2020

The Effects of Problem-Based Learning on the Academic Achievement of Elementary Students and Teacher Perception

Eva Marie Cwynar
Walden University

Walden University

College of Education

This is to certify that the doctoral study by

Eva Cwynar

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. John Johnson, Committee Chairperson, Education Faculty
Dr. Evelyn Ogden, Committee Member, Education Faculty
Dr. Salina Shrofel, University Reviewer, Education Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
2020

Abstract

The Effects of Problem-Based Learning on the Academic Achievement of Elementary

Students and Teacher Perception

by

Eva Cwynar

MA, University of Scranton, 2016

BS, University of Florida, 2002

Project Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

Walden University

August 2020

Abstract

As a result of a district's initiative to change educational practices, schools in the local setting were considering the problem-based learning (PBL) constructivist model as a way of increasing student achievement. The problem was that it was unknown to what extent PBL was being used in the classroom and how its use correlated with student achievement. The purpose of this sequential mixed methods study was to determine the correlation between teachers' reported degree of PBL implementation and the academic achievement of their students on the ELA assessment and to explore teachers' experiences when implementing PBL. The study took place in 2 elementary schools where PBL had been implemented since 2016. A sample of 17 teachers were surveyed within the 2 school sites to determine their self-report of the extent to which they used PBL in their classroom and to learn how they rated the benefits, challenges, and problems associated with the implementation of PBL. Fifteen of the 17 teachers were interviewed to gather more in-depth information regarding their survey responses. A Spearman Correlation was used to determine the relationship between the academic achievement scores of enrolled students and their teachers' reported degree of implementation of PBL strategies using the PBL-related index tool. Interview data were then analyzed using a 2-cycle coding process. Findings showed that there was a statistically significant weak positive correlation between the degree of PBL implementation and the students' ELA academic achievement. The qualitative data showed other benefits of implementing PBL, including the development of skills beyond the academic content. This research could promote social change within the local setting by identifying potential challenges and problems related to PBL implementation and supporting teachers in future PBL implementation through the development of a standards-based PBL curriculum guide.

Mixed-Methods Study of the Effects of Problem-Based Learning on the Academic

Achievement of Elementary Students and Teacher Perception

by

Eva Cwynar

MA, University of Scranton, 2016

BS, University of Florida, 2002

Project Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

Walden University

August 2020

Dedication

With heartfelt gratitude, I dedicate this work to my loving husband and 4 beautiful

children. To my husband, who has been there for me through many sleepless nights of

editing and data analysis, who supported me through all of my moments of frustration

and pushed me to persist even though there were so many times that I wanted to quit. I

could NEVER have done this without you by my side, you are my rock. To my children,

know that you can achieve anything you put your minds to. The completion of this work

is an example that persistence and perseverance do pay off and that you can accomplish

anything through the love and support of your family.

I love you all more than words can say.

Acknowledgements

I would like to recognize Dr. John Johnson, chairperson of my committee, for his support and advice throughout this process. Though I stumbled frequently, he always kept me focused on the finish line. In addition, I want to acknowledge Dr. Ogden and Dr. Shrofel who have been instrumental in guiding me through this journey. Thank you all for your patience and kindness throughout the revision process and for assisting me in improving my dissertation.

Table of Contents

List of Tables

Section 1: The Problem

Introduction

Problem-based learning (PBL) has been described as a student-centered teaching approach based on constructivist principles that engages students in real-world problem-solving activities (Nariman & Chrispeels, 2015; Wilder, 2015). In this student-centered approach to teaching and learning, students are presented with a problem, must conduct research, and then must apply knowledge and skills in order to develop viable solutions. Tandogan (2007) described PBL as a teaching and learning approach that engages students in an interdisciplinary curriculum through open-ended questioning and collaborative group work. Researchers have shown that students learn and retain more information when they are actively engaged in the learning process (Choi & Lee, 2015; Knaggs & Sondergeld, 2015). Although PBL was developed decades ago to assist medical students in building problem-solving skills and learning how to apply knowledge to real-world situations (Mustaffa, Ismail, Tasir, & Said, 2016), there is still more to learn about the effectiveness of this approach in K to 12 settings (Wilder, 2015).

Principals and teachers at two elementary schools in the local setting committed to implementing PBL within the curricula 4 years ago. In 2015, the schools applied for a grant to support training and implementation focused on PBL from the Buck Institute for Education. During the first year of implementation in 2016, 10 teachers from Grades K to 2 engaged in the professional development. The next year, the schools applied for another grant to receive follow-up professional development as well as initial training for an additional six teachers from Grades 3 to 5. Both the follow-up training and the initial training for the new group of

teachers took place over the summer of 2017. Throughout these 2 years, both schools increased the number of classrooms implementing PBL with students by engaging in professional learning communities (PLCs) and a teacher trainer model. By 2019, most teachers within each of the school sites implement PBL strategies to some degree within their curriculum.

The Local Problem

The problem is that it is unknown to how PBL implementation correlates to student achievement and how teachers experience implementing PBL within their classroom. According to Wilder (2015), more empirical evidence on the influence of PBL on student achievement is necessary. In addition, Nariman and Chrispeels (2015) recommended that further research be done to explore specific strategies used in PBL methodology as well as how these strategies connect students' prior knowledge to new content being learned. They specifically mentioned the need for more research into how PBL is related to academic achievement and its role in increasing content acquisition (Nariman & Chrispeels, 2015).My study would align with and extend the research of Wilder (2015) and Han, Capraro, and Capraro (2015) by determining the correlation between the use of PBL learning strategies and the academic achievement of elementary students.

In this local setting, increasing the academic achievement of all students through high-quality, rigorous instruction by teachers in the classroom is one of the central tenants of the district (as indicated in the organization's website) and places student-centered teaching approaches like PBL as a prominent feature in the district's strategic plan. The strategic plan was developed in response to an internal assessment of student achievement data where it was

determined that there was a local need for a change in educational practices. According to the superintendent (as reported in the district's strategic plan), the goal of this change in educational practice was to create educational environments and classroom experiences that were personalized to meet the needs of all learners through effective and relevant instruction. However, within the local context, Grade 5 science scores on the State Standardized Assessment have continued to drop at least 1 point per year during the last 5 years. In addition, English Language Arts (ELA) scores in Grades 3, 4, and 5 have dropped by up to 2 points each year for the last 2 years while scores on the Grade 3 mathematics test have not changed. As a result of the district's initiative to change educational practices to address falling student achievement scores in ELA, some of the 113 elementary schools not currently using PBL are considering implementing PBL strategies as a way of increasing achievement. However, not enough is known about the relationship between PBL implementation and student achievement.

Rationale

When implementing a PBL approach to teaching and learning, students are presented with a problem, must conduct research, and must apply knowledge and skills in order to develop viable solutions. In response to student data and the implementation of a strategic plan at the local level, some of the 113 schools not currently using PBL within this district are looking to PBL as a possible method to increase student achievement. As schools search for effective methods at improving the academic achievement of students, increasing student engagement in the learning process, and preparing students to be college and career ready, effective school and teaching practices need to be available to affect change within the school

culture. This research could lead to positive change by helping educators not currently using PBL strategies determine if this approach is something that they would want to use within their own school site in order to impact student achievement. The purpose of this sequential mixed methods study was to determine the correlation between the reported degree of implementation of PBL strategies and elementary students' academic achievement in ELA and to explore teachers' experiences when implementing PBL in order to learn more about PBL's effect on student achievement.

Definition of Terms

Constructivism: Constructivism can be defined as the way that humans make meaning in relation to the interaction between their experiences and their ideas (Piaget, 1950).

Problem-based learning (PBL): PBL is an instructional strategy that requires the use of extended student investigation centered on a real-world problem, an in-depth inquiry into a topic being studied that engages students in an interdisciplinary curriculum through open-ended questioning and collaborative group work, and some degree of self-direction and choice that allows learners to assume the responsibility for their own learning (Barrows, 1996; Nariman & Chrispeels, 2015; Ravitz, 2008; Wilder, 2015).

