifically, results suggest that when grade four students receive PBL instruction they have greater academic growth scores in reading.

Table 10

Mean Fall-to-Spring Growth Scores on NWEA MAP Reading Assessment Grade Five

	Non-PBL		PBL					
	M	*SD*	*M*	*SD*	*Mean Difference*	*t*	*df*	*sig.*
Grade 5	5.47	9.30	6.49	9.74	1.02	2.70	3226	<.01

**Result of Levene's Test for Equality of Variances is significant (p <0.05); equal variances not assumed*

An independent samples *t*-test was conducted to compare academic growth scores in reading for PBL and non-PBL students. There was a significant difference between the grade six academic growth scores of PBL students (*M* = 7.32, *SD* = 9.67) and non-PBL students (*M* =

5.47, *SD* = 9.30); *t* (3746) = 5.79, *p*<0.01. These results suggest that PBL instruction does have a greater effect on academic scores than non-PBL instruction (see Table 11). Specifically, results suggest that when grade six students receive PBL instruction they have greater academic growth scores in reading.

Table 11

Mean Fall-to-Spring Student Growth Scores on NWEA MAP Reading Assessment Grade Six

	Non-PBL		PBL					
	M	*SD*	*M*	*SD*	*Mean Difference*	*t*	*df*	*sig.*
Grade 6	5.47	9.03	7.32	9.67	1.85	5.79	3746	<.01

**Result of Levene's Test for Equality of Variances is significant (p <0.05); equal variances not assumed*

An independent samples *t*-test was conducted to compare academic growth scores in reading for PBL and non-PBL students. There was not a significant difference between the grade seven academic growth scores of PBL students (*M* = 5.04, *SD* = 8.44) and non-PBL students (*M* = 4.39, *SD* = 9.31); *t* (3655) = 1.34, *p* = .18. These results suggest that PBL instruction does not have a greater effect on academic scores than non-PBL instruction (see Table 12). Specifically, results suggest that when grade seven students receive PBL instruction they do not have greater academic growth scores in reading. However, PBL students' mean score was greater than the non-PBL students' mean, *M* = 5.04 and *M* = 4.39 respectively, but not at the level of statistically significant.

Table 12

Mean Fall-to-Spring Student Growth Scores on NWEA MAP Reading Assessment Grade Seven

	Non-PBL		PBL					
	M	*SD*	*M*	*SD*	*Mean Difference*	*t*	*df*	*sig.*
Grade 7	4.39	9.31	5.04	8.44	0.65	1.34	2655	.18

**Result of Levene's Test for Equality of Variances is significant (p <0.05); equal variances not assumed*

An independent samples *t*-test was conducted to compare academic growth scores in reading for PBL and non-PBL students. There was significant difference between the grade eight academic growth scores of PBL students (*M* = 4.86, *SD* = 8.03) and non-PBL students (*M* = 3.50, *SD* = 8.87); *t* (635) = 3.14, *p* <0.01. These results suggest that PBL instruction does have a greater effect on academic scores than non-PBL instruction (see Table 13). Specifically, results suggest that when grade eight students receive PBL instruction they have greater academic growth scores in reading.

Table 13

Mean Fall-to-Spring Student Growth Scores on NWEA MAP Reading Assessment Grade Eight

	Non-PBL		PBL					
	M	*SD*	*M*	*SD*	*Mean Difference*	*t*	*df*	*sig.*
Grade 8	3.50	8.87	4.86	8.03	1.36	3.14*	635	<.01

**Result of Levene's Test for Equality of Variances is significant (p <0.05); equal variances not assumed*

The high degree of within-group variance indicated by the large standard deviations in both math and reading contributed to the use of Levene's Test for Equality Variances yielding a significant result (*p* <.01) in four of the five grade levels tested in math, and two of the five grade levels tested in reading. Also contributing to the unequal variances in PBL versus non-PBL groups, at certain grade levels, was the difference in population sizes (see Table 1). The significant result ($p < .05$) from Levene's Test indicates a violation of the assumption of homogeneity, precluding the use of the traditional ANOVA to compare student groups. Alternate methods were employed to nonetheless generate valid comparisons. For grade levels where the Levene's Test yielded a significant result, equal variances were not assumed for the *t*-test, and corrections were made including a reduction of the degrees of freedom that allowed for a usable *t*-statistic

Math MAP Growth Results ANOVA

In order to verify the analysis, a one-way Welch's ANOVA was conducted on student growth by PBL exposure and grade level. Welch's ANOVA takes into account the unequal sample sizes and heterogeneity of variance and provides another view of how the data from the two groups compare. The *F* value in a one-way ANOVA helps to answer the question "Is the variance between the means of two populations significantly different?" When the *p* value is less than the alpha level the null hypothesis is rejected (Statistics How To, 2016). For MAP math growth scores, Welch's ANOVA confirmed that the effect of PBL was significant on respondents' average growth scores in grades four, five, six, and seven F (1,3635) = 12.22, p <.01; F (1,3070) = 9.49, p <.01; F (1,3829) = 7.32. Given these results the null hypothesis was rejected (see Table 14). For grade 7, the significant difference between the groups F (1,2902) = 10.66, p <.01, reflected PBL students demonstrated smaller fall-to-spring growth in math than non-PBL students (See Table 18).

Table 14.

ANOVA: Fall-to-Spring Growth on MAP Math Assessment, PBL versus non-PBL Summary

Grade Level	Measure	MAP Math Growth				
		df	*SS*	*MS*	*F*	*Sig.*
Grade 4	Between Groups	1	861.96	861.96	12.22	<.01
	Within Groups	3635	256455.40	70.55		
	Total	3636	257317.36			
Grade 5	Between Groups	1	701.59	701.593	9.49	<.01
	Within Groups	3070	226937.24	73.92		
	Total	3071	227638.83			
Grade 6	Between Groups	1	538.20	538.20	7.32	<.01
	Within Groups	3829	281699.12	73.57		
	Total	3830	282237.32			
Grade 7	Between Groups	1	708.41	708.41	10.66	<.01
	Within Groups	2902	192862.29	66.46		
	Total	2903	193570.90			
Grade 8	Between Groups	1	45.84	45.84	.682	.34
	Within Groups	2550	171308.93	67.18		
	Total	2551	171354.77			

A one-way between subjects ANOVA was conducted to compare the effect of PBL instructional methodology on grade four MAP math growth scores with non-PBL instructional methodology's effect on MAP math growth scores. There was a statistically significant effect of PBL on MAP math growth scores at the $p < .01$ level for the three conditions [$F(1, 3635) = 12.22$, $p < .01$] in grade four (see Table 15).

Table 15.

ANOVA Fall-to-Spring Growth MAP Math Assessment, PBL versus non-PBL Grade Four

Grade Level	Measure	MAP Math Growth				
		df	*SS*	*MS*	*F*	*Sig.*
Grade 4	Between Groups	1	861.96	861.96	12.22	<.01
	Within Groups	3635	256455.40	70.55		
	Total	3636	257317.36			

A one-way between subjects ANOVA was conducted to compare the effect of PBL instructional methodology on grade five MAP math growth scores with non-PBL instructional methodology's effect on MAP math growth scores. There was a statistically significant effect of PBL on MAP math growth scores at the $p < .01$ level for the three conditions [F (1, 3070) = 9.49, $p < .01$] in grade five (see Table 16).

Table 16.

ANOVA: Fall-to-Spring Growth on MAP Math Assessment, PBL versus non-PBL Grade Five

Grade Level	Measure	MAP Math Growth				
		df	*SS*	*MS*	*F*	*Sig.*
Grade 5	Between Groups	1	701.59	701.593	9.49	<.01
	Within Groups	3070	226937.24	73.92		
	Total	3071	227638.83			

A one-way between subjects ANOVA was conducted to compare the effect of PBL instructional methodology on grade six MAP math growth scores with non-PBL instructional methodology's effect on MAP math growth scores. There was a statistically significant effect of PBL on MAP math growth scores at the p <.01 level for the three conditions [F (1, 3829) = 7.32, p <.01] in grade six (see Table 17).

Table 17.

ANOVA Fall-to-Spring Growth Map Math Assessment, PBL versus non-PBL Grade Six

Grade Level	Measure	MAP Math Growth				
		df	*SS*	*MS*	*F*	*Sig.*
Grade 6	Between Groups	1	538.20	538.20	7.32	<.01
	Within Groups	3829	281699.12	73.57		
	Total	3830	282237.32			

A one-way between subjects ANOVA was conducted to compare the effect of PBL instructional methodology on grade seven MAP math growth scores with non-PBL instructional methodology's effect on MAP math growth scores. There was a statistically significant effect of PBL on MAP math growth scores at the $p < .01$ for the three conditions [F (1,2902) = 10.66, p <.01] in grade seven (see Table 18).

Table 18.

ANOVA Fall-to-Spring Growth on MAP Math Assessment, PBL versus non-PBL Grade Seven

Grade Level	Measure	MAP Math Growth				
		df	*SS*	*MS*	*F*	*Sig.*
Grade 7	Between Groups	1	708.41	708.41	10.66	<.01
	Within Groups	2902	192862.29	66.46		
	Total	2903	193570.90			

A one-way between subjects ANOVA was conducted to compare the effect of PBL instructional methodology on grade eight MAP math growth scores with non-PBL instructional methodology's effect on MAP math growth scores. There was no statistically significant effect of PBL on MAP math growth scores at the $p < .01$ level for the three conditions [F (1,2550) = .682, p = .34] in grade eight (see Table 19).

Table 19.

ANOVA Fall-to-Spring Growth on MAP Math Assessment, PBL versus non-PBL Grade Eight

Grade Level	Measure	MAP Math Growth				
		df	*SS*	*MS*	*F*	*Sig.*
Grade 8	Between Groups	1	45.84	45.84	.682	.34
	Within Groups	2550	171308.93	67.18		
	Total	2551	171354.77			

Reading MAP Growth Results ANOVA

For reading MAP growth scores Welch's ANOVA confirmed that the effect of PBL was significant on respondents' average growth scores in grades four, five, six and eight $F(1,3634) = 34.15$, $p < .01$; $F(1,3226) = 7.27$, $p < .01$; $F(1,3746) = 33.49$, $p < .01$; and $F(1,2609) = 8.60$, $p < .01$, respectively. Given these results, the null hypothesis was rejected (see Table 20). There were no grade levels at which PBL students achieved less growth on the MAP reading assessment than non-PBL students.

A one-way between subjects ANOVA was conducted to compare the effect of PBL instructional methodology on grade four MAP reading growth scores with non-PBL instructional methodology's effect on MAP math growth scores. There was a statistically significant effect of PBL on MAP reading growth scores at the $p < .01$ level for the three conditions [$F(1,3634) = 34.15$, $p < .01$] in grade four (see Table 21).

A one way between subjects ANOVA was conducted to compare the effect of PBL instructional methodology on grade five MAP reading growth scores with non-PBL instructional methodology's effect on MAP reading growth scores.

Table 20.

ANOVA for Fall-to-Spring Growth on MAP Reading Assessment, PBL versus non-PBL Summary

		MAP Reading Growth				
		df	*SS*	*MS*	*F*	*Sig.*
Grade 4	Between Groups	1	2901.42	2901.42	34.15	<.01
	Within Groups	3634	308739.79	84.96		
	Total	3635	311641.22			
Grade 5	Between Groups	1	644.44	644.44	7.27	<.01
	Within Groups	3226	286041.15	88.67		
	Total	3227	286685.59			
Grade 6	Between Groups	1	2867.13	2867.13	33.49	<.01
	Within Groups	3746	320747.54	85.62		
	Total	3747	323614.68			
Grade 7	Between Groups	1	151.11	151.11	1.80	.15
	Within Groups	2655	223269.14	84.09		
	Total	2656	223420.25			
Grade 8	Between Groups	1	656.10	656.10	8.60	<.01
	Within Groups	2609	199086.00	76.31		
	Total	2610	199742.10			

Table 21.

ANOVA Fall-to-Spring Growth MAP Reading Assessment, PBL versus non-PBL Grade Four

Grade Level	Measure	MAP Reading Growth				
		df	*SS*	*MS*	*F*	*Sig.*
Grade 4	Between Groups	1	2901.42	2901.42	34.15	<.01
	Within Groups	3634	308739.79	84.96		
	Total	3635	311641.22			

There was a statistically significant effect of PBL on MAP reading growth scores at the p <.01 level for the three conditions [F (1, 3226) = 7.27, p <.01] in grade five (see Table 22).

Table 22.