Student-centered learning: Student-centered learning shifts student learners from the role of passive receivers of information to active participants in their own discovery process. What students learn, how they learn it, and how their learning is assessed are all driven by each student's individual needs and abilities (Hannafin & Land, 1997).

Significance of the Study

The quantitative and qualitative findings may assist principals not currently using PBL within the district determine if PBL is a way to address falling test scores by identifying potential benefits, problems, and challenges related to PBL implementation with elementary students as well as provide feedback in terms of specific PBL strategy use and their correlation to the academic achievement in ELA for third through fifth grade students. Teachers of third through fifth grade students within both schools were asked to self-report the extent to which they use PBL in their classroom through the use of the PBL-related index established by the American Institute for Research (AIR) and adapted by Ravitz (2008).

This research could lead to positive social change within the local setting by helping educators not currently using PBL strategies determine if this approach is something that they would want to use within their own school site, by guiding members of the administration in school sites to determine if PBL strategies should be implemented as a way to improving academic achievement and to assist both teachers and administrators in identifying and overcoming potential challenges and problems related to the implementation of PBL strategies with elementary students. In addition, if study findings show that there is a positive correlation between PBL implementation and student achievement, students could potentially benefit from this study by improving standardized test scores and increasing student engagement and concept understanding as a result of the use of these strategies.

Research Questions and Hypotheses

The problem is that it is unknown how PBL implementation correlates to student achievement and teachers' experience implementing PBL within their classroom. The purpose

of this sequential mixed methods study was to determine the correlation between the reported degree of implementation of PBL strategies and elementary students' academic achievement in ELA and to explore teachers' experiences when implementing PBL in order to learn more about PBL's effect on student achievement. In order to address the purpose and problem in this study, the following research questions and hypotheses have been designed to learn more about how teachers experience PBL implementation and to determine the correlation between teachers' reported degree of PBL implementation and students' academic achievement:

Research Question (RQ)1: What is the relationship between teachers' reported degrees of implementation of PBL strategies and elementary students' academic achievement in ELA?

H_0: There is no significant relationship between teachers' reported degrees of implementation of PBL strategies and elementary students' academic achievement in ELA.

H_A: There is a significant relationship between teachers' reported degrees of implementation of PBL strategies and elementary students' academic achievement in ELA.

RQ2: How do teachers rate the benefits, problems, and challenges associated with implementing PBL within an elementary classroom?

RQ3: How do teachers experience implementing PBL in their classroom?

Review of the Literature

Conceptual Framework

PBL is grounded in the theoretical framework of social constructivism where students are engaged in an interdisciplinary curriculum through open-ended questioning and collaborative group work (Tandogan & Akinoglu, 2007). According to Piaget (1950), whose work was the basis of constructivist learning theory, learning takes place when students are

provided the opportunity to make meaningful connections to the content being learned. According to Savery and Duffy (2001), the literature supports a clear lineage between the theory of constructivism and the instructional model of PBL. PBL involves an active learning process that enables students to solve real-world problems by using their critical thinking and analysis skills and makes the student the driving force within the learning process and the teacher a facilitator of learning (Han et al., 2015). This process encourages students to learn new content and material when solving problems and allows them to merge existing knowledge with new knowledge through inquiry, data collection, and evaluation. PBL models empower students to be active participants in the learning process and constructors of meaning. Barrows (1996) described the constructs of PBL as

- Real-world in that learners must deal with an authentic problem that they could encounter outside the classroom environment.

- Student-centered where learners assume the responsibility for their own learning.

- Reflective as students engage in discussions about the problem, the methods used to solve it, and what was learned as a result of their experiences and problem-solving methods.

These constructs of PBL framed this study by providing a structure for teaching and learning within the elementary classroom settings being examined. PBL can be characterized as a project that starts with an authentic problem that is then used as the mechanism through which learning and problem-solving skills are applied. Throughout this project, students are self-directed within the learning process as they work in small groups to tackle the problem at hand while the teachers work as facilitators to the learning process (Buck Institute for

Education, 2018; Gijbels, Dochy, Van den Bossche, & Segers, 2005; Scott, 2014). By basing the PBL teaching model in social constructivist learning theory, the teacher helps the student to create new and meaningful models for learning, and students gain knowledge and skills that support them in future learning.

According to Ravitz (2008), PBL is a constructivist, empirically researched instructional strategy that engages students in learning and encourages a deep understanding of the content through rigor, relevance, and relationships. The Buck Institute for Education conducted a survey of project-based learning implementation as a catalyst for school reform across a dozen high schools in California using Ravitz's (2008) AIR Index. The schools tested used handbooks, online resources, and professional development from the Buck Institute for Education to engage students in learning and encourage a deeper understanding of the content being studied. The two schools examined in this study used these same Buck Institute for Education resources and materials for teacher professional development related to the implementation of PBL.

Using the AIR Index tool, Ravitz (2008) concluded that there was a significant relationship between the use of PBL and school reform. This study provides a research-based survey tool that can be used to assist teachers in self-reporting the degree of PBL implementation strategy use. Using Ravitz's AIR Index tool as the basis for the survey (see Appendix B) being used within this study, as well as a teacher interview protocol (see Appendix C), teachers were asked to answer a series of questions related to their teaching practice and the degree of PBL implementation within their classrooms. The questions in the AIR index assess the PBL constructs described by Barrows (1996) as well as elements of the

constructivist learning theory described by Han et al. (2015) and Tandogan and Akinoglu (2007). The survey and interview questions were focused on identifying if the constructs of PBL (a social constructivist teaching method) have an effect on the academic achievement of students and how teachers in an elementary classroom setting perceived the implementation of this teaching method. The framework further informed my study in that the specific PBL construct strategies and methods implemented within the participating classrooms can be studied further to determine if there is a correlation between the teachers' reported degree of implementation and students' academic achievement. These processes and methods can be best evaluated using interviews focused on the planning and implementation of PBL practices, classroom culture and personalization, as well as barriers to PBL use and equity of outcomes (Ravitz, 2008).

Review of the Broader Problem

In reviewing the literature surrounding the concepts being studied in this paper, several themes emerged that deemed further review. Within this section, the topics discussed can be categorized into the following groups: benefits and challenges in implementing PBL, the roles of both students and teachers when implementing PBL, and the effects on student outcomes, including both academic achievement and the development of soft skills needed to support academic achievement. The literature reviewed included peer-reviewed articles and scholarly works from EBSCO, ERIC, ProQuest, SAGE Collections, Walden University Library, and national databases. For the selection criteria, I identified appropriate articles using search terms such as *problem based learning, elementary, implementation, effects, instruction*, and *impacts*.

According to Nariman and Chrispeels (2015) and Wilder (2015), more research needs to be conducted regarding PBL instructional methods. In two studies, a case-study method was used and data were collected regarding teachers' perceived benefits and challenges during PBL development and implementation. During the implementation process, teachers observed an increase in student engagement and cooperative teamwork as well as the development of operational strategies (Alrababah, 2017; Nariman & Chrispeels, 2015). Although limited in sample size, these findings could be applied to other studies related to PBL instructional methods. According to Ibrahim, Arshad, Rosli, and Shukor (2017), the roles of students and teachers must be clearly identified in order for PBL methods to be effective. When not clearly identified, teachers found that there were difficulties in monitoring student progress, and students became more passive within this self-directed learning environment. According to Nariman and Chrispeels, often teachers welcome the idea of implementing PBL strategies within their classrooms and are committed to experimenting with how to shift from traditional teaching practices to one where students are engaged in PBL. However, teachers expressed that they needed support in how to make the shift and wanted assurance that students' academic achievement would not be negatively impacted by this shift in teaching practice (Nariman & Chrispeels, 2015). These studies related to my research in that the researchers' findings provided evidence of effective PBL strategies used in a school setting as well as PBL resources that could help me better formulate a methodology for my local setting. These findings could be used as a foundation to study which PBL strategies are most effective and how those strategies relate to overall academic achievement.

Researchers in several of the studies examined how the timing of the implementation of a problem-based approach affected overall student outcomes. Lozinski, Poon, and Spano (2017) found that students preferred to engage in PBL before any formal lecture and instruction as it allowed them to develop their own understanding of the concepts before being formally instructed. Students reported that the approach helped their thinking and reasoning and led to an increased retention of the content over time. These findings were also supported by the findings of Tandogan (2007) and Choi and Lee (2015) who noted an increase in content retention and as well as student engagement through the use of PBL strategies. The findings of Lozinski et al. (2017) were further supported by research conducted by Firdaus, Wahyudin, and Herman (2017); these researchers found that PBL led to a significant increase in mathematical literacy skills when it replaced direct instruction. Primary school students in different demographic areas were surveyed to determine if a PBL approach affected their mathematical fluency skills. While all students surveyed experienced an increase in mathematical literacy, those students living in urban areas, such as my own local context, experienced the most dramatic increase. These results were not limited to school age students; preservice teachers who engaged in PBL to acquire content during the training process further developed the skills necessary to teach the subject to others (Baysal, 2017). Positive reflections from the teachers who participated in the study included increased motivation and active engagement, the development of real-world connections, and making personal connections to other students in the course.

Researchers in several of the studies examined found that PBL positively influenced the academic achievement of high school students through the development of soft skills such

as collaboration, critical thinking, and problem-solving (Amalia, Surya, & Syahputra, 2017; Bashith & Amin, 2017; Mustaffa et al., 2016; Wilder, 2015). While researchers were unable to provide evidence to support the claims that PBL increases student content knowledge more than traditional teaching approaches, researchers did find that these methods impacted the academic achievement for this specific group of students. In addition, Amalia et al. (2017) studied the effects of using PBL in measuring the ability of mathematics problem solving in seventh grade students. *T* tests were used to analyze data from five essay tests of mathematical problem solving ability (Amalia et al., 2017). The results showed that the average test score for students who were taught using PBL were higher than students who were taught using a conventional model (Amalia et al., 2017). According to Amalia et al., it can be concluded that the use PBL in teaching and learning was effective in enhancing the ability of mathematics problem solving for students. The researchers found that when teaching with PBL, students are guided to find their own answer by following the steps of PBL model instead of being told how to solve the problems using a more traditional approach (Amalia et al., 2017).

These findings were further reinforced through the work of Brassler and Dettmers (2017) who concluded that PBL methodology developed students' interdisciplinary competence such as teamwork, reflective behavior, and the development of clear connections between content area topics. The researchers concluded that through the application of these skills and the ability to transfer knowledge, these methods had the potential to increase student content acquisition over time (Brassler & Dettmers, 2017). In addition to the development of soft skills, the implementation of PBL methods also increases students' motivation and satisfaction (Wijnen et al., 2017). Wijnen et al. (2017) found that a PBL approach to teaching

increased law student satisfaction and relatedness to both peers and instructors. This increase in relatedness led to increased student motivation and higher academic performance for law students participating in the study (Wijnen et al., 2017). These studies relate to my research by providing insight into the overall satisfaction of students using PBL methods at both the secondary and postsecondary level.

In addition to examining the skills and competencies developed by PBL methods, other research focused on how this approach to learning affected specific groups of students. Both Hung (2016), Agustiningsih, Bektiarso, Mutiah, and Ahmad (2017) and Han, et al. (2015) studied the impact of student factors on achievement using PBL methods on English Foreign Language (EFL) students. Han, et al. (2015) studied 836 high school students to determine if factors such as performance level, gender, age, and language proficiency affected the student academic achievement levels when using PBL methods. Hung (2016) took a closer look at the design of the PBL problem itself and how the structure and implementation of the components of the PBL design affect the cognitive processes of students using this constructivist approach to learning. The researchers in both studies found that cognitive performance levels showed different growth rates and that these factors affected the effectiveness of PBL methods. Even though the researchers were able to determine that there was an influence on student achievement, the researchers were unable to determine how and why this occurred. Mohammadi (2017) furthered the work of Han et al. (2015) by studying how authentic problem-based vocabulary learning tasks affected the vocabulary acquisition of EFL students over time. The researchers found that authentic problem-based vocabulary tasks increased the vocabulary recall and retention rate of students. In addition, Wijnen, et al.

(2017) studied 154 law students to determine how PBL methods related to motivation, perceived autonomy, competence, and relatedness. The researchers that conducted this study found that a PBL approach to teaching increased law student satisfaction and relatedness to both peers and instructors. This increase in relatedness led to increased student motivation and higher academic performance for law students participating in the study. These studies relate to my research by providing insight into the overall satisfaction of students using PBL methods at both the secondary and post-secondary level. Using the researchers' recommendations for further study, my study may add to the knowledge available concerning the effectiveness of implementation strategies of PBL on the various subgroups of students present in my local setting.

Implications

As school districts search for effective methods to improve the academic achievement of students, increase student engagement in the learning process, and prepare students to be college and career ready, effective school and teaching practices need to be available to affect change within the school culture. This research could lead to positive change by helping educators not currently using PBL strategies determine if this approach is something that they would want to use within their own school site. In addition, this research could assist members of administration in other school sites to determine if PBL strategies should be implemented as a way to increase academic achievement and to assist both teachers and administrators in identifying and overcoming potential challenges and problems related to the implementation of PBL strategies with elementary students. Project deliverables include grade-level specific curriculum guides that incorporate findings from the quantitative and qualitative data.

Summary

According to the findings of the literature review, there is still much to learn about the implications of using PBL in an elementary classroom setting. The constructivist framework grounding this study further informs my research in that the specific PBL construct strategies being implemented within the participating classrooms can be studied to determine if there is a relationship between the teachers' reported degree of implementation of these strategies and students' academic achievement. This research could lead to positive change within the local setting by helping educators not currently using PBL strategies determine if this approach is something that they would want to use within their own school site in order to increase the academic achievement of elementary students. The next section of the paper will provide an overview of the research design approach, the justification of the use of a mixed methods approach, and both the quantitative and qualitative design elements.

Section 2: The Methodology

Research Design and Approach

In order to gather more comprehensive data regarding the implementation of PBL instruction and its relationship to academic achievement within the elementary classroom, a mixed method approach was used to gather data. Quantitative data were gathered to determine the correlation between teachers' reported degree of implementation of PBL strategies and elementary students' academic achievement in ELA and to determine how teachers rated the benefits, problems, and challenges associated with PBL implementation. Qualitative data were gathered to determine how teachers experience implementing PBL within their classrooms.

Justification for Mixed Study Traditions

A sequential mixed method study was used in order to answer the research questions and address the purpose and problem stated in this paper. According to Burkholder, Cox, and Crawford (2016), in a sequential mixed method study, the researcher collects both qualitative and quantitative data, analyzes them separately, and then compares the findings to confirm, cross-validate, or corroborate the findings. In order to determine the correlation between teachers' reported degree of PBL implementation and student achievement, the teacher's survey responses were coded to each student's score who was enrolled in their class on their grade-level specific (either third, fourth or fifth grade) State Standardized Assessment for ELA. Both the qualitative data and quantitative data were gathered independently in July, 2019. Spearman correlation was used to analyze the data to determine the relationship between teachers' reported degree of PBL implementation and the academic achievement of elementary students on the ELA assessment. Descriptive statistics from the teachers' survey

responses were analyzed to determine how teachers rated the benefits, problems, and challenges associated with implementing PBL. Teacher interview responses were transcribed and then coded to identify themes that emerged related to teachers' experiences when implementing PBL in an elementary classroom.