ANOVA Fall-to-Spring Growth on MAP Reading Assessment, PBL versus non-PBL Grade Five

Grade Level	Measure	MAP Reading Growth				
		df	*SS*	*MS*	*F*	*Sig.*
Grade 5	Between Groups	1	644.44	644.44	7.27	<.01
	Within Groups	3226	286041.15	88.67		
	Total	3227	286685.59			

A one-way between subjects ANOVA was conducted to compare the effect of PBL instructional methodology on grade six MAP reading growth scores with non-PBL instructional methodology's effect on MAP reading growth scores. There was a statistically significant effect of PBL on MAP reading growth scores at the $p<.01$ level for the three conditions [F (1,3746) = 33.49, p<.01] in grade six (see Table 23).

Table 23.

ANOVA Fall-to-Spring Growth MAP Reading Assessment, PBL versus non-PBL Grade Six

Grade Level	Measure	MAP Reading Growth				
		df	*SS*	*MS*	*F*	*Sig.*
Grade 6	Between Groups	1	2867.13	2867.13	33.49	<.01
	Within Groups	3746	320747.54	85.62		
	Total	3747	323614.68			

A one-way between subjects ANOVA was conducted to compare the effect of PBL instructional methodology on grade seven MAP reading growth scores with non-PBL instructional methodology's effect on MAP reading growth scores. There was no statistically significant effect of PBL on MAP reading growth scores at the $p < .01$ level for the three conditions [F (1,2655) = 1.80, $p = .15$] in grade seven (see Table 24).

Table 24.

ANOVA Fall-to-Spring Growth MAP Reading Assessment, PBL versus non-PBL Grade Seven

Grade Level	Measure	MAP Reading Growth				
		df	*SS*	*MS*	*F*	*Sig.*
Grade 7	Between Groups	1	151.11	151.11	1.80	.15
	Within Groups	2655	223269.14	84.09		
	Total	2656	223420.25			

A one-way between subjects ANOVA was conducted to compare the effect of PBL instructional methodology on grade eight MAP reading growth scores with non-PBL instructional methodology's effect on MAP reading growth scores. There was a statistically significant effect of PBL on MAP reading growth scores at the $p < .01$ level for the three conditions [F (1,2609) = 8.60, $p < .01$] in grade eight (see Table 25).

Table 25

ANOVA Fall-to-Spring Growth MAP Reading Assessment, PBL versus non-PBL Grade Eight

Grade Level	Measure	MAP Reading Growth				
		df	*SS*	*MS*	*F*	*Sig.*
Grade 8	Between Groups	1	656.10	656.10	8.60	<.01
	Within Groups	2609	199086.00	76.31		
	Total	2610	199742.10			

Qualitative Teacher Survey Findings

The qualitative data collected consisted of a teacher survey that asked for teachers' perceptions on two instructional delivery methodologies, PBL and the traditional textbook-based model. The 18 question survey was conducted and results collected during the months of September and October. The survey was conducted online and teachers were invited to participate via a district email. Teachers were invited through a random selection of 12 school site sites. All teachers at the 12 sites were invited to participate.

Instrument Reliability

The question survey was organized into three topical areas: Ease of use, student engagement, and academic rigor. Within each area, one item was an open-ended question, and five items asked respondents to indicate their preference on a five-point Likert scale, where 1 indicated "strongly prefer a traditional textbook" and 5 indicated "strongly prefer a project-based unit of study". The survey instrument demonstrated strong reliability, indicated by a Chronbach's alpha of 0.97. As for the topical areas, ease of use yielded a Chronbach's alpha of 0.93, student engagement a Chronbach's alpha of 0.92, and academic rigor a Chronbach's alpha of 0.96. Reliability measurements for the areas and the instrument as a whole all surpassed the commonly accepted alpha level of 0.80.

Teacher Population and Responses

Of the teachers invited to participate, approximately 30% chose to participate. Of the teachers participating, 42% had taught for more than 20 years, 34% had taught between 13 and 20 years, and 25% had fewer than 13 years. Ethnic demographic data was not collected for teachers. Twenty-six percent of respondents declined to state a gender; among those who chose male or female, the preponderance was female (44 out of 47, or 94%). Respondents were comprised of teachers of kindergarten through grade eight, with a low of two representing grade seven and a high of 13 representing grade two. In all, 42.2% taught primary (grades K – 2), 36.0% taught at the upper elementary level (grades three – five), and 21.8% taught at the middle school level (grades six – eight). The data in Table 26 provides the numerical values for each.

Table 26

Teacher Survey Respondent Demographics

Demographic		*Count*	*%*
Gender	Female	44	68.8
	Male	3	4.7
	Decline to State	17	26.6
Years Teaching	0 – 4 years	9	14.1
	5 – 8 years	2	3.1
	9 – 12 years	4	6.3
	13 – 20 years	22	34.4
	More than 20 years	27	42.2
Grade Level Taught	Kinder	6	9.4
	1st	8	12.5
	2nd	13	20.3
	3rd	8	12.5
	4th	4	6.3
	5th	11	17.2
	6th	7	10.9
	7th	2	3.1
	8th	5	7.8

Usability

Mean scores for the five closed-end items in the Usability domain ranged between *M* = 1.92 and *M* = 2.64, all below the "neutral" value of 3. The data indicated teachers generally believed that the traditional textbook was easier to use than the PBL units of study. Table 27 displays the mean Likert scale score for each question in the Usability domain. A mean score of one indicated a strong preference for a textbook-based instructional model. A mean score of three indicated a neutral or no preference. A mean score closer to five indicated a strong preference for PBL based instruction. The standard deviation varied from *SD* = 1.36 to *SD* = 1.43 indicating consistency within the teacher preference for a textbook-based instructional model.

Table 27

Mean Survey Responses, Usability

Item	*N*	*M*	*SD*
Usability (aggregate)	65	2.29	1.37
Considering the time required to prepare lessons, I prefer…	65	1.92	1.27
Considering the time required to deliver lessons, I prefer…	65	2.19	1.38
Considering the time required to assess student performance, I prefer…	65	2.34	1.42
Considering the ability to vary the assessment type and length, I prefer…	65	2.64	1.43
Considering the access to digital resources, I prefer…	65	2.34	1.36

To further clarify the preferences of respondents, values were recoded from a five point scale down to a three point agreement scale, with values one and two coded as “prefer textbook”, a value of three recoded as “neutral”, and values of four and five recoded as “prefer units of study”. Rather than only comparing the percentages of those who preferred the textbook to the units of study, in order to give weight to the responses of participants who indicated that they were neutral on whether textbooks or UOS were preferable, the method used to analyze survey results was a one sample chi-square. Employing this method bypassed the need for the data to be normally distributed, as it is in a non-parametric test. Results indicated that for all of the survey items related to ease of use, teachers were partial to textbooks rather than the PBL units of study as indicated in Figure 7.

The responses to the open-ended question related to teacher preference for an instructional program that meets the need of usability were reviewed by the researcher and coded for common and unique responses. The most common responses (25) indicated that teachers found PBL to be too time consuming for preparation of lessons and in locating and preparing resources. Six teachers reported greater usability of PBL units due to the flexibly they offered in delivering instruction. Seven teachers expressed the need for a textbook as the main resource for instruction.

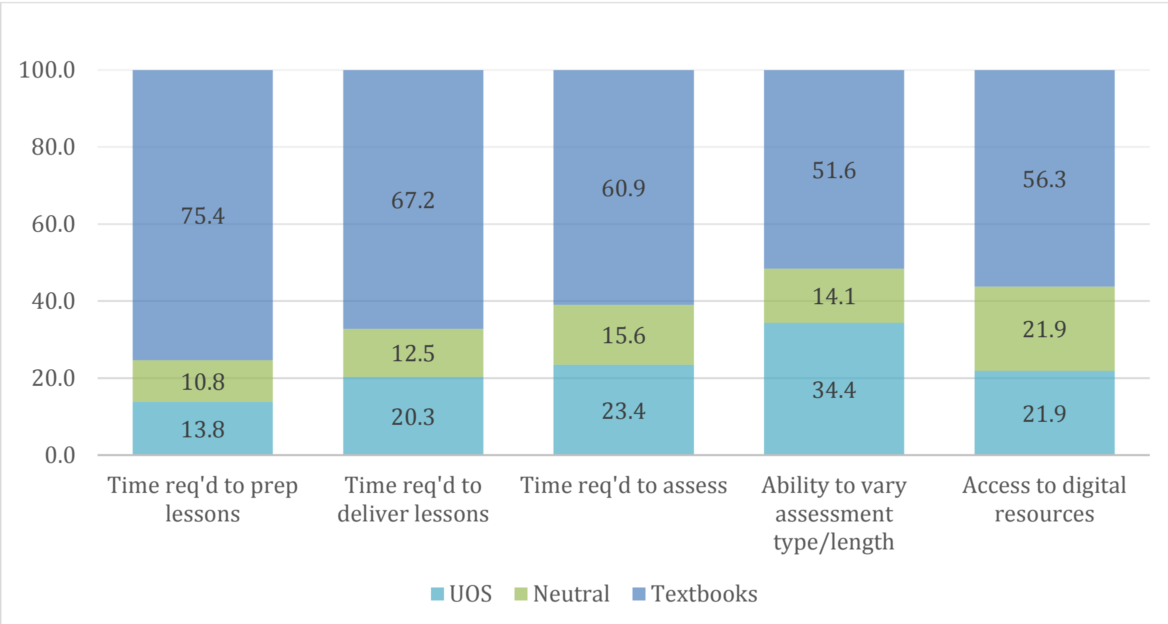

Figure 7: Usability Responses. Sahli 2017

Many teachers provided comments in support of the usability of the PBL units. The positive comments where related to the flexibility and creativity found in the units. One teacher expressed that the units allowed her to do what she was trained to do, which is to teach. The following responses where collected from the teacher survey by the researcher, conducted in the month of September, using a Google form (see Table 28).

Table 28

Positive Responses, Usability

Comment 1	"Units of study provide me with the opportunity to meet my students where they are instead of where a textbook thinks they should be. I also enjoy the flexibility of assessment."

Comment 2	"I enjoy the project based UOS over the text book and the flexibility it allows.
Comment 3	"I like the flexibility of the UOS as well as the suggested links. The flexibility allows for me to access and use additional resources. My students are enjoying the links that have a story and/or a song."
Comment 4	"I feel my students benefit more from Project Based Learning. The students are more engaged. I enjoy having some say in curricula that can be used."
Comment 5	"The project-based unit of study allows for more creativity. It allows me, as the teacher, to do what I was trained to do. It is easier to differentiate instruction and cater instruction to the needs of the students. It is so much better than the often one-size fits all model of a textbook. Yes, it takes more time and planning, but it is more fun to teach."
Comment 6	"I believe the unit of study meets the need of usability if you put the time in to prepare the lessons."
Comment 7	"I prefer a UOS for several reasons. First, I am not tied to the textbook. I can adjust my lessons to the students' needs and pace. The textbook is written at one level and even the beginner or basic levels don't meet my students' needs. Resources are not that hard to find. I think people want to open to a page and teach without preparing. The UOS takes prep, no doubt."

Many teachers provided comments in support of textbook-based instruction. The negative comments pertaining to the units related to the additional planning time necessary to locate resources and planning. A few teachers spoke against the PBL units due to their assessment that teachers are not curriculum writers and are paid to deliver curriculum, which implied they were to follow a script provided to them, often found in traditional textbook programs (see Table 29).

Table 29

Survey Responses, Usability

Comment 8	"Units of study are a "guide" at best. Teachers are paid to deliver curriculum and teach students. Planning and implementing units of study requires teachers to write curriculum. Teachers are not paid to write curriculum."
Comment 9	"Textbooks when used by everyone in that grade level district-wide provides the institutionalization of what we are teaching. The Projects are a creative way to supplement the text and enhance the learning. I think that both are good but the UOS is not a textbook. I have been teaching since the 70's and have never felt so lost. It takes all of my free time after and before school on weekends to hunt down materials and then copy them for my class."
Comment 10	"Finding resources has been the most challenging aspect of the UOS. The units are well written and contain some resources, but I am always needing more. Also, it is often challenging to determine if the resource I am selecting is grade level appropriate. I feel I am wasting planning time searching for appropriate resources, when I should be planning out my lesson."
Comment 11	"Having a curriculum is much easier to use and manage than the current units of study. The units of study are too open-ended, which leads to confusion, frustration, and self-doubt."
Comment 12	"My preference for the textbook-based model is mostly due to the amount of time it takes to plan lessons for the units of study."