Setting and Sample

Setting

The district in which this study took place serves 176,00 students. It is considered a large urban district and employs 22,600 professionals, including more than 12,947 classroom teachers. As reported in the district's website, the district is comprised of 113 elementary schools (62 of which are classified as Title 1), 45 middle schools (15 of which are classified as Title 1), and 32 high schools (11 of which are classified as Title 1) and has a 59.92% free and reduced lunch student population. Two schools in the district were selected for this study because of their commitment to implementing PBL within their curricula. When the study was conducted, School A (pseudonym), a suburban school, had 70 teachers and 983 students where 75% of students qualified for free or reduced lunch. Student demographics consisted of 57% Black, 22% Hispanic, 11% White, 4% Asian, and 6% Other. School B (pseudonym), also a suburban school, had 48 teachers and 763 students where 71% of students qualify for free or reduced lunch. Student demographics consisted of 47% Black, 26% Hispanic, 21% White, 3% Asian, and 3% Other. These data are shown in Table 1.

Table 1

Participating School Characteristics in 2019

Characteristics	School A	School B
Students	983	763
Teachers	70	48
FRL students (%)	75	71
Student demographics (%)		
Black	57	47
Hispanic	22	26
White	11	21
Asian	4	3
Other	6	3

Sample

Principals and teachers within the two schools examined committed to implementing PBL within the curricula in 2016. By the beginning of the 2018-2019 school year, most teachers within each of the school sites implemented PBL strategies to some degree within their curriculum.

A convenience sample from the two schools was chosen to participate in the study because both schools had engaged in similar professional development opportunities focused on PBL, and both principals stated that they are dedicated to the implementation of PBL within their campuses. All third to fifth grade teachers within the two schools were given the opportunity to participate in the study in order to reduce selection bias. Of the total teacher population, the information was sent to 49 teachers because they taught in Grades 3 to 5 that administered the ELA state assessment test. Of the 49 teachers who were invited to participate, 35% of the teachers agreed to participate in the research ($N = 17$). From the two

schools, there were a total of six third grade teachers, six fourth grade teachers, and five fifth grade teachers who gave their consent. Using Questions 1 to 5 and 16 from the survey, demographic data were collected and re shown in Table 2. According to survey data, 14% of participating teachers reported teaching for less than 5 years, 28% of teachers reported teaching between 6 and 15 years, 42% of teachers reported teaching between 16 and 30 years, and 16% of teachers reported teaching for 31+ years. When asked in the survey if they taught in a self-contained (teaching all content areas) or departmentalized (teaching only specific content areas) classroom, 43% of the teachers responded that they taught in a self-contained classroom and 57% responded that they taught in a departmentalized classroom (three teachers responded that they taught only math and science and seven teachers responded that they taught only ELA and social studies). When asked in the survey how many years they have been teaching using PBL strategies (Question 16), 24% of teachers responded 1 year, 18% of teachers responded 2 years, 29% of teachers responded 3 years, and 29% of teachers responded 4 years. To protect the identity of the participants, each participant was assigned a number ranging from 1 to 17.

Table 2

Demographic Data for Teacher Participants

Teacher	Years teaching	Grade level	Departmentalized or self-contained	Years using PBL
1	15	4th	Self-contained	3
2	30	4th	Departmentalized	4
3	27	3rd	Departmentalized	3
4	15	5th	Departmentalized	4
5	26	4th	Self-contained	4
6	3	5th	Departmentalized	1
7	22	4th	Departmentalized	1
8	18	3rd	Self-contained	2
9	4	5th	Departmentalized	1
10	26	3rd	Self-contained	2
11	12	4th	Departmentalized	3
12	31	5th	Departmentalized	4
13	31	3rd	Self-contained	4
14	8	5th	Departmentalized	2
15	20	3rd	Self-contained	3
16	10	4th	Departmentalized	3
17	33	3rd	Self-contained	1

Participants were asked to volunteer to participate in the study using the Informed

Consent Letter that was sent to them via email. The digital AIR Index survey was sent to the

teachers using Google Forms and included a statement asking if participants were willing to

engage in a follow-up interview to elaborate on their responses and provide more insight into

their experiences. If willing to participate in the interview, they were to provide their name

and personal email contact to coordinate an interview date and time. Of the 17 teachers who

volunteered to participate in the survey, 15 volunteered to participate in the follow-up

interview.

Data Collection Strategies

Quantitative Sequence

Archival data from the 2019 administration of the state assessment in ELA were used to identify student achievement level. This state standardized reading assessment consists of 56 to 66 items administered in two 80-minute sessions. The Department of Education (2019) has identified achievement level bands that are broken into five levels based on student proficiency on grade level standards (see Table 3).

Table 3

State Assessment Scale Scores for Each Achievement Level

Grade level assessment	Level 1	Level 2	Level 3*	Level 4	Level 5
Grade 3 ELA	240-284	285-299	300-314	315-329	330-360
Grade 4 ELA	251-296	297-310	311-324	325-339	340-372
Grade 5 ELA	257-303	304-320	321-335	336-351	352-385

* The lowest score in Level 3 is considered a minimum passing score for each grade level and subject.

All elementary students enrolled within public schools are required to take this assessment in Grades 3 to 5 at the end of each school year. The students' state assessment ELA scores were provided to me by the district once the district's research review committee gave approval/consent and gathered the requested data. The district provided me the student scores for each of the third, fourth, and fifth grade students enrolled at the two participating schools. Each student's state assessment score was matched to their teacher, and only the student data from the teachers who participated in the study was kept ($N = 416$). Teacher

participants ($N = 17$) completed the digital survey adapted from Ravitz's AIR PBL-related

index using Google Forms (see Appendix B). The use of this tool provided a research-based

survey tool that could be used to assist teachers in self-reporting the degree of PBL

implementation strategy use. Permission to use and adapt the Index Survey was granted by

Ravitz (see Appendix D). The survey questions gathered demographic data, data regarding the

amount of time and degree with which teachers use PBL in their classroom, how teachers rate

the benefits, problems, and challenges associated with PBL, and the types of strategies and

activities that the teachers use within their classrooms. The Spearman rank correlation,

calculated using SPSS, was used to determine the relationship between the academic

achievement scores for those students exposed to PBL and the teachers' reported degree of

implementation of PBL strategies from the PBL-related index. In order to conduct the

Spearman correlation, IBM SPSS Statistics Student Version 25 software was used to conduct

an analysis of the data. The Spearman correlation test was chosen because it measures the

strength and direction of the relationship between two variables. In this study design, the

researcher takes paired observations of two variables in order to determine if there is a

monotonic relationship (either positive or negative) between the two variables (Statistics

Laerd, 2018). All raw data are available upon request from me.

Qualitative Sequence

Teachers who completed the quantitative survey were asked to participate in a

qualitative in-person interview to elaborate on their responses and provide more insight into

their personal experiences related to implementation of PBL within their classrooms. Fifteen

of the 17 teachers who completed the survey agreed to participate in the interview by

providing personal contact information so that interviews could be scheduled during the summer of 2019. The in-person interview questions provided more in-depth information from the teachers about why they chose specific strategies over others, the perceived impact of those strategies on student achievement, and the challenges, problems, and benefits associated with PBL implementation (see Appendix C).

Teachers who agreed to participate in the interview process were asked, using Google Calendar, to schedule a time slot that was most convenient for them and allowed ample opportunity to complete the interview should it take longer than the one-hour time period allotted. A 1½ hour window was scheduled for each of the 15 teachers over the course of three and a half days in July, 2019. The interviews took place within the two participating school sites in a conference room that had a lockable door in order to ensure privacy during the interview process and a location that was familiar to the participant. These interviews were audio recorded using Voice Memo to ensure that there was an accurate account of what was said. Once the interview was complete, the researcher, using voice-typing functions in Google Docs, transcribed the interview data. A transcript of the interview was provided to each participant so that they had the ability to review the transcript to ensure accuracy and to provide the participant the ability to elaborate or adjust their responses.

As a Curriculum Specialist for the participating district, I did not serve in a supervisory role for any of the teachers participating within the study in order to reduce bias and minimize influence within the participant groups. My capacity as a district employee working in the Curriculum Department was explained to the teachers via email within the

Participant Recruitment Letter. This letter also explained that this research study was completely separate and unrelated to my role within the district.

Data Analysis

A sequential mixed method study was used in order to answer the research questions and address the purpose and problem stated in this paper. According to Burkholder et al. (2016), in a sequential mixed method study the researcher collects both qualitative and quantitative data, analyzes them separately, and then compares the findings to confirm, cross-validate or corroborate the findings. Because educational initiatives can be multifaceted, they can have a broad impact on schools, teachers, administrators, students, and the community. Therefore, in order to obtain a thorough understanding of the implications of the use of PBL in an elementary classroom setting, it was vital to examine various forms of data including test scores and teacher survey responses.

In order to answer the first research question, which asked what the relationship is between teachers' reported degree of implementation of PBL strategies and the academic achievement of elementary students in ELA, achievement scores on the State Standardized Assessment were collected for all third, fourth, and fifth grade students in both schools participating in the study. These data were provided to the researcher by the district once the district's research review committee gave approval/consent and gathered the requested data. Each student's SSA score was matched to their teacher and only the student data from the teachers participating in the study were kept (n = 416). Teacher participants (N=17) completed the digital survey adapted from Ravitz's AIR PBL-related index using Google Forms (see Appendix B). Overall, the index of items used in the Ravitz survey had strong reliability

(alpha = .90, with inter-item correlations ranging from .46 to .74) (Ravitz, 2008). In order to conduct the Spearman Correlation, IBM SPSS Statistics software version 25 was used to conduct an analysis of the data. Before conducting the analysis, three assumptions were checked to ensure that the data being analyzed could be analyzed using the Spearman Correlation (Statistics Laerd, 2018).

Assumption 1: Assumption 1 requires that the two variables being analyzed be either continuous or ordinal. The teacher self-reported implementation score is an ordinal variable and student scores on the ELA state assessment is a continuous variable.

Assumption 2: Assumption 2 requires that the two variables being examined represent paired observations. Each student's state assessment ELA score was paired with their teacher's self-reported PBL implementation score.

Assumption 3: Assumption 3 requires that there be a monotonic relationship between the two variables being examined. I visually inspected a scatterplot created in SPSS and concluded that there was a positive monotonic relationship between the participating teachers' self-reported PBL implementation scores and the state assessment ELA score of the elementary students being studied.

Once I verified that the three assumptions were met, a Spearman Rank Correlation, calculated using SPSS version 25 was used to determine the relationship between the academic achievement scores for those students exposed to PBL and the teachers' reported degree of implementation of PBL strategies from the PBL-related Index. In order to answer the second research question, which asked how teachers rate the benefits, problems, and challenges associated with implementing PBL, I analyzed the teachers' responses for survey

questions 11, 19, and 21 using descriptive statistics. Data from questions 2, 5, 6, 7, 8, 10, 12, 13, 14, 17, 18, 20, and 22 from the survey were not used in the analysis.

Teachers who completed the quantitative survey were asked to participate in an in-person interview in order to answer the third research question which asked how teachers describe their experiences when implementing PBL within their classrooms. Fifteen of the 17 teachers who completed the quantitative survey agreed to participate in the interview. The in-person interview questions provided more in-depth information from the teachers who implemented PBL about why they chose specific strategies over others, their perceived impact of those strategies on student achievement, and the challenges, problems, and benefits associated with PBL implementation (see Appendix C). Questions 3 and 4 asked teachers explain how and why they chose specific strategies or activities in their classroom. Questions 4 and 5 asked which PBL strategies teachers perceived were the most impactful on the academic achievement of students and why. Lastly, questions 7 and 9 asked teachers to share the challenges and problems they experienced when implementing PBL and why. Questions 1, 2, and 8 from the interview were not used in the analysis.

The qualitative data was then analyzed using a two-cycle process of in vivo coding and axial coding. In vivo coding was used to section and label the interview responses from each teacher so that the data could be broken down into more manageable segments. These data were labeled and marked based on key words and ideas that emerged from the transcript responses. For the second cycle, axial coding was used to search for recurring ideas or themes by transferring the codes into Google Sheets and then sorting the column for recurring words or phrases. These recurring words and phrases were then combined into categories or themes

(see Table 4). The goal of these processes was to identify patterns and themes to provide a deeper understanding of PBL implementation within the elementary classroom.

Table 4

Codes and Themes That Emerged From Interview Data

Codes	Themes
real-world skills; creativity; engagement; retain content; critical thinking; collaboration; interpersonal skills; communication; future-ready skills development	why teachers choose specific PBL strategies
topic/standards dependent; student interest; engagement; comfort with topic; student ability; real-world connection; personal passion (student and/or teacher)	how teachers choose PBL-specific strategies
interdisciplinary thinking; interest in subject; engagement throughout day; development of 4C's; retain content; application of content; goal/target oriented; metacognition; purposeful learning; problem-solving; critical thinking; personal and professional development for future; content mastery	impact on student achievement
planning time; identifying quality resources; where to look for resources; structure of school day; scope aligned; guiding focus throughout learning; interdisciplinary connections; testing/accountability; materials/planning resources; framework needed	challenges faced when implementing PBL

Triangulation of both the PBL-related index survey and the in-person interview questions were used to strengthen the validity of the data gathered as well as capture different dimensions of the PBL experience. The PBL-related index survey provided information about teachers' perceived degree of PBL implementation within their classroom, the teachers' reasons for using PBL in their classroom, and the frequency with which specific PBL strategies were used (see Appendix B). Then, sequentially building upon the survey data, teachers provided more in-depth insights into their personal experiences with implementing PBL, why the teachers chose specific PBL strategies, which strategies they felt were the most impactful, and shared their perceived challenges and benefits to PBL implementation (see Appendix C). Through analysis of these data, multiple codes were developed based on each participants' interview responses. Similar codes were grouped together to form categories. These categories were then grouped together into recurring themes that reflected the larger issues and ideas.

In order to minimize researcher bias, special attention was paid to the use of direct quotes and specific keywords used when coding the qualitative data so as to minimize conclusions being made that were outside of the observed data. Findings were confined to the sample population in order to reduce overgeneralization of conclusions to larger general populations that may be different than the school populations that was studied.

Data Analysis Results

Quantitative Analysis and Findings

In this sequential mixed methods study, participating teachers completed a survey that asked them to explain their experiences when implementing PBL in their classroom.

Achievement scores on the State Standardized Assessment were collected for all 3rd, 4th, and

5th grade students in both schools participating in the study. Each student's state assessment

level score (provided by the district) was matched to their teacher's self-reported

implementation score provided in survey question 15. This question asked participating

teachers to self-report the time spent implementing PBL within their classroom where 0 = not

at all, 1 = less than ¼ of time throughout the school year, 2 = ¼ to ½ of time throughout the

school year, 3 = ½ to ¾ of time throughout the school year, and 4 = more than ¾ of time

throughout the school year. Table 5 below shows the number of students at each level by

participant.