Academic Rigor

Mean scores for the five closed-end items in the academic rigor area ranged between M = 2.55 and M = 3.28, generally in the range of the "neutral" value of three. This indicated that teachers generally believed that the traditional textbook facilitated student engagement as well as the PBL units of study.

The mean Likert scale score for each question in the academic rigor domain was presented (see Table 30). A mean score of one indicated a strong preference for a textbook-based instructional model. A mean score of three indicated a neutral or no preference. A mean score closer to five indicated a strong preference for PBL based instruction. The standard deviation varied from *SD* = 1.27 to *SD* = 1.50, indicating consistency within the teacher preference for a textbook-based instructional model.

Table 30

Mean Survey Responses, Academic Rigor

Item	*N*	*M*	*SD*
Academic Rigor (aggregate)	65	2.37	1.38
In terms of actively engaging students in the lesson I prefer…	65	2.42	1.43
In terms of your ability to use creativity in delivering the lesson I prefer…	65	2.48	1.50
In terms of the flexibility in delivering the lesson, the structure and format, I prefer…	65	2.09	1.40
In terms of your ability to integrate other content areas in the lessons I prefer…	65	2.16	1.29
In terms of capacity for differentiation and scaffolding to meet the needs of all students I prefer…	65	2.69	1.27

When the scale was condensed from a five-point rating scale to a three-point scale, results for academic rigor items statistically significant differences (*p <.05)* in teachers selecting textbooks over units of study or neutrality (see Figure 6). The two items in which textbooks were preferred were in addressing the standards with accuracy (68.8%) and addressing the standards completely (62.5%).

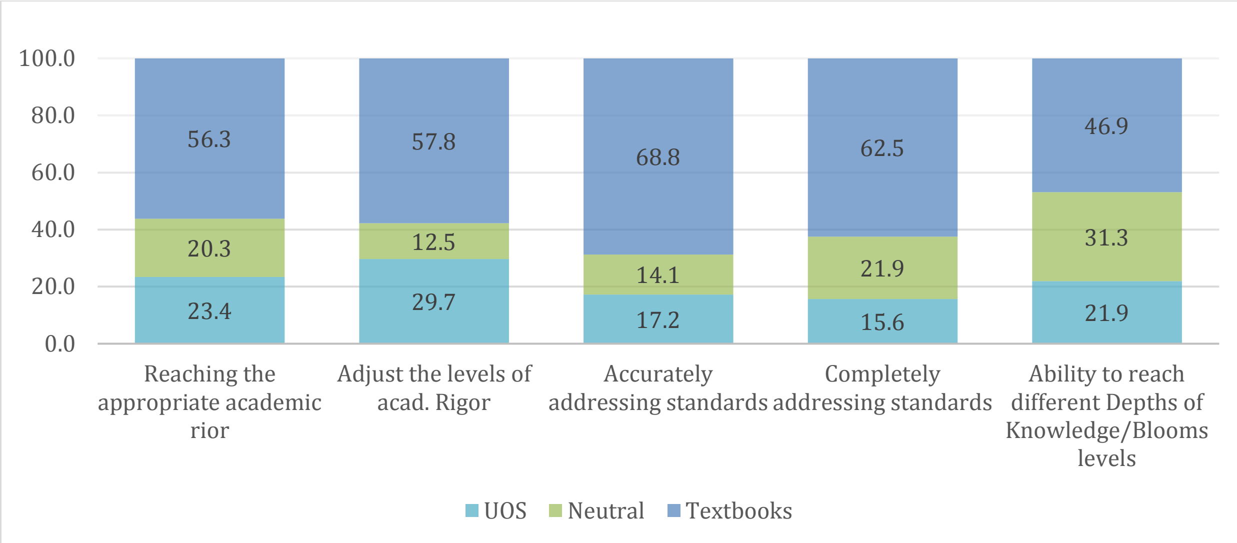

Figure 8: Academic Rigor Responses. Sahli 2017

The descriptive statistic data reported mean scores for rigor between M = 2.57 and M = 3.31, which was a preference for the use of a textbook-based instructional program. The percentage figures for each question visually demonstrated this same preference.

The responses to the open-ended questions related to teacher preference for an instructional program that meets the need of academic rigor were reviewed by the researcher and coded for common and unique responses. The most common responses (seven) indicated that both PBL and the textbook provided the appropriate level of rigor. Similar to what was found in the usability category, several teachers (10) expressed the need for a textbook as the main resource for instruction. A total of four teachers indicated that it wasn't the PBL model or textbook model that met the need for academic rigor, it was the teacher who was responsible for and provided the appropriate level of rigor by modifying their instructional delivery.

Many teachers provided comments in support of the PBL units meeting academic rigor while others reported negatively on PBL units meeting rigor. The negative comments frequently promoted that textbook programs were more consistent in addressing grade level standards. Comments ranged from PBL units being too vague, to too rigorous, and even being too stifling. According to the teacher survey conducted in the month of September using a Google form, the following responses were collected: (see Table 31).

Table 31

Negative Survey Responses, Rigor

Comment 13	"Having a textbook makes me feel like I have a more direct path as a first year teacher. With the units of study I often times feel unsure of what direction to take next."
Comment 14	"I believe that both Depths of Knowledge and Bloom's levels can be reached using the traditional textbook-model. Teachers can successfully use the textbook-model to educate students. Using textbooks doesn't have to be a bad thing. If textbooks are used, teachers can focus more on enrichment and less on "filling in the blanks" of an UOS that changes from year-to-year. There is a basic foundation that stays consistent, in textbooks that teachers can be used for reference for more seasoned individuals and a guide for those who struggle or are new to the profession. The UOS are vague and require a lot of preparation time, especially since they frequently change."
Comment 15	"We are teachers and our creative side is actually stifled by the UOS materials. Yes they provide ideas but that's what we are good at. We know how to do this. Please provide textbooks."
Comment 16	"I feel a text-book based curriculum will cover the academic standards more than the UOS. Traditional curriculum usually has differentiation embedded in it, and it is easier to have a baseline and then bump the rigor up or down as the teacher sees is needed. The UOS, I feel are TOO rigorous, and are often times not age-appropriate. There needs to be balance and professional discretion."

Comment 17	"Our units of study do not meet all of the standards. There are plenty of curricular programs that would address the common core standards. This would give us the freedom and flexibility to focus on strategic teaching rather than on planning and looking for the materials that we need. Our units of study do not meet all of the standards. There are plenty of curricular programs that would address the common core standards. This would give us the freedom and flexibility to focus on strategic teaching rather than on planning and looking for the materials that we need."

Teacher comments in support of PBL units also were submitted that spoke in favor of PBL meeting the need for rigor and meeting academic standards (see Table 32). Several teachers expressed the units allowed for a greater flexibility in targeting the specific needs of their students.

Table 32

Teacher Positive Survey Responses, Rigor

Comment 18	"Standards are being addressed in age appropriate ways. Each aspect of the unit addresses a grade level standard instead of what a textbook writer thinks the students should know. The alignment is much better with the units of study."
Comment 19	"Project-based units of study allow me to challenge my higher performing students while supporting my lower performing students. Scaffolding is much easier."
Comment 20	"Textbooks may have the standards printed on their pages, but often the activities don't meet the rigor of the standard. Or they go too fast or not low or high enough. I would much prefer the freedom of a UOS to use my professional judgement in designing appropriate activities for my students."

Teacher commentary was provided by a few teachers expressing that teachers should not be considered to be curriculum writers. Their comments expressed the need for professional curriculum writers to produce the instructional material and they were to deliver the content written for them. These teachers preferred a textbook-based instructional program with a highly detailed and defined teacher's guide (see Table 33).

Table 33

Textbook Positive Survey Responses, Rigor

Comment 21	"With the units of study within my grade level (3rd), I have found most units have some good resources, but they are in no way written as curriculum and have to be copied, pasted, and edited, but remain too difficult for a mostly EL class to get to the independent stage (other than a few students). Most instruction stays at scaffold and guided instead of reaching independent. If the students had a textbook in their hands that would be much easier for me to work with having small groups and I could modify for intervention. I've often stated, I want to teach and become a better teacher, not write curriculum."
Comment 22	"Teachers are not curriculum writers. Though the UOS provides some rigor and addresses the CCSS, the curriculum that teachers have used in the past were also designed to be used to meet the necessary rigor and address the CCSS. Most textbook based curriculum can be just as easily modified to meet the rigor and standards teachers are trying to address in the classroom without hours of preparation. It is unnecessary to try and reinvent the wheel with the UOS."

As was reported in other areas of the survey, a small number of teachers reported that it was neither PBL nor textbook-based instruction that best met the need of meeting rigor and academic standards, it was the teacher who used his or her skill and knowledge to meet the needs of the students within the parameters of any curriculum (see Table 34).

Table 34

Teacher Impact Survey Responses, Rigor

Comment 23	"Incorporating rigor in the classroom doesn't come from a textbook or a unit of study. It comes from the teacher knowing her students individually and knows what questions will help meet the needs of that given student."
Comment 24	"Rigor is not provided by a textbook. It is provided by the teacher. The teacher needs to go beyond the book and give students projects to show what they know."

Student Engagement

Mean scores for the five close-ended items in the student engagement area ranged between M = 2.55 and M = 3.28 – generally in the range of the "neutral" value of three. This indicated that teachers generally believed that the traditional textbook facilitated student engagement approximately as well as the PBL units of study.

Table 35 displays the mean Likert scale score for each question in the student engagement domain. A mean score closer one indicated a strong preference for a textbook-based instructional model. A mean score of three indicated a neutral or no preference. A mean score closer to five indicated a strong preference for PBL based instruction. The standard deviation varied from SD = 1.29 to SD = 1.47, indicating consistency within the teacher preference for a textbook-based instructional model.

When the scale was condensed from a five-point rating down to a three-point scale, results for student engagement items indicated no statistically significant differences in teachers selecting textbooks, units of study, or neutrality for four of the five items. The one item where significantly more teachers opted for a traditional textbook related to ease of differentiation and scaffolding. More than half (56.3%) of respondents indicated that textbooks facilitated this aspect of engaging students as indicated in Figure 7.

Table 35

Mean Survey Responses, Student Engagement

Item	*N*	*M*	*SD*
Student Engagement (aggregate)	65	2.88	1.39
In terms of actively engaging students in the lesson I prefer…	65	3.28	1.29
In terms of your ability to use creativity in delivering the lesson I prefer…	65	2.92	1.36
In terms of the flexibility in delivering the lesson, the structure and format, I prefer…	65	2.80	1.42
In terms of your ability to integrate other content areas in the lessons I prefer…	65	2.55	1.47
In terms of capacity for differentiation and scaffolding to meet the needs of all students I prefer…	65	2.88	1.43

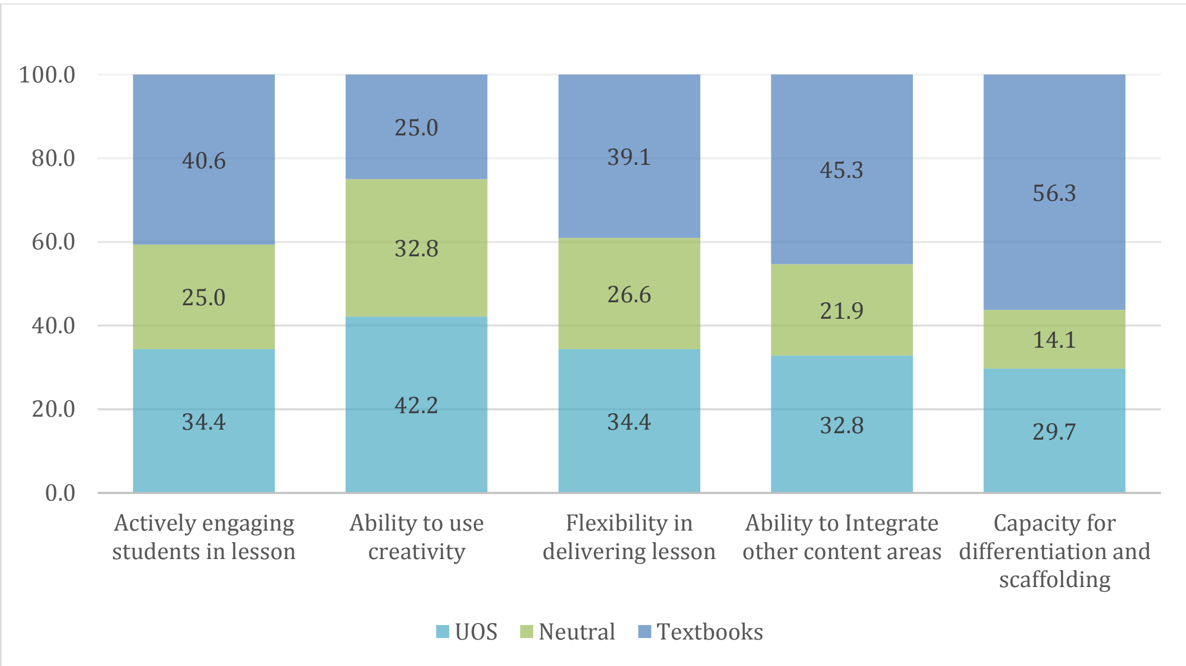

Figure 9: Academic Engagement Responses. Sahli 2017

The descriptive statistic data reports mean scores between $M = 2.14$ and $M = 2.72$ in this category, which is a preference for the use of a textbook-based instructional program. The percentage figures for each question visually demonstrated a more even distribution of preferences for as well as no preference. The engagement category was the most balanced in terms of teacher preference.