Table 5

Total Number of Students Per Level Compared to Teacher Participant's PBL Implementation
Score and Mean Class Score

Teacher	PBL Score	Level 1 Students	Level 2 Students	Level 3* Students	Level 4 Students	Level 5 Students	Total Students	Mean ELA Score
1	1	3	7	6	8	1	25	3.21
2	1	10	2	12	2	1	27	2.69
3	2	3	2	11	11	3	30	3.72
4	3	2	4	13	4	1	24	3.38
5	2	6	4	12	4	4	30	3.24
6	3	0	2	1	12	6	21	4.51
7	3	4	2	7	4	2	19	3.33
8	2	2	3	16	4	1	26	3.33
9	3	1	2	16	5	4	28	3.84
10	2	3	3	9	5	0	20	3.23
11	1	1	7	6	3	3	20	3.43
12	2	3	4	13	4	0	24	3.16
13	2	2	3	10	6	0	21	3.32
14	3	1	8	9	6	2	26	3.42
15	1	5	6	11	6	0	28	3.16
16	1	2	7	9	1	0	19	3.11
17	3	0	1	7	9	12	29	4.68

Participants 1, 2, 11, 15, and 16 all self-reported implementing PBL less than ¼ of the time throughout the school year (level 1). For these five teachers, the mean state assessment ELA scores ranged between 2.69 and 3.43 (M = 3.12). Participant numbers 3, 5, 8, 10, 12, and 13 all self-reported implementing PBL between ¼ to ½ of the time throughout the school year (level 2). For these 6 teachers, the mean state assessment ELA scores ranged between 3.16 and 3.72 (M = 3.33). Participant numbers 4, 6, 7, 9, 14, and 17 all self-reported implementing PBL between ½ to ¾ of the time throughout the school year (level 3). For these 6 teachers, the mean state assessment ELA scores ranged between 3.33 and 4.68 (M = 3.86).

In order to answer the first research question, which asked what the relationship is between teachers' reported degree of implementation of PBL strategies and the academic achievement of elementary students in ELA, the Spearman Rank Correlation test was conducted. The ELA state assessment scores for each student enrolled in the 17 participating teachers' classes were matched to their teacher's self-reported PBL implementation score. The results of the Spearman Correlation are shown in Table 6.

Table 6

Spearman Rank Correlation Results

Test	Scores	Coefficient	Teacher implementation	Student ELA score
Spearman's rho	Teacher implementation score	Correlation coefficient	1.000	.273**
		Sig. (2-tailed)		.000
		N	416	416
	Student ELA score	Correlation coefficient	.273**	1.000
		Sig. (2-tailed)	.000	
		N	416	416

** Correlation is significant at the 0.01 level (2-tailed).

There was a statistically significant, weak correlation between the level of PBL implementation and student academic achievement in ELA, (r_s = 0.273, p = 0.000). Although a weak positive correlation, these data lead me to accept the hypothesis that there is a statistically significant relationship between the reported degree of implementation of PBL strategies and the academic achievement of elementary students in ELA.

In order to answer the second research question, which asked how teachers rate the benefits, problems, and challenges associated with implementing PBL, question numbers 11, 19, 21 from the survey were analyzed using descriptive statistics.

Perceived Benefits of PBL

Data from question 11 was analyzed to determine how teachers rated reasons for using PBL in their classrooms. The question asked teachers to measure the importance of each of the factors as a reason for why they chose to use PBL within their elementary classroom setting. Table 7 shows the mean, median, and standard deviation for each subsection of question 11 from the survey.

Table 7

Teachers' Ratings of Importance for Use of PBL

Reasons for using PBL	N	Mean	Median	SD
11A: Variation in learning	17	2.47	3.00	0.62
11B: Teaching academic content more effectively	17	2.53	3.00	0.52
11C: Teach skills beyond academic content	17	2.76	3.00	0.44
11D: Promote civic engagement	17	1.88	2.00	0.60
11E: Create personalized learning experience	17	2.71	3.00	0.47
11F: Promote cross-cultural understanding	17	2.18	2.00	0.39

In this section of the survey, the teachers rated the importance of specific reasons for why they chose to use PBL in the classroom. They ranked each reason on a scale of 1 = *somewhat important*, 2 = *important*, or 3 = *especially important*. A mean score of 1 – 1.99 indicated low importance, 2 to 2.99 indicated moderate importance, and any score of a 3 or higher indicated a high level of importance to the teachers. The means in Table 9 show that the teachers expressed that variation in learning *(11A, M=2.47)*, teaching academic content more effectively *(11B, M=2.53)*, teaching skills beyond the academic content *(11C, M=2.76)*, creating personalized learning experiences *(11E, M=2.71)*, and promoting cross-cultural understandings *(11F, M=2.18)* were all moderately important reasons for why they chose to use PBL in their classrooms. The teachers expressed that promoting civic engagement *(11D, M=1.88)* was of low importance to them. The low standard deviation (SD) for every item in Question 11 shows that most of the teachers' individual responses are clustered close to the mean score. The mean scores and standard deviation scores for this question show that the teachers surveyed have a general agreement of which reasons are of high, moderate, and low levels of importance.

Challenges and Problems With PBL

The data from Questions 19 and 21 in the survey were used to identify specific challenges and problems teachers faced when implementing PBL. Question 19 asked participating teachers to rate how prepared they perceived that they were to engage in specific PBL-development actions. Teachers responded by rating their perceived preparation level for engaging in PBL-related actions. They ranked each action on a scale of 1 = *not prepared*, 2 = *somewhat prepared*, 3 = *well prepared*, or 4 = *very well prepared*. A mean score of 1 to 1.99

indicated that they felt unprepared, 2 to 2.99 indicated a level of moderate preparation, 3 to

3.00 indicated that they felt prepared, and any score of a 4 or higher indicated a high level of

preparation for the teachers (see Table 8).

Table 8

Perceived Preparation for PBL-Development Actions by Teacher Implementation Level

PBL-development actions	*N*	Mean	Median	*SD*
19A: Finding existing projects				
Level 1	5	1.20	1.00	0.45
Level 2	6	1.00	1.00	0.00
Level 3	6	2.33	2.00	1.03
19B: Designing new projects				
Level 1	5	1.20	1.00	0.45
Level 2	6	1.00	1.00	0.00
Level 3	6	2.33	2.00	1.03
19C: Meeting standards				
Level 1	5	1.40	1.00	0.55
Level 2	6	1.84	2.00	0.75
Level 3	6	2.17	2.00	1.17
19D: Assessing students' content learning				
Level 1	5	2.00	2.00	1.00
Level 2	6	1.67	1.50	0.82
Level 3	6	2.33	2.50	0.82
19E: Promoting depth & quality of student work				
Level 1	5	2.80	3.00	0.83
Level 2	6	2.00	2.00	0.00
Level 3	6	2.67	2.50	0.82
19F: Facilitating & managing groups				
Level 1	5	3.20	3.00	0.45
Level 2	6	3.00	3.00	0.00
Level 3	6	3.00	3.00	0.63
19G: Structuring presentations				
Level 1	5	3.20	3.00	0.45
Level 2	6	3.00	3.00	0.00
Level 3	6	3.17	3.00	0.41
19H: Teaching skills beyond academic content				
Level 1	5	1.60	2.00	0.55
Level 2	6	1.67	2.00	0.51
Level 3	6	2.50	2.00	1.22
19I: Assessing student groups				
Level 1	5	3.00	3.00	0.71
Level 2	6	1.50	1.50	0.55
Level 3	6	2.17	2.50	0.98

The means in Table 8 show that the teachers at all levels expressed that they felt prepared to facilitate and manage groups (*19F, Level 1 M = 3.20; Level 2 M = 3.00; Level 3 M = 3.00)* and structure student presentations so the whole class learns (*19G, Level 1 M = 3.20; Level 2 M = 3.00; Level 3 M = 3.17).* Both level 1 and level 2 teachers expressed that they felt unprepared to find existing projects (*19A, Level 1 M = 1.20; Level 2 M = 1.00)*, design and plan new projects (*19B, Level 1 M = 1.20; Level 2 M = 1.00)*, meet standards using PBL (*19C, Level 1 M = 1.40; Level 2 M = 1.84)*, and teach skills beyond the academic content (*19H, Level 1 M = 1.60; Level 2 M = 1.67)* and level 3 teachers expressed that they felt moderately prepared *(19A, M = 2.33; 19B, M = 2.33; 19C, M = 2.17; 19H, M = 2.50).* The teachers at all 3 levels expressed they felt moderately prepared to promote the depth or quality in student work during PBL *(19E, Level 1 M = 2.80; Level 2 M = 2.00; Level 3 M = 2.60).* The low standard deviation (SD) for every item in Question 19 at each level shows that most of the teachers' individual responses are clustered close to the mean score. The mean scores and standard deviation scores for this question show that the teachers surveyed at each implementation level have a general agreement of which actions they felt unprepared, moderately prepared, prepared, and very well prepared to conduct.

Question 21 asked participating teachers to rate specific challenges that limited their use of PBL. The teachers were asked to rate the challenges as not a challenge, a minor challenge, a moderate challenge or a major challenge (Table 9).

Table 9

Challenge Factors in Implementing PBL

Factor	N	Mean	Median	SD
21A: Too many students	17	1.18	1.00	0.53
21B: Short teaching blocks	17	2.88	3.00	1.17
21C: Limited space	17	1.24	1.00	0.56
21D: Student skill	17	1.94	2.00	0.56
21E: Parental expectations	17	1.06	1.00	0.24
21F: Testing requirements	17	3.35	4.00	0.86
21G: Lack resources	17	2.88	3.00	0.86
21H: Lack models	17	3.24	3.00	0.75
21I: Lack time to plan	17	3.26	3.00	0.76
21J: Lack time in curriculum	17	3.35	3.00	0.70
21K: Lack professional development	17	1.94	2.00	0.56

In this section of the survey, the teachers rated the level of challenge specific factors played in implementing PBL in their classroom. They ranked each factor on a scale of 1 *not a challenge*, 2 *a minor challenge*, 3 *a moderate challenge* or 4 *a major challenge*. A mean score of 1 – 1.99 indicated that a factor was not a challenge, 2 – 2.99 indicated that a factor was identified as a minor challenge, 3 – 3.99 indicated that a factor was identified as a moderate challenge, and any score of a 4 or higher indicated a factor was identified as a major challenge to the teachers. The means in Table 9 show that the teachers expressed that too many students *(21A, M = 1.18)*, limited classroom space *(21C, M = 1.24)*, student skill level *(21D, M = 1.94)*, parental expectations *(21E, M = 1.06)*, and professional development *(21K, M = 1.94)* were identified as factors that did not pose a challenge to the teachers. The teachers expressed that short teaching blocks *(21B, M = 2.88)* and a lack of funds, resources and materials *(21G, M = 2.88)* posed a minor challenge in their classrooms. The following factors were identified as a moderate challenge within their classroom environment: too many testing and

accountability requirements *(21F, M = 3.35)*, lack of models or examples using PBL *(21H, M = 3.24)*, time to find, create, or plan projects *(21I, M = 3.26)*, and time in the curriculum to carry out projects *(21J, M = 3.35)*. The low standard deviation (SD) for every item in Question 21 shows that most of the teachers' individual responses are clustered close to the mean score. The mean scores and standard deviation scores for this question show that the teachers surveyed have a general agreement of which factors are perceived as not a challenge, a minor challenge, a moderate challenge, or a major challenge.

Summary of Quantitative Analysis

There was a statistically significant weak correlation between the participating teachers' reported degree of PBL implementation and the academic achievement of elementary students in ELA. Therefore, we can reject the null hypothesis and accept the alternative hypothesis. In order to answer the second research question and determine how teachers rate the benefits, problems, and challenges associated with implementing PBL within an elementary classroom, the data from questions 11, 19, and 21 were analyzed. Responses from question 11 regarding how teachers rated the reasons for using PBL in their classrooms included the personalization and variation in learning experiences, more effective teaching experiences in relation to academic content knowledge, and the development of skills beyond the academic content. Teacher responses to question 19 regarding perceived preparation to engage in PBL-related actions included finding existing high-quality projects, designing and planning new projects, and meeting state standards through PBL as barriers to PBL implementation. In question 21, teachers expressed that identifying exemplar models of PBL,

finding the time to create and plan projects, and establishing time within the curriculum to carry out projects all posed moderate challenges within their classroom environment.

Qualitative Analysis and Findings

Included in the quantitative survey was a statement at the end of the Google Form that asked participating teachers to provide contact information if they were willing to engage in a follow-up interview to elaborate on their responses and provide more insight into their personal experiences. Of the 17 teachers who completed the survey, 15 teachers provided their contact information and agreed to participate in the in-person interview process. These questions were formulated to answer the third research question, which asked how teachers experience implementing PBL in their classroom. The goal of these questions was to better understand why teachers chose the strategies that they chose (interview question 3), when and how often specific teaching strategies were used (interview question 4), which strategies teachers felt had the most impact on academic achievement (interview questions 5 and 6), why teachers felt that they were prepared (or felt not prepared) to implement specific PBL-related activities (interview question 7) and specific challenges that limited the use of PBL in their classrooms (interview question 9).

In vivo coding was used to section and label the interview responses from each teacher so that the data could be broken down and then labeled and marked based on key words and ideas that emerged from the transcript responses. For the second cycle, axial coding was used to search for recurring ideas or themes using recurring words or phrases. These recurring words and phrases were then combined into categories or themes that assisted in developing a deeper understanding of the PBL implementation experience within the elementary classroom.

Four major themes were derived from the analysis of the qualitative interview questions. (1) why teachers choose PBL-specific strategies (2) how teachers choose PBL-specific strategies (3) impact on student achievement (4) challenges faced when implementing PBL. A description and discussion of each theme is provided below.

Theme 1: Why teachers choose PBL-specific strategies. All 15 participants discussed specific skills that go beyond teaching academic content when providing reasons for why they chose PBL-specific strategies. Some participants responded that they chose PBL strategies for their ability to foster future-ready skills. Participant 5 stated "the use of PBL allows me to develop interpersonal and relational skills, such as group work and collaboration, that are valuable life skills for all humans in our global society". Participant 9 identified specific skills fostered by the implementation of PBL. These skills included: critical thinking, communication skills, project management and deadline skills, and the understanding of group norms and roles related to group dynamics. Participants explained that "working in groups when sharing or communicating data, developing projects that are shared with others to create understanding, or creating action plans to solve problems build skills that are useful in all subject areas." Participant 15 explained that they chose specific strategies based on the ability of PBL strategies to develop skills that are necessary for life in the real- world. "I want students to become life-long learners and collaborators. They need to be able to communicate with co-workers, learn ways to find information and research, develop empathy and understanding for others that they interact with".

Beyond the skills and dispositions listed above, other reasons provided for why teachers chose specific PBL strategies were related to the promotion of cultural or civic

engagement in world issues. Several participants made comments regarding the ways that PBL allows students to see the connection among themselves and the larger world. For example, Participant 4 stated that activities like researching community issues or interviewing community members allowed students

> to understand that their actions play a role in the global society, that they can choose (or not choose) to be leaders of their future. Their voice and influence shapes choices that will be made for their community and their government and it is their duty to bring a voice to the voiceless.

Participant 6 stated that "our world is full of problems where the content that they learn in school can be applied to real-world contexts. This connection allows students to better understand why they need to better understand the content."

Other participants discussed the ways that PBL strategies help students retain content. Participant 11 stated "when students create a product such as an exhibit, museum-type display, or artistic performance, it creates a lasting connection to what they learned that really sticks with them". Participant 14 explained that when you have students engage in high-complexity tasks

> such as constructing models or developing prototypes, they apply the math and science that they are learning in ways that force them to think critically in out-of-the-box ways…these skills not only foster creativity but also force them to internalize specific subject area skills and processes.

The participants responses revealed that the reasons why they choose specific strategies are not only to support content retention and understanding but also to help foster skills that they

will continue to use throughout their school careers and beyond. They identified 21st century skills, or future-ready skills, such as collaboration, critical thinking, communication, and problem-solving skills that help the students apply content information to real-world contexts.