The responses to the open-ended question related to teacher preference for an instructional program that meets the need for student engagement were reviewed by the researcher and coded for common and unique responses. The most common responses (11) indicated that PBL units offered creativity and flexibility that met the need for student engagement. Of the respondents five indicated that PBL and a traditional textbook both met the need for student engagement.

Many teachers provided comments in support of the PBL units for engaging students. The positive comments where related to the creativity and flexibility found in the units. Teachers' comments express students enjoying the units and eager to engage in hands-on projects (see Table 36).

Table 36

Positive Survey Responses, Student Engagement

Comment 25	"Project-based UOSs can easily meet the different instructional needs of students by providing hands on activities to meet the different modality levels."
Comment 26	"The units of study lends itself to provide a wider and broader way of presenting the required material. Being able to be creative and less scripted I feel lends itself to producing students who are excited about their learning and eager to dive in. Incorporating creative means to teaching always increases student involvement and increases intrinsic motivation to do well and learn in a place where it is fun and enjoyable."

Comment 27	"I am able to use content that my students are interested in in order to engage them. I have heard students saying things like, this is so cool, during a lesson. That doesn't happen with a boxed curriculum."
Comment 28	"Project-based units are usually designed to have a greater student buy in, though not all UOS interest the students. Teachers have the ability to adjust to fit the need of individual classes."
Comment 29	"I prefer the UOS because the students enjoy it more."
Comment 30	"The units of study have been great because it has allowed me to pick and choose what I want to teach my students based on their levels and understanding. I have also been able to better combine different subjects to create lessons."
Comment 31	"I do like the creativity and the flexibility of units of study. There is a lot more time planning. I like the available resources given online."
Comment 32	"It's easier to differentiate the instruction with the UOS because the projects are standards based."
Comment 33	"I do like that the units of study allow for more flexibility for what resources you are using in the class."
Comment 34	"I appreciate the flexibility that the UOS offers. I definitely do not like having the expectation for teachers on the same exact lesson as the teacher next door."
Comment 35	"Student engagement is higher with project-based units of study because I can incorporate topics students are actually interested in. Every student does not have to be working with the same material at the same time."
Comment 36	"Units provide students with hands-on activities to meet the different learning modalities. It does require some planning, but you can do it."

Many teachers provided comments in support of textbook-based instruction. The positive comments where related to consistency of a textbook and the resources provided to the teacher and the student in a publisher's full program kit, which commonly includes multiple sets of workbooks (see Table 37).

Table 37

Negative Survey Responses, Student Engagement

Comment 37	"Students thrive on routine and clear expectations. The textbook-based model allows for stronger routines and expectations that are easy to implement and follow. Students are able to mentally prepare and manage their time and behavior more effectively when routines are consistent week-to week."
Comment 38	"Students have a baseline for what they are learning in the textbook. The teacher has a benchmark for what the student and class is capable of at grade level and the reading text is available for various projects and discussions for example. I want a textbook please."
Comment 39	"With textbooks rigor can be added through projects, however the same cannot be said for project-based instruction. I believe there is a need for textbooks for those students who are not motivated and therefore get little out of projects."
Comment 40	"I do believe that the UOS allow for flexibility. However, I would still prefer a textbook-based model that ensures all standards are being met. I have found that the UOS tasks only loosely align with some of the standards they claim to target."
Comment 41	"Students love making projects, but does it cover the SBAC questions by making an Indian Dwelling? The district needs to buy common core textbooks, teachers are unhappy."
Comment 42	"Teachers need to use multiple strategies to engage students. There is need to be familiar with the standard and the instructional materials needed to deliver the lessons. Having access to core textbook materials supports this endeavor. This is especially so for new teachers."

Several times within the teacher survey contradictory statements were found. One teacher would express that PBL units were not rigorous or engaging, and another teacher provided the exact opposite viewpoint. It is clear through the comments that teacher perceptions there was a consistent strongly preference for the traditional textbook-based model, many teachers had completely opposite perceptions and opinions of the two instructional models.

A small number of teachers, fewer than ten surveyed, provided commentary that it is not the instructional curriculum that is the most important factor in the process of learning, it was the teacher who determined and ensured that students were engaged and academic rigor was being met. The following comments demonstrated this viewpoint (see Table 38). The comments were very important in understanding the viewpoint of teachers and their role in the educational process. This topic is covered in more detail in chapter five.

Table 38

Teacher Impact Survey Responses, Student Engagement

Comment 43	"Ultimately engagement is created by the teacher, not the material."
Comment 44	"While I think that generally speaking, the UOS tend to be more engaging than a more traditional curriculum, I think a good teacher can make a text-book based curriculum more engaging by supplementing here and there."
Comment 45	"Both resources can get student engaged. It all depends how the teacher goes about it and how creative they are. I think both resources are at two ends of the spectrum. The UOS in my opinion is two free and some manuals are too tight. We just have to find one that gives us the best of both. But we do need a more structured curriculum to guide us in the right direction."

Veteran and Non-Veteran Teachers

There was no significant difference in teacher preference between veteran and non-veteran teachers, those with more or less than 13 years of teaching experience. The 13-year mark was selected since the implementation of strict adherence to a scripted textbook-based program for reading and math began with the implementation of NCLB in 2002. Teachers with fewer than 13 years teaching experience had not been exposed to more flexible instructional models similar to PBL. Teachers with more than 13 years in teaching would have experienced more flexible instructional models similar to PBL. NCLB ushered in strict adherence to the publisher's textbook, known at the time as instruction that had fidelity to the program.

Teacher Survey Question Responses

A one sample *t*-test was conducted to measure the 3-point Likert scale instead the 5-point scale (textbook, neutral, or PBL unit). The test value was set to 3 so that anything significant would be significantly not neutral. The distance from 3 determined significance. The negative number was how far below 3 (neutral) the average for the item. A negative mean difference indicated teachers favor the use of textbooks. The greater the negative mean the stronger the preference as seen in Table 39. There were 15 Likert questions given and 14 of 15 results were negative numbers and showed a preference for textbook-based methodology.

Summary

The research identified whether the PBL or textbook-based instructional model was more effective in producing student academic growth scores in reading and math. The data also identified teacher perceptions on the strengths of the two models and whether they perceived one as more effective in achieving academic growth and student engagement. MAP assessment data provided the basis for the determination of academic growth scores. Teacher survey results provided a basis for determination of teacher perceptions of which instructional model was most effective in achieving academic gains for students.

Table 39

One-Sample t-Test of Teacher Survey Questions

					95% Confidence Interval of the Difference	
	t	*df*	Sig. (2-tailed)	Mean Difference	Lower	Upper
Q01	-6.865	64	.000	-1.078	-1.39	-.76
Q02	-4.749	64	.000	-.813	-1.15	-.47
Q03	-3.735	64	.000	-.656	-1.01	-.31
Q04	-2.027	64	.047	-.359	-.71	-.01
Q05	-3.889	64	.000	-.656	-.99	-.32
Q07	-.704	64	.484	-.125	-.48	.23
Q08	1.754	64	.084	.281	-.04	.60
Q09	-.463	64	.645	-.078	-.42	.26
Q10	-1.156	64	.252	-.203	-.55	.15
Q11	-2.489	64	.015	-.453	-.82	-.09
Q13	-3.250	64	.002	-.578	-.93	-.22
Q14	-2.772	64	.007	-.516	-.89	-.14
Q15	-5.219	64	.000	-.906	-1.25	-.56
Q16	-5.275	64	.000	-.844	-1.16	-.52
Q17	-1.979	64	.052	-.313	-.63	.00

CHAPTER 5: DISCUSSION

The purpose of this study was to understand whether or not the implementation of a PBL instructional model would result in higher academic growth MAP scores for students in both reading and math, as compared to a traditional textbook-based instructional model. The research was conducted in one urban school district in northern California. The chosen school district participated in the shift to CCSS through the implementation and creation of the RCD PBL units of study as its adopted reading and math program of instruction. Teachers have both welcomed and rejected the PBL units. In this chapter, the researcher will present the impact of PBL on academic achievement and teacher reaction and offer recommendations for further research and responses to the findings.

The problem of low academic achievement in an urban school district was reviewed by this researcher. The low academic achievement was found to be consistent over a period of decades. Over the course of this research period, the demographics of the student population in the district studied was consistent. The population consisted of mostly Hispanic and other minority groups and over 80% qualify as having low socio-economic status. A factor the researcher considered in creating this study was the structure of public education. The mass education of the population was conducted within a large-scale factory-based model of consistency and conformity, including the use of a common textbook-based curriculum. To counter the problem of low academic achievement, some factors in education needed to be changed or results would remain status quo. The researcher questioned the effects of two instructional delivery models.

The researcher focused on one urban school district located in Northern California. The chosen school district implemented a PBL model based on the RCD model of Ainsworth (2011).

Immediately prior to the research time period, a change in the curriculum standards occurred with the adoption of the CCSS, both nationally and in California. The CCSS replaced the California Standard adopted in 1999, said to have been some of the most rigorous in the nation and closely aligned to the rigor of the CCSS. One significant change the CCSS brought was the reduction of multiple choice questions on the end-of-year test, which were largely replaced by constructed response questions. The shift in assessments required students to explain their answers rather than to simply select an answer from a list of answers. Traditional textbook-based curriculum was formatted similarly to emulate the end-of-year assessments through the use of a multiple-choice assessment style. This researcher sought to find out if a PBL model of instruction would help students better understand the questions and answers and therefore, achieve higher academic growth each year, as measured by the MAP assessment.

Summary of the Study

The MAP growth scores were found to be significantly higher during the year of PBL instruction (2015-2016). Results of the *t*-test indicate that at many grade levels the students who engaged in PBL in 2015-2016 demonstrated greater academic growth than their counterparts from 2012-2013 who received textbook-based instruction. Results indicate that at grades four, five, and six, PBL was associated with greater growth in math compared to non-PBL students (see Table 2). Results indicate that at grades four, five, six, and eight, PBL was associated with greater growth in reading compared to non-PBL students (see Table 8).

Null Hypothesis

The first research question asked if there was there a difference in the mathematic growth scores of students taught using PBL compared to those taught from the traditional textbook approach. Table 2 and Table 4 provide results indicating that the hypothesis, PBL would result in higher mathematic growth scores, is true for grades four, five, six, and seven, so the null hypothesis is accepted for these grades and rejected for grade eight.

The second research question asked if there was there a difference in the reading growth scores of students taught using PBL compared to those taught from the traditional textbook approach. Table 3 and Table 5 provide results indicating that the hypothesis, PBL would result in higher reading growth scores, is true for grades four, five, six, and eight, the null hypothesis is accepted for these grades, and was rejected for grade seven.

There was a decrease in the scores noted by grade level in student MAP growth scores, which is also seen in state standardized testing results. The mean growth scores decreased for both PBL and non-PBL students for math in grades 4-8. The average growth score in math for PBL students decreased from 9.90 among grade four students to 4.81 among grade eight students. Growth scores for non-PBL students in math, PBL students in reading, and non-PBL students in reading followed a similar pattern. A contributing factor could be that as students reach higher grade levels, the skills they must master to demonstrate growth are increasingly complex and require multi-step problem solving skills, which allow more opportunities for error. Another possible explanation could be that a student's reading proficiency is more important in the upper grade levels. Math testing in the upper grades required more interpretation of mathematical word problems, and since student reading proficiency was weak overall in these grades, there was a subsequent impact on math performance. Therefore, analyses of achievement and growth are best considered by grade level rather than across all grades levels.

The mean growth scores decreased for both PBL and non-PBL students for reading in grades 4-8, with a small increase at grade 7. One possible explanation could be the increased emphasis on the comprehension of informational, rather than fictional, text. The pattern of decreased reading performance was reflected in state-wide reading averages as noted in Figure 10.

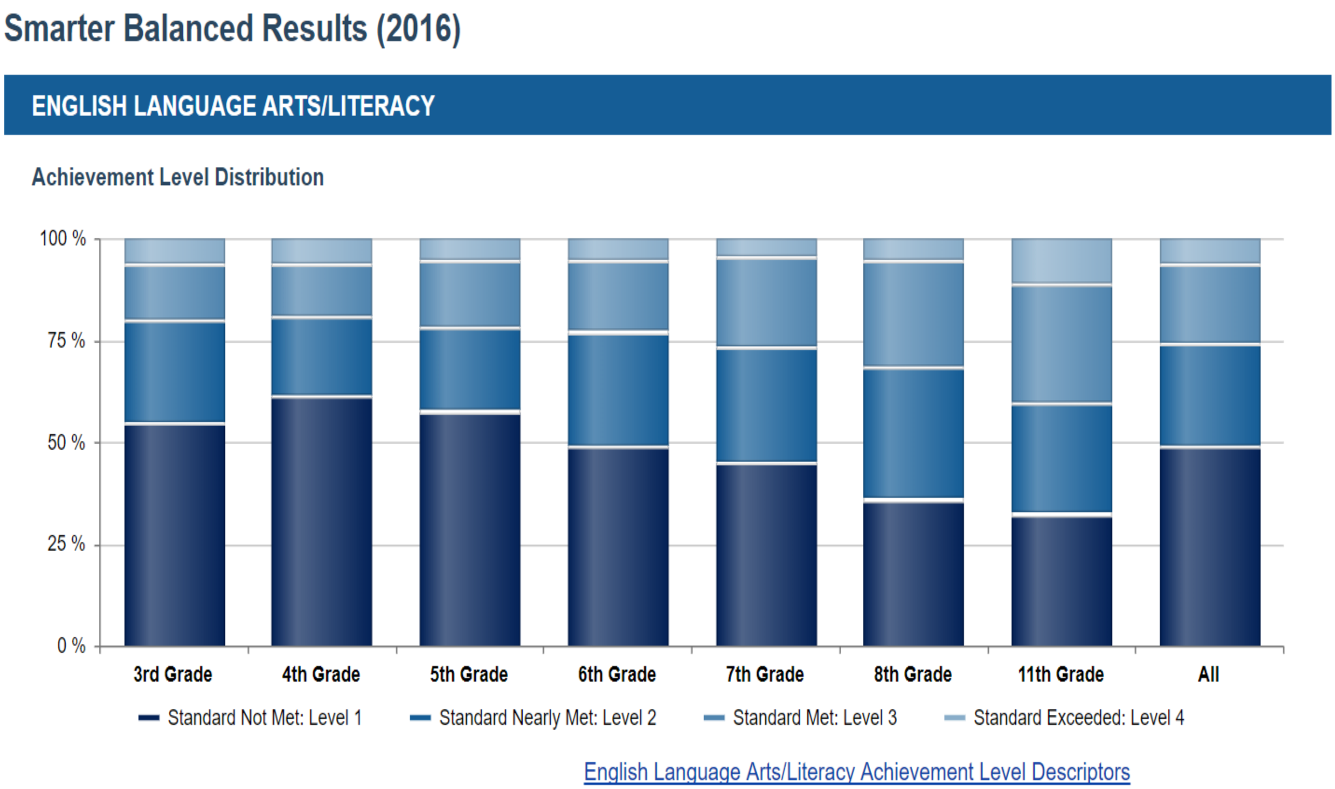

Figure 10: Smarter Balanced Results (2016) English Language Arts/Literacy

Survey Results

The teacher survey results demonstrated a preference for a traditional textbook-based curriculum in all three areas: usability, student engagement, and academic rigor. The comments provided indicate the primary hindrance to teacher support for PBL was the need for additional planning and preparation. Only one teacher surveyed voiced support to indicate that the PBL units of study resulted in reaching higher levels of academic rigor, which the quantitative data supports (see Table 40).

Table 40

Survey Responses

Comment 46	"The UOS are definitely more rigorous than our traditional textbooks. I prefer the rigor of the UOS, but feel that the rigor would be there if we were using a common core textbook based curriculum."

The teachers may not have recognized higher MAP growth scores since the data does not show a very high impact. With district scores so low initially it may require and almost doubling of performance to get the attention of teachers, particularly when considering the frequent comments pertaining to the need for additional planning and preparation time (see Table 41).

Table 41

Planning Time Survey Responses

Comment 47	"In a textbook-based model, the curriculum provides activities and reading materials at different levels. In a UOS, the teacher must find the resources and then copy them for the students."
Comment 48	"With actual curriculum to guide instruction, teachers can supplement as they see fit with differentiated materials/projects. These units of study require too much time investigating and creating of an actual lesson."

The MAP growth scores increased only a few points in the two years of data and only to approximately half of what they should be for nationally normed growth by grade level. Another plausible consideration is that teachers are not skilled in the implementation of formative assessments that should occur as students receive both written and oral comments regarding their progression throughout the life of the project or unit, whereby in theory supporting an increase in the summative achievement (Jacques, Bissey, & Martin, 2016).

Usability Domain

The survey responses indicate a teacher preference for a traditional textbook model with 47% of the 65 participants choosing a strongly prefer or prefer Likert score for this domain, 11% choosing a strongly prefer or prefer Likert score, and 42% choosing no preference. Based upon the teacher comments from the open-ended question in this domain, the greatest factor in preference for the traditional textbook model was the additional time teachers required to prepare lesson plans and resources for the PBL units of study.

Engagement Domain

The survey responses indicate an almost balanced teacher preference for a traditional textbook model with 20% of the 65 participants choosing a strongly prefer or prefer Likert score for this domain, 22% choosing a strongly prefer or prefer Likert score, and 58% choosing no preference. Based upon the teacher comments from the open-ended question in this domain teachers felt student engagement could be realized in both methods and several teachers expressed it was up to the teacher to ensure student engagement (see Table 42).

Academic Rigor Domain

The survey responses indicate a teacher preference for a traditional textbook model with 43% of the 65 participants choosing a strongly prefer or prefer Likert score for this domain, 15% choosing a strongly prefer or prefer Likert score, and 42% choosing no preference. Based upon the teacher comments from the open-ended question in this domain the greatest factor in preference for the traditional textbook model was related to resources. Teachers expressed that a textbook publisher's teacher resources were more complete and robust providing them more direction and support (see Table 43).

Table 42

Student Engagement Survey Responses

Comment 49	"Ultimately engagement is created by the teacher, not the material."
Comment 50	"I am able to use content that my students are interested in in order to engage them. I have heard students saying things like, this is so cool, during a lesson. That doesn't happen with a boxed curriculum."
Comment 51	"Both resources can get students engaged. It all depends how the teacher goes about it and how creative they are. I think both resources are at two ends of the spectrum. The UOS in my opinion is two free and some manuals are too tight. We just have to find one that gives us the best of both. But we do need a more structured curriculum to guide us in the right direction. Some more than others."
Comment 52	"I prefer neither when it comes to student engagement. That is up to the teacher to decide which engagement strategies work best for their students."

A general summary of the teacher survey's open-ended responses found most teachers were reflective on how the PBL or textbook-based methodology impacted the teacher, rather than the impact on the student. The topics reviewed in chapter two of this study were rarely mentioned. However, some of the comments directly or indirectly referencing Webb's DOK, or differentiation or scaffolded learning were, which are related to the individualized learning and relevant learning research and writings of Dewey, Montessori, and Piaget.

Table 43

Textbook Supportive Survey Responses

Comment 53	"I feel a text-book based curriculum will cover the academic standards more than the UOS. Traditional curriculum usually has differentiation embedded in it, and it is easier to have a baseline and then bump the rigor up or down as the teacher sees is needed."
Comment 54	"Having a textbook-based model curriculum, which is closely/in most cases directly tied to the standards allows you to start with a firm foundation, which opens up time to best research and plug in other outside resources that may best fit your students' needs. Whereas beginning with the UOS can be very vague and challenging to even begin a lesson with confidence and at times success due to the "bare bones" of the planning guide."

Although PBL can be associated with greater fall-to-spring growth in reading and math, due to the high variance within the PBL and non-PBL data set, further analysis is needed. Future research may incorporate additional independent variables, such as the percent of teachers schoolwide fully implementing PBL with fidelity. This will support an analysis of comparable students (e.g., same school year, grade level) with school-level variables that may impact teaching and learning. For the purposes of this study teachers were not asked to disclose the level of fidelity of implementation of PBL. All teachers in the district were instructed to implement PBL units of study. However, resistance to implementation has been encountered and many do not implement fully. The passive resistance of teacher implementation required this researcher to include the limiting measure of collecting data from students with six unit of study end-of-unit assessment scores as a validation measure that the student was in a classroom fully implementing the PBL units of study.

Curriculum Adoptions

In California, school districts adopt new curriculum on a seven or eight-year cycle. Many publishers participate in these adoptions cycles since California has the largest student population in the country. When reviewing new programs, districts should consider adopting those that include a PBL component. Given the strong preference by teachers for a traditional textbook-based program which includes a highly detailed teacher's edition from which they may plan and follow, districts should adopt the programs that provide multiple teacher resources and shorter lesson formats. The programs should contain a blend of more traditional scripted lessons with some PBL units and performance tasks.

Based upon the teacher feedback, the greatest hindrance to the use of PBL units was the additional time required for planning and locating resources, which were typically identified as worksheets. The traditional textbook provides the worksheets, but more importantly, within the weekly and daily lessons found in the teachers' edition, the script of teacher and student lesson talk, in some cases an actual script and in others the suggested dialogue. The request by teachers for a daily in-class worksheet and a daily homework worksheet is still prevalent. The PBL unit does not provide the high level of detail consisting of weekly and daily lessons. This is not an oversight but rather the purpose is that this allows the teacher the ability to modify a lesson to best meet the needs and abilities of his or her class. Individual teachers did report in the open-ended survey questions that they enjoyed the professional freedom the PBL units gave them, which is not found in a traditional textbook program.

Publishers must meet two important criteria when developing and producing new programs. First, it is required that they meet the guidelines established by the state departments of education. These requirements range from specific content standards, such as inclusion of the

California Gold Rush in history, to the inclusion of polynomials in math. Additional requirements are dictated, such as the inclusion of specific demographic groups in photographs and stories, so students see themselves reflected in the curriculum and the materials are not ethnocentric. Second, publishers must meet the wants and needs of teachers who will select the materials to be used when district purchases are made. Teachers request multiple resources to supplement their instruction. These additional resources are often workbooks for in-class and homework assignments. Foremost, the state requirements must be met to be included in state adoptions. To sell teachers on the programs, teacher preferences must be met.

Hands-on materials and project-based assignments, requiring additional preparation time and cleanup, are not well received as evidenced by the district in this study's purchase of the Full Option Science System (FOSS) in the last science adoption of 2006. At the time teachers, were initially excited by the many standards-based investigative science activities, and students found the activities engaging and relevant to everyday experiences that explained the nature world at the appropriate grade level of understanding. The FOSS kits arrived in large boxes, approximately a cubic yard in size, most classrooms received three of these boxes with each containing different theme-based materials for hands-on science lessons. Teachers found the lesson prep and cleanup to be time consuming, and the FOSS kits have remained little used, verified by the fact that few teachers ever asked for the supply replenishment kits that should have been necessary each year if the hands-on activities had been completed. This study could have focused on measuring growth in science content knowledge through implementation of the FOSS system, but the lack of use was simply an impediment to such a study.

The consequences for publishers in reacting to this phenomena is if they seek to utilize a PBL instructional format, the projects need to be largely paper-based and contained within a workbook format. Publishers could make these workbooks and worksheets digital to reduce paper consumption. Workbooks require almost no teacher preparation, other than identifying which page in the workbook they will direct their students to complete.

Professional Learning

The need to enhance the professional learning of teachers is very high in the areas of creating daily and weekly lesson plans. The last state-wide curriculum adoptions the district participated in, 2007 and 2009, included math and reading programs that provided highly scripted program of instruction. The units and chapters were broken down by week and by day. The daily lessons were further broken down to blocks of minutes allocated to a particular portion of a lesson. The lessons were so highly formulated by the publisher that it was quite possible for a teacher to review the daily instructional plan in as little as five or ten minutes and be prepared to deliver the lesson. This is simply not possible when delivering PBL units of study. PBL units require additional planning time. Over the course of eight to ten years with the previous publisher's textbook-based programs teachers became very comfortable utilizing the publisher's planning templates and became resistant to devoting additional time to planning for PBL. Many of the newer teachers, those who entered the teaching profession within the last decade, had not been required to create daily and weekly lesson plans since the textbook programs included a highly scripted teacher's edition. These newer teachers who may have studied lesson planning in their university programs had little need for it. The further development of knowledge and skills to create and fine-tune lessons was often not realized, illustrating the need for additional teacher training in the area of lesson planning.

Professional learning for the teachers must include research that demonstrates when students participate in authentic problem solving, the PBL supports engineering design principles, use of the scientific method, and measurement skills necessary for college and career readiness (McCright, 2012). This professional learning must demonstrate to the teachers the value of facilitation; i.e. how to provide support and encouragement when facilitating small groups (McCright). Furthermore, by opening doors for students to connect newly learned details to their prior knowledge, and to use PBL to motivate and understand, rather than simply memorize facts, leads to improved student achievement (Remmen & Froyland, 2014).

Response to Pragmatism

When considering the results of this study, the findings that PBL units do result in higher MAP growth scores and PBL units do require additional planning and preparation time, it is important to consider the cost-benefit ratio. Where the PBL MAP growth scores high enough to compensate for the additional planting time required? Teachers have a difficult job not only instructing their class but also managing their class. Teachers will choose whether or not to devote additional time to areas where they feel there will be a personal benefit as well as a benefit to the class. This is simply a pragmatic decision. In terms of managing their classroom, PBL units do result in more active classrooms, with students working in groups or with peers on projects, as opposed to individually working on worksheets. Collaborative work in small groups with the guidance of the teacher, opens the door for learners to develop their knowledge base with PBL in a more in-depth and detailed manner than if they were to merely do worksheets (Frank & Barzilai, 2004). Many teachers do not feel comfortable in this active environment. However, there is a distinct difference between productive and unproductive noise levels. Teachers must learn to appropriately manage classroom noise levels (Tomlinson & Imbeau, 2010). Many educators and parents feel that classrooms must be quiet and orderly and that busy and louder classrooms are not educationally productive. The teacher must determine if a noisier classroom is actually a perceived loss of control, or actual loss of control, and develop the skills to manage productive educational noise levels.

Change Process

It is important to consider in this discussion the change process that occurs when a new curriculum is implemented. Teachers are no different than any other individuals. Research on the change process has frequently identified a level of 10% annual change or adoption is typically seen when major change initiatives are implemented. Moving from a traditional textbook-based curriculum, packaged and scripted for the teacher to implement easily, to a PBL unit model that is packaged for teachers to be creative and provide flexibility in meeting the needs of their students, is a major change. The change has been met with teacher resistance demonstrated in the survey comments (see Table 44).

Table 44

Survey Responses, Resources

Comment 55	"The UOS is nice for thematic lessons. However, I feel that they are very time consuming to find and prepare the resources. I feel like we are constantly looking and searching on the site for resources. Then we have to copy each one. We are spending a lot of our free time just finding what we need. The book was nice because they told us up front what to teach but we still had options and could use creativity to adjust them to be more engaging."
Comment 56	“It's too much trouble to pull the resources from various websites to make copies of handouts.”

Further complicating an acceptance or adherence to any changes in the district studied is the frequent change in district leadership at the highest level, the superintendent. On average over the course of the last decade, the tenure of the superintendent in the district studied, has been 18 months. Each new superintendent has brought one or more new initiatives to be implemented in the classroom to address low academic achievement issues. Teachers have developed initiative fatigue that is typically followed with comments such as “wait, this too shall pass,” therefore no need to implement the initiative. The PBL initiative has suffered less than full implementation due in part to this initiative fatigue factor, regardless of any positive impact seen by the teachers. Hattie’s and Robinson’s work speaks to a need for close to wholesale change in the classroom, which is not welcomed by teachers, and so the status quo remains the norm.

Technology

For the district in this study, technology plays an important role in the delivery of curriculum as evidenced by the significant funding expended to achieve a nearly 1:1 student to Chromebook ratio. The 2017-2018 school year should see the attainment of the 1:1 ratio. Teachers indicated in the teacher survey that they preferred digital resources in the textbook-based curriculum over the PBL units, by a ratio of two-to-one. This response is very peculiar due to the fact that the PBL units are fully digital and all resources found in the units are also fully digital. The textbook-based curriculum offers fewer digital resources making this finding very difficult to reconcile. Further research is needed into the teacher use and expectations of digital curriculum and resources and how teachers would like to utilize these resources.

The use of these devices, Chromebooks, provides an opportunity for teachers to utilize and leverage technology’s ability to provide more individualized assessments and academic work assignments. Computer adaptive content programs are established in the district. These programs are available to support both math and reading curriculum. The programs use the power of technology to modify the work assigned to a student based upon the student’s responses to questions they either previously answered correctly, or incorrectly. When a student responds correctly to questions, the subsequent questions posed become more academically difficult and vice versa. The technology can respond to an unlimited number of student responses, which is not possible for a classroom teacher. As teachers struggle to meet the needs of each individual student they must move from whole-class instruction to small group instruction two individual instruction. The time a teacher can allocate to individual instruction is extremely limited and therefore the benefit technology provides should be maximized (Basye, 2014). Whether or not future curriculum adoptions are more aligned to a traditional textbook-based model or a PBL model, the benefit of an individualized computer adaptive program to supplement and enhance the curriculum is desired by teachers, as indicated in the teacher survey.

Role and Importance of the Teacher

Results from the open-ended questions in the teacher survey found that a number of teachers identified the most important factor in improved academic achievement and student engagement is the teacher. They report both PBL and textbook-based instruction could be beneficial when the teacher adapts each lesson for the purpose of meeting the needs and interests of their students (See Table 45).

Adaptation of lessons is intended to be normal in the PBL units, which is why they are not scripted to the point of daily lesson plans. Textbook-based programs are not intended to be adapted in such a way. The teachers who noted the importance of the teacher, chose to take professional license and adapt both the textbook and PBL unit as necessary. This mindset of teacher importance is needed. The growth mindset believes you can take the best of a curriculum and tailor it to meet the needs of the students. Teachers with these beliefs also take ownership of their instruction and their students’ learning. Teachers who follow the script of a publisher's program are able to identify the program as inadequate when student achievement is not realized. Fewer than 20% of the teacher respondents provided commentary that identified the teacher as the critical factor in the classroom.

Table 45

Teacher Impact Survey Responses

Comment 57	"While I think that generally speaking, the UOS tend to be more engaging than a more traditional curriculum, I think a good teacher can make a text-book based curriculum more engaging by supplementing here and there."
Comment 58	"Incorporating Rigor in the classroom doesn't come from a textbook or a unit of study. It comes from the teacher knowing her students individually and knows what questions will help meet the needs of that given student."
Comment 59	"The textbook will work as a base of information for your students. Teachers will use their knowledge and creativity to deliver the lessons and make the lessons rigorous."
Comment 60	"Rigor is not provided by a textbook. It is provided by the teacher. The teacher needs to go beyond the book and give students projects to show what they know."

Recommendations for Further Research

Additional research is needed to better understand teacher resistance to the implementation of new instructional programs. Teachers are at times asked to make major shifts in the use of materials and strategies for instruction. These shifts can at times be mandated by district, state, or federal initiatives. When these shifts occur, teachers are often not fully informed of the reasons and rational for the shift. Teachers may be more welcoming to the shifts if they are better informed of the effectiveness a new program or strategy. This researcher proposes that further study is needed on what factors contribute to a higher level of teacher acceptance of new shifts in education. Are teachers more influenced by empirical research, case studies, peer testimonies, or some other factor? The answers are needed since it is the classroom teacher who can make a program have value and benefit, or not. The best programs and strategies available are only effective if properly implemented by the teacher.

Additional research is needed to obtain the input of students on how they learn best. The student can become the most passive person in the educational process, and often find that instruction is something done to them rather than with and for them. Students' opinions should be collected on whether they prefer to learn from workbooks, textbooks, digital information sources, in groups, within projects, models, or simulations, from lecture, group discussion, or other methodology. This study focused on the perceptions of teachers as the practitioners of instruction at the point of delivery. Additional study should focus on the recipients of the instruction.

To determine if the PBL effect size would increase over multiple years, the researcher recommends a longitudinal study and the use of a 2 x 5 factorial ANOVA. The calculated effect size using Cohen's *d* was small for each grade level, which could be due in part to the comparisons being conducted based on one-year data. Another factor in the small effect size may have been the newness of the instructional strategies of PBL in practice by teachers in the study. Teachers' experience with PBL was not in-depth at the time of this study and a longitudinal study would have the benefit of teachers being more comfortable with the PBL routines over time and could result in a greater effect.

There are many other districts that have implemented Ainsworth's RCD framework for the creation of PBL units of study. Additional research is needed focused on a comparison of these districts and non-RCD districts. Within such a study, it would be valuable to measure the level of implementation, or adoption, of the process by teachers in each district. Is the process working better in some districts than in others? What are the contributing factors for successful PBL implementation?

Conclusions and Summary

This study was conducted to gain additional knowledge of the academic benefits of two instructional methodologies, one a traditional model with greater teacher control of the learning process, and one with greater student control of the learning process. Both methods require the skill and knowledge of the classroom teacher to maximize educational gains by and for students. This researcher presented background research, information, and a history of low academic performance in an urban school district. To see improvement in student academic performance, some component of the educational process must change, or the results will remain low through a continuance of status quo educational processes.

The district in the study embarked on a radical change to the instructional process by shifting from a highly scripted textbook-based program of instruction to a PBL model of instruction, using teacher authored units of study. A comparison was conducted and the research and supporting data provided for the conclusion that in most of the grade levels measured, PBL resulted in higher academic growth scores than the traditional textbook-based method of instruction. Additionally, the research provided data that teachers prefer a traditional textbook-based model that supplies a greater number of readily at-hand printed resources and a daily lesson plan. There was data to support that many teachers did prefer PBL and the flexibility and creativity it provided teachers and students, but these teachers were in the minority. In summary, PBL instruction resulted in higher academic growth scores for students, but PBL was not the preferred methodology of teachers. The implications are that to realize the full benefit of PBL, the district must assist teachers with additional preparation aides and resources to reduce the time required to prepare for the PBL unity of study's implementation.

In this chapter, a summary of the findings regarding each of the three research questions was presented, including the decision to accept or reject the null hypothesis associated with each question. Implications for instructional practice and recommendations for further research were provided by the researcher, with an eye toward informing educators on current research on best instructional practices, specifically PBL. This study will conclude with an epilogue in which the author will discuss personal experience in making significant pedagogical changes in one district in pursuit of significant gains in students' academic achievement to reverse decades of low performance.

CHAPTER 6: EPILOGUE

The researcher began the study of the effects of PBL as the culmination of a multiple year process when the researcher's district transitioned its curriculum from a traditional textbook-based model, scripted under the NCLB era, to that of a PBL model entitled units of study, created using the RCD model. The transition was implemented to address the transition to the CCSS. The district superintendent chose to adopt the rigorous curriculum design model during his first year in the district as a measure of his response for the upcoming Common Core curriculum. RCD is a 10-step process created by Ainsworth (2011) in which standards are mapped in a kindergarten through 12th grade articulated manner broken down into units of study for each grade level. These units follow the PBL methodology in which performance tasks are a critical component and worksheets are not the norm, as is found in a textbook-based model.

The Process

As the district's Curriculum Director at the time, this researcher was assigned the task of convening a group of expert teachers from the district to receive training in the RCD process and to ultimately create units of study and the assessments associated with them. The process itself was initially completed within a two-year time frame which consisted of initial teacher training and utilization of the knowledge of an RCD consultant to lead teachers through the creation process of the units. The teachers who participated committed a significant amount of time to process, up to 15 days out of the classroom in a single school year. Teachers were released from their assignment to meet in grade level teams and craft the units. The process was very demanding but at the culmination of the second year the initial nits of study had been created and were released for a pilot year of instructional use. During this pilot year teacher teams continued to work to refine the units, correct errors, and add instructional resources.

Teachers who participated in this process were asked to complete an application providing their interest, as well as evidence of their expertise as a teacher. The teacher's site administrator was required to approve the teacher's participation. The time commitment required was very high and therefore, many tremendously qualified teachers chose not to participate, not wanting to be removed from their classroom for so many days. Those that chose to apply and participate were extremely interested in a new curriculum model to meet the needs of shifting to the new CCSS. Grade level teams of four or five were created. Veteran teachers, as well as some novice teachers, were included to provide variability in the expertise and point of view of the teacher. Veteran teachers were able to contribute their expertise and knowledge, while new teachers were able to contribute a novice's perspective and point out needed unit of study features so the units would be usable and accessible by all teachers.

A peculiar and interesting issue arose from this process. Many of the participating teachers did not want to be identified as a member of the RCD committee. There is an unfortunate level of criticism leveled upon teachers who stepped out of the ranks and choose to participate in innovative efforts and a change process. Change, as it is found in many environments, is not often welcome. However, moral purpose and change, at first glance, appear to be strange bedfellows. On closer examination they are natural allies (Fullan, 1993). Stated more directly, moral purpose, or making a difference, concerns bringing about improvements. Teachers who participate in change events are often not welcome. This researcher finds this extremely unfortunate since in the field of education, professional educators should always be looking for effective and productive change, rather than defending the status quo. The researcher, as Curriculum Director, chose to honor the request for anonymity. However, at the end of the process, all names were brought forward to the district's Board of Education for recognition of their efforts.

The Phase-out of the Traditional Textbook

The units of study are a replacement for the traditional textbook. A phase out of the use of the textbook occurred during the years of the transition to PBL units. The phase out was a change from the status quo and often not welcomed by many of the rank-and-file teachers. The previously adopted textbooks were left in the classrooms as a resource and were, at times, referred to within the nits of study as a resource. During the refinement process of the nits of study, any reference to the previously adopted textbook was removed so that the units could stand alone. Multiple resources are identified in the units, most of which are available online. Found in the online format, the benefit of having multiple resources is realized. Teachers are able choose resources that more specifically target the needs of their class. In the traditional textbook model, there is one workbook provided for each student; typically, there is one page of work per day in class and one page of work per day for homework. The opportunity for flexibility and variability in addressing student needs is minimal to non-existent in this format. However, this format provides great efficiency for assigning work. The use of the online resources does require additional preparation in selecting the most advantageous worksheets or other assignments. Teachers must weigh the benefits of multiple resources against the time saved in singular resources.

Teachers Welcome Professional Freedom

Many of the more veteran teachers, those who had been teaching 15 or more years (prior to what was an almost lockstep cadence of instruction under the NCLB), found the PBL units invigorating and a throwback to the type of instruction they provided in the 1990s and earlier.

These veteran teachers welcomed having more power over their instructional day and considered it an act of professionalism to fine-tune the lessons, when given the autonomy to do so, within the framework of a PBL unit. These veteran teachers lamented having to “follow the script” as was found with the use of the textbook. The units of study provided them the opportunity to better meet the individual instructional needs of their students. The novice teachers have found the PBL units to be flexible but also difficult when planning, due to their lack of experience teaching without a scripted teacher’s guide, as most entered the field when scripted adherence to the textbook was expected.

Teacher Resistance

The units of study were met with pushback from teachers. A major complaint was having to find resources and additional planning time necessary to properly implement the units. With the textbook-based model daily lessons were essentially scripted so the teacher had minimal planning time required of them (see Table 46).

With the scripted textbook model, a teacher could walk in five minutes before the class began, quickly review the teacher's guide, and begin instruction when the class was seated. The daily worksheets provided for in-class and at-home work required no time of the teacher, other than to identify the page to be assigned. It is interesting to note that under the NCLB era a consistent complaint of teachers was that there was no flexibility in the instruction, that they were required to adhere to a pacing guide in order to deliver the complete program within the school year. After over a decade of this type of instruction, many teachers became quite comfortable with the rote instruction and minimal preparation time. The change to a more time demanding preparation model was not welcomed. Change, good or bad, is often not welcomed and was not in this instance.

Table 46

Planning Survey Responses

Comment 61	“Teachers are not curriculum writers. Though the UOS provides some rigor and addresses the CCSS, the curriculum that teachers have used in the past were also designed to be used to meet the necessary rigor and address the CCSS. Most textbook based curriculum can be just as easily modified to meet the rigor and standards teachers are trying to address in the classroom without hours of preparation. It is unnecessary to try and reinvent the wheel with the UOS.”
Comment 62	“Units of study are a "guide" at best. Teachers are paid to deliver curriculum and teach students. Planning and implementing units of study requires teachers to write curriculum. Teachers are not paid to write curriculum. New and inexperienced teachers do not yet possess the skill set to effectively write curriculum.”
Comment 63	“I prefer a textbook-based model because I do not have to search for every lesson. A textbook lesson has what I need right there and if I want to add things I can search but I do not have to find a lesson, every day.”

Coincidentally, during the implementation of PBL in which more preparation time is required, the district's teacher union agreed to three more hours per month of working time in exchange for additional salary. The additional working hours was for the sole purpose of collaboration time. Collaboration time is exactly what is necessary to provide quality planning for the units of study. Given that the teachers union has significant political power in the district, union leadership is quick to resist change and press district leadership, including school board members, against any change. A number of school site principals were also found to resist the move to PBL. These principals may be against the PBL model or are simply wanting to be seen as supportive of their teachers, good or bad. The inconsistency of who sits in the district superintendent's seat, as well as board members' seats, also contributed to the teacher resistance. As new superintendents are seated they frequently bring new programs for implementation to the district. Teachers find this frequent change of program with each new superintendent counterproductive and find the rationale to adopt a stance of "just wait, this too shall pass." The current status of district politics leaves open a strong potential for reverting back to a scripted textbook-based curriculum.

Continuing the Journey

The status of the PBL units of study is stable. All the units have been improved and refined more than once and have been validated to be of a very high quality by the well-respected educational entity WestEd. To address the issue that most PBL resources reside online, the district adopted a nearly one-to-one student technology device program. It is expected that in the current school year the district will require enough additional Chromebooks so that by the end of the school year the district will be at a one-to-one student to Chromebook ratio. This technology enhancement means that all students have access to online resources.

There was still strong resistance by teachers who did not welcome the additional preparation time necessary for full implementation of a PBL curriculum. The ease of a textbook-based instructional model was very palatable to them. While a large percentage of teachers have welcomed and embraced the PBL units, they unfortunately are not a very vocal group. It was very clear, the additional PBL unit preparation time was not welcome. It was also important to note that after over a decade of following the scripted textbook model only a third of the district's students we're able to achieve at grade level proficiency in reading and mathematics.

Something must change for these numbers to improve. Either the curriculum or the instructional strategies must change, if not both. Students' needs must be addressed by approaching their educational needs from a different angle. The answer is not solely in changing the curriculum. It has been found in research, most notably those of John Hattie (2012), that the most effective methods to improve student achievement outcomes hinge upon what the teacher does in the classroom. There are many programs and many instructional strategies. Hattie's meta-studies would suggest that teachers who react to the needs of their students and deliver instructional and curriculum programs, whether these programs are strong or weak, will find success with most any program since it is the teacher's delivery that ultimately provides the most impact on student achievement outcomes. Student achievement is the common goal.

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APPENDIX A

Sample PBL Unit of Study Planning Organizer

Stockton Unified School District
Grade 5 English Language Arts
Unit 1 Planning Organizer

Subject	***English Language Arts***
Grade	***Grade 5***
Unit of Study	***Unit 1: Key Ideas and Details in Informational Text with Expository Writing/Living Off the Land***
Pacing	***5 weeks***

Unit Overview
Students will practice close reading and annotation of informational text about Native North Americans in order to determine main idea and supporting details, identify text structures, and understand genre characteristics of informational text. During collaborative discussions, students will summarize text, clearly expressing their ideas and building on the ideas of others. They will gather evidence from texts on the history and culture of Native North Americans and write an informative / explanatory essay to communicate information clearly. Students will create appropriate focus in their essays, cite relevant evidence, and will specifically focus on introductory paragraphs and sentence fluency.

Standards
RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. ***Est. Teaching:*** ***RI.5.2 Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.***

RI.5.3 Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text. ***RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.*** ***W.5.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.*** ***a. Introduce a topic clearly, provide a general observation and focus, and group related information logically; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension.*** ***b. Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic.*** ***c. Link ideas within and across categories of information using words, phrases, and clauses (e.g., in contrast, especially).*** ***d. Use precise language and domain-specific vocabulary to inform about or explain the topic.*** ***e. Provide a concluding statement or section related to the information or explanation presented.*** ***SL.5.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.*** ***L.5.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.*** ***L.5.1a Explain the function of conjunctions, prepositions, and interjections in general and their function in particular sentences.*** ***L.5.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.*** ***L.5.2.b Use a comma to separate an introductory element from the rest of the sentence.***

Engaging Scenario & Task Synopsis
Imagine! You are a Native American living off the land that will one day become the United States. You live off the resources available to you. There are no grocery stores, hardware stores, or pharmacies.

While collecting water one morning, you are suddenly transported to the future. You find yourself as the guest expert in a fifth grade classroom in Stockton, California. Your job is to convey to these twenty-first century kids what life is like for you in your day.

There are three performance tasks in this unit. To expand your knowledge of the indigenous peoples of North America, you may pick different tribes to study for each task.

Teacher Notes

<u>Performance Task 1 (Graded):</u> RI.5.1, RI.5.2, SL.5.1 Main Idea/Detail

<u>Performance Task 2 (Graded):</u> L.5.1, L.5.1a, L.5.2, RI.5.2 "A Day in the Life" Storyboard

<u>Performance Task 3 (Graded):</u> W.5.2, W.5.2a, RI.5.2, RI.5.3 Informative / explanatory text on Native American Dwelling

<table>
<tr><th colspan="2">Instructional Sequence</th></tr>
<tr><td rowspan="2">Weeks 1-2

RI.5.2 Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.

SL.5.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.</td><td>Learning Targets

● I can determine the main idea of a text and explain how it is supported by key details.
● I can summarize a piece of informational text and include main ideas and key details.
● I can prepare for a class discussion and participate by using my preparations and responding to others.
● I can follow agreed-upon rules for class discussions
● I can ask and answer questions during a discussion to elaborate on the remarks of others.
● I can review ideas expressed and draw conclusions using information gained in a discussion.</td></tr>
<tr><td>Suggested Texts

● Short informational texts
○ www.newsela.com is a good resource</td></tr>
</table>

	● ***Our Nation, Scott Foresman Social Studies textbook***
	Instructional Options ***To prepare students for success on Task 1, main idea and key details lessons should be taught using a variety of informational texts.*** Main Idea Graphic Organizer Summary graphic organizer Lessons for main idea and details in informational text ***Students benefit from a systematic approach to locating the main idea.*** ***Suggestions:*** ***1. Read each paragraph.*** ***2. Jot down a word or a few words that best describe what the paragraph is mostly about.*** ***3. After reading all paragraphs on the page(s), group, if possible, which paragraphs share the same main idea.*** ***4. During their discussion, students have to defend why they grouped certain paragraphs together.*** ***5. Locate details that support each main idea.*** ***Here is a video, showcasing a model of the above approach:*** Critically Analyze Text: Video ***Another suggestion is Reciprocal Teaching:*** http://www.readingrockets.org/strategies/reciprocal_teaching/ ***Model and practice partner/group work.***
Administer Task 1	
Week 3 ***L.5.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.***	***Learning Targets*** ● ***I can explain the function and effectively use conjunctions, prepositions and interjections to create fluency in my sentences.*** ● ***I can explain the relationships or interactions between individuals, events, ideas, or concepts in a historical period based on information in the text.***

<table>
<tr>
<td rowspan="2">L.5.1a Explain the function of conjunctions, prepositions, and interjections in general and their function in particular sentences.

L.5.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

RI.5.2 Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.</td>
<td>Suggested Texts
History Channel Native American Cultures
Encyclopedia Britannica: Indigenous Peoples of Canada and United States
Ducksters: Native American Tribes and Regions
Our Nation, Scott Foresman Social Studies textbook</td>
</tr>
<tr>
<td>Instructional Options

In Task 2, students will use what they’ve learned about main idea and details to summarize a day in the life of a certain Native American tribe.

They will need instruction in the following areas:

Conjunctions:
Conjunction Resource
Conjunctions Practice

Prepositions:
Preposition Resource
What are Prepositions?
Lesson: Preposition Books

Interjections:
Interjection Resource
Schoolhouse Rock Interjection Video</td>
</tr>
<tr>
<td colspan="2">Administer Task 2

Graphic Organizer Sample</td>
</tr>
<tr>
<td rowspan="2">Weeks 4-5

W.5.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.</td>
<td>Learning Targets
I can write an informative/explanatory piece, to examine a topic and convey ideas
I can introduce a topic, provide a general focus, group related information, and include formatting and illustrations when helpful</td>
</tr>
<tr>
<td>Suggested Texts</td>
</tr>
</table>

W.5.2a Introduce a topic clearly, provide a general observation and focus, and group related information logically; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension. ***RI.5.2 Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.***	• Native American Homes • Native Americans: History and Facts
	Instructional Options ***Students will research the dwelling of a particular Native American tribe, then create a representation (model, drawing, poster, picture from a media source) of that dwelling. Provide instruction and modeling on how to conduct research, determining which information is most important and most reliable.***
	Provide explicit instructional support for the informative writing process. Students will produce a full essay on the dwellings used by their chosen Native American group, including:
	a. Introduce a topic clearly, provide a general observation and focus, and group related information logically.
	b. Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic.
	c. Link ideas within and across categories of information using words, phrases, and clauses (e.g., in contrast, especially). ***d. Use precise language and domain-specific vocabulary to inform about or explain the topic.*** ***e. Provide a concluding statement or section related to the information or explanation presented.*** ***Provide direct instruction on writing informative/explanatory texts.*** *Lesson Resources for W.5.2* *Lesson Resources for W.5.2a* *Resources to Teach Informative/Explanatory Writing* *Informative/Explanatory Writing Anchor Charts* *Teaching Channel: Writing to Learn* *Teaching Channel: Making Students into Better Writers* *Article on 8 Smart Strategies for Teaching Writing* *Teaching Channel: Writing Fluency* *Student samples of Informative/explanatory writing* *Graphic Organizer (free download)*
Administer Task 3	

Resource List
Quality Instructional Resources for the Teacher Resources ***Unwrapped Skills and Concepts*** Skills and Concepts Chart ***Academic Vocabulary*** Unit Vocabulary Terms ***English Language Learners*** http://www.cde.ca.gov/sp/el/er/documents/eldstndspublication14.pdf ***Universal Design for Learning*** Strategies for Differentiation ***Small flexible grouping*** ***Individual writing conferences*** ***Class discourse***

APPENDIX B

Quantitative Survey

Teacher Survey

Using the following scale, 1 strongly prefer textbook use, 2 prefer textbook use, 3 neutral preference, 4 prefer project-based unit of study, 5 strongly prefer project-based unit of study, please check the number of your choice.

Traditional textbook strongly prefer		neutral		Project-based learning unit of study strongly prefer
1	2	3	4	5

1. In terms of ease of use, time required to prepare lessons, I prefer (textbook or project-based unit of study)

2. In terms of ease of use, time required to deliver lessons, I prefer (textbook or project-based unit of study)

3. In terms of ease of use, time required to assess lessons, I prefer (textbook or project-based unit of study)

4. In terms of ease of use, the ability to vary the assessment type and length, I prefer (textbook or project-based unit of study)

5. In terms of ease of use, access to a digital copy resources, I prefer (textbook or project-based unit of study)

6. Please describe in one or two paragraphs how your overall preference for either the textbook or PBL instructional model meets the need for a useable and manageable instructional program.

7. In terms of student engagement and active participation in the lesson I prefer (textbook or project-based unit of study)

8. In terms of your ability to use creativity in delivering the lesson I prefer (textbook or project-based unit of study)

9. In terms of the flexibility in delivering the lesson structure and format I prefer (textbook or project-based unit of study)

10. In terms of your ability to integrate other content areas in the lessons I prefer (textbook or project-based unit of study)

11. In terms of capacity for differentiation and scaffolding to meet the needs of all students I prefer (textbook or project-based unit of study)

12. Please describe in one or two paragraphs how and why your overall preference, either the textbook or PBL instructional model, meets the need of having an engaging and adjustable lesson.

13. In terms of correct level of academic rigor I prefer (textbook or project-based unit of study)

14. In terms of ability to adjust the level of academic rigor I prefer (textbook or project-based unit of study)

15. In terms of correctly addressing the standards I prefer (textbook or project-based unit of study)

16. In terms of completely addressing the standards I prefer (textbook or project-based unit of study)

17. In terms of ability to reach different Depths Of Knowledge and Bloom's levels I prefer (textbook or project-based unit of study)

18. Please describe in one or two paragraphs how your overall preference for either the textbook or PBL instructional model meets the need of aligning instruction to appropriate instructional standards for students at different levels of understanding.

Please circle the choices that describes you.

1. Gender
   a. Male   b. Female

2. How many years in teaching
   a. 0-3
   b. 4-6
   c. 7-10
   d. 11-20
   e. more than 20

3. Have you taught using the district's units of study?
   4. Yes   b. No

5. Grade level are you currently teaching
   K   1   2   3   4   5   6   7   8   High School

APPENDIX C

Adult Informed Consent Form Letter

Survey: Informed Consent Form for Participation in Robert Sahli's Research Study on Project-Based Learning

Dear Teacher,

You are invited to participate in a research study that is trying to ascertain the teacher's perspective of the effectiveness of Project-Based Learning (PBL). Your answers will be used to evaluate whether teachers perceive PBL as academically rigorous, manageable to deliver and therefore useable, and engaging.

Your answers will be kept confidential and the researcher will not be able to designate any participant to a specific set of answers. If you have any questions please feel free to ask the researcher, Robert Sahli, or email Dr. Belinda Karge, the supervising faculty for this research (belinda.karge@cui.edu). At any time you may email questions or comments to Robert Sahli at robert.sahli@eagles.cui.edu .

You do not have to participate in this study and you can stop participating in the study at any time. It is not expected that the survey will cause distress or discomfort; however, if at any time you feel uncomfortable, please feel free to stop responding to the survey and place it into the survey collection envelope. Your participation will help provide data for a research study that is studying the effectiveness of PBL from the perspective of a classroom teacher. It is hoped that the research will help the educational community better understand the contribution of PBL instruction on academic success.

Again, please note that your responses to this study are confidential. In the future, follow-up interviews may be conducted and your participation would be appreciated again. At the end of the ADULT INFORMED CONSENT FORM you will find a signature line. If you are willing to participate in an interview at a later date, please put an X on the appropriate line as well.

Thank you,

Robert Sahli

APPENDIX D

Adult Informed Consent Form

INFORMED CONSENT
The study in which you are being asked to participate is designed to investigate a teacher's perspective regarding the effectiveness of project-based learning (PBL) on student academic achievement and teacher perceptions on project-based learning. This study is being conducted by Robert Sahli, under the supervision of Dr. Belinda Karge, Professor in the School of Education, Concordia University, Irvine. This study has been approved by the Institutional Review Board, Concordia University, Irvine CA.

PURPOSE: The purpose of this study is to examine the effectiveness of project-based learning on student academic achievement and teacher perceptions of PBL.

DESCRIPTION: You are being asked to fill in a survey with questions about your teaching experiences.

PARTICIPATION: Your participation is completely voluntary and you may discontinue participation at any time.

CONFIDENTIALITY OR ANONYMITY: Your identity will remain completely anonymous, and neither the district's name nor school name will be reported. The findings, reported in my doctoral dissertation, will simply say that data was collected from teachers within a central California school district. All data and findings will be stored either in a locked file cabinet in the researcher's home, or in the researcher's private computer that is protected by security software and passwords. All records will be destroyed by January 1, 2019.

DURATION: The researcher plans to conduct a survey. The entire data collection phase should last from September 1, 2017 - December 31, 2017. The survey should take about ten minutes to complete.

RISKS: It is not expected that the survey or interviews will cause distress or discomfort; however, if at any time you feel uncomfortable, please let the researcher know and discontinue participation.

BENEFITS: Participants may benefit from the self-reflection inherent in the survey and the follow-up interview as they consider their beliefs, student's needs, and instructional practices. The higher education community will benefit from a better understanding of PBL instruction.

CONTACT: For questions about the research and research participants' rights, or in the event of a research-related injury, please contact Dr. Belinda Karge, dissertation committee chair: 949-214-3333, Belinda.karge@cui.edu

RESULTS: The results of this study will be published in the researcher's doctoral dissertation at Concordia University Irvine.

CONFIRMATION STATEMENT: I agree to participate in the research study described.

SIGNATURE:______________________ _____________________________ ____________

Print Name **Signature** **Date**

APPENDIX E

Levene's Test for Equality of Variance

Grade 4 Reading

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Actual Read Fall Spring Growth	1.00	2470	6.64	9.460	.190
	2.00	1166	8.55	8.681	.254

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Actual Read Fall Spring Growth	Equal variances assumed	6.294	.012	-5.844	3634	.000	-1.914	.328	-2.556	-1.272
	Equal variances not assumed			-6.026	2470.879	.000	-1.914	.318	-2.537	-1.291

Grade 5 Reading

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Actual Read Fall Spring Growth	1.00	2396	5.47	9.303	.190
	2.00	832	6.49	9.736	.338

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Actual Read Fall Spring Growth	Equal variances assumed	.883	.347	-2.696	3226	.007	-1.022	.379	-1.764	-.279
	Equal variances not assumed			-2.637	1392.906	.008	-1.022	.387	-1.781	-.262

Grade 6 Reading

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Actual Read Fall Spring Growth	1.00	2473	5.47	9.030	.182
	2.00	1275	7.32	9.672	.271

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Actual Read Fall Spring Growth	Equal variances assumed	1.260	.262	-5.787	3746	.000	-1.846	.319	-2.472	-1.221
	Equal variances not assumed			-5.661	2423.913	.000	-1.846	.326	-2.486	-1.207

Grade 7 Reading

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Actual Read Fall Spring Growth	1.00	2223	4.39	9.306	.197
	2.00	434	5.04	8.439	.405

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Actual Read Fall Spring Growth	Equal variances assumed	3.173	.075	-1.341	2655	.180	-.645	.481	-1.589	.299
	Equal variances not assumed			-1.432	655.824	.153	-.645	.451	-1.530	.240

Grade 8 Reading

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Actual Read Fall Spring Growth	1.00	2189	3.50	8.865	.189
	2.00	422	4.86	8.026	.391

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Actual Read Fall Spring Growth	Equal variances assumed	5.490	.019	-2.932	2609	.003	-1.362	.464	-2.272	-.451
	Equal variances not assumed			-3.136	635.545	.002	-1.362	.434	-2.215	-.509

Grade 4 Math

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Actual Math Fall Spring Growth	1.00	2470	8.85	8.679	.175
	2.00	1167	9.90	7.774	.228

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Actual Math Fall Spring Growth	Equal variances assumed	13.110	.000	-3.495	3635	.000	-1.043	.298	-1.628	-.458
	Equal variances not assumed			-3.636	2529.458	.000	-1.043	.287	-1.605	-.480

Grade 5 Math

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Actual Math Fall Spring Growth	1.00	2396	7.73	8.711	.178
	2.00	676	8.88	8.185	.315

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Actual Math Fall Spring Growth	Equal variances assumed	7.090	.008	-3.081	3070	.002	-1.154	.374	-1.888	-.419
	Equal variances not assumed			-3.190	1142.459	.001	-1.154	.362	-1.863	-.444

Grade 6 Math

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Actual Math Fall Spring Growth	1.00	2473	6.86	8.568	.172
	2.00	1358	7.65	8.594	.233

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Actual Math Fall Spring Growth	Equal variances assumed	.431	.512	-2.705	3829	.007	-.784	.290	-1.352	-.216
	Equal variances not assumed			-2.702	2786.686	.007	-.784	.290	-1.352	-.215

Grade 7 Math

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Actual Math Fall Spring Growth	1.00	2223	5.97	8.554	.181
	2.00	681	4.80	6.674	.256

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Actual Math Fall Spring Growth	Equal variances assumed	35.532	.000	3.265	2902	.001	1.166	.357	.466	1.866
	Equal variances not assumed			3.718	1426.125	.000	1.166	.314	.551	1.781

Grade 8 Math

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Actual Math Fall Spring Growth	1.00	2189	4.42	8.391	.179
	2.00	363	4.81	6.904	.362

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Actual Math Fall Spring Growth	Equal variances assumed	13.187	.000	-.826	2550	.409	-.384	.464	-1.295	.527
	Equal variances not assumed			-.949	555.584	.343	-.384	.404	-1.178	.410