   Theme 2: How teachers choose PBL-specific strategies. All 15 participants discussed how they made the decisions to use or not use specific strategies in their classroom. For example, when asked why direct instruction was chosen (or not chosen) responses included comfort with the topic being taught, student engagement, and topic interest. Participant 16 stated that

> when I am not comfortable teaching a topic or content, I default to direct instruction that comes straight out of the book because I'm afraid that I won't understand how to make connections for students when they ask questions or want to delve deeper into PBL-style work.

Participant 6 explained that "because I use PBL strategies about 3-4 times per year, I find that I use direct instruction less because I spend more time teaching PBL units. PBL doesn't lend itself to direct instruction because of its student-centered focus." Participant 8 said that

> I try to limit the amount of direct instruction I use because it impacts student engagement. When I use direct instruction, students don't really engage because they are passive learners. PBL strategies create better student engagement because the students are the ones doing the work.

A few participants discussed the reasons they chose to use interdisciplinary projects, service learning, or real-world problems was because of connections to the content they were teaching. Participant 12 stated that

the overlap between the math and science topics just made sense. If I have to teach plants in science and graphing in math, it just makes sense to have them measure the growth rates of plants, then graph the growth rate over time, and explore which factors affected the growth rate through experimentation.

Participant 6 explained that using

real-world connections to solve problems allows me to teach students why and how the content is applied in life. Carpenters have to use perimeter and area models in their jobs. If I can show them that the math they are doing has a purpose in real-life, they are more likely to pay attention.

Participants at all levels stated that flexibility was a key factor in their classrooms. Participant 1 stated that they "have such diverse ability levels in my classroom. What works for one student isn't going to work for another so being flexible allows me to differentiate so that I can support all of my students". Participant 17 explained that

student passion is a huge driver of choice in my classroom. Some of my students love science and conducting research while others like the creativity involved with creating videos to demonstrate their understanding. I want my classroom to be a space where students feel like they can be themselves and play to their strengths.

Participant 9 said,

Sometimes I have to change on a dime what I'm doing in class if the students aren't engaged or aren't understanding. Other times students are so driven to keep the learning going that I have to carve out extra time in my lesson plan to allow for them to continue the learning process.

As discussed, there are a wide variety of factors that assisted teachers in making PBL-related decisions.

  Theme 3: Impact on student achievement. All participating participants described ways that they have observed PBL impact student achievement both academically and in the development of 21ˢᵗ century or future-ready skills. Participant 3 stated that using driving questions and problem statements

> have had a significant impact on students' content mastery. In having them focus on what the expectation for learning is and how the lessons connect to the overarching goal or question, they can keep asking themselves what the lesson or activity has to do with that driving question or problem statement so that they know why they are doing what they are doing and how it all connects.

Participant 6 explained that allowing for flexibility "helps students engage in the content and builds interest through differentiation. Ultimately, I think this is why they have higher test scores because the learning experience is more personalized." Participant 3 stated that

> using interdisciplinary learning experiences allows my students to retain content more because they use the content to problem-solve and think critically. They solve real-world problems so that they understand that there is a purpose for learning the reading and writing skills I am trying to teach them because they have to use them to communicate their voice or share their understanding.

Several participants stated that they saw effects on student achievement beyond the academic content. Participant 2 explained that

using reflection as a strategy in my classroom allows my students to learn about themselves as learners. They think about their strengths, their learning styles, the good and bad habits that have, and how much they have grown over the course of the year. This metacognitive reflection impacts all subject areas and will continue to carry them through all their academic years.

Participant 12 stated that they constantly assess skills beyond the academic content because these are skills that will "get them jobs in the future. No matter what major they pursue, these skills transcend just content area learning and impact achievement across all years and into their career." Based on participant responses, PBL impacts student achievement by both affecting content mastery as well as the development of 21st century or future-ready skills.

Theme 4: Challenges faced when implementing PBL. All 15 participants who participated in the interviews made comments concerning the challenges that they face when attempting to implement PBL. Multiple respondents expressed that the time to find, plan, or create projects and the lack of exemplar models of PBL in specific subject areas were major challenges to PBL implementation. Participant 1 stated

I find it difficult to make connections among ELA, math, science, and social studies. I am comfortable with ELA content and teaching strategies related to that content, but I sometimes have difficulties helping students engage in science and social studies content that addresses real-world issues while supporting ELA instruction.

Both participant 11 and participant 15 explained that finding time to research the standards, identify the student target overlaps, and forming a framework to make PBL connections among different content areas is extremely difficult. Several participants stated that their one-

hour or half-hour block of planning time every day was not enough to collaborate with other grade-level team members to plan PBL units of instruction. Participant 13 stated

> commonly this planning time is taken up by parent meetings, required school-focused meetings such as IEP accommodation meetings or team meetings and teachers are left with little to no time to plan PBL instruction and gather resources to facilitate the process.

With regard to the challenges in the curriculum timing to implement PBL, several participants stated how the pace of the scope and sequence plays a major role on whether or not they feel they can dedicate instructional time to using PBL strategies within their day. Participant 15 stated that "teaching multiple content areas in one day is overwhelming. While I want to teach multiple content areas a day, I find that I focus on one (with depth) to the detriment of the others. I keep swapping which one I focus on and hope that I can get through it all". Others stated that their school follows prescribed instructional blocks for specified content areas. These specific block requirements made it harder for teachers to teach using an interdisciplinary approach during their instruction for fear that an instructional leader might come in and not see them teaching using prescribed methods during their reading block time or their math block time. Participant 2 explained that

> if I could show my principal how all of the standards-based content from multiple subject areas was being taught through the PBL instruction simultaneously, they might not feel the need to use prescribed blocks of time where content was taught in isolation instead of through an integrated, real-world PBL approach.

Lastly, participants reported that testing and accountability requirements posed a challenge to the implementation of PBL strategies. Participants noted that they experienced difficulty with the mandatory requirements by district-level staff to administer multiple unit-based formative and summative assessments that mirrored state assessment format. This mandatory administration hindered their ability to implement interdisciplinary problem-based projects and units of instruction. Participant 6 stated that "these assessments were required of students every couple of weeks, thus slowing down the pace and momentum of students engaged in student-focused learning". Oftentimes, the specific standards being mandated during the scope and sequence would not correlate to that week's work or align to the standards being taught during that PBL causing students to do poorly on those formative and summative assessments.

Summary of Qualitative Analysis

The interview questions allowed participants to elaborate upon their survey responses and express in greater detail the benefits and challenges they perceived as a result of their PBL implementation experiences. The participants identified the development of future-ready skills and the retention of academic content as factors for choosing to use PBL in their classrooms and identified student engagement, the application of content topics to real-world contexts and the creation of personalized learning environments as reasons that they chose specific PBL strategies to teach the academic content. Among the challenges identified in interview responses, the time to plan integrated curriculum, the struggle to develop interdisciplinary projects that allow students to see the overlap in content connections, and time within the scope and sequence to implement PBL were expressed most frequently. Other identified challenges included testing and accountability requirements and the ability to develop a PBL

plan. Interview responses from questions 3, 4, 5 and 6 supported the quantitative findings in

question 11 (Table 7) that showed that participants' perceived benefits extend beyond

academic achievement and content mastery to the development of differentiated, and

personalized learning environments that challenge students to develop skills beyond the

academic content and reflect upon their own metacognitive processes. Interview questions 7

and 9 delved deeper into the challenges expressed in survey questions 19 and 21 (tables 8 and

9) in order to identify aspects of PBL planning that challenge the PBL teachers at all 3

implementation levels. Specifically, the ability to integrate content area standards into

cohesive learning units that require students to see the crossover among multiple content areas

and apply content understanding to real-world settings were reported most frequently.

Another identified challenge that was further expanded upon within the interview responses

dealt with the time it takes to plan and create high-quality interdisciplinary units that meet the

state standards. Participants expressed that much of their planning time is devoted to other

educational demands instead of being able to make meaningful connections among content

area standards that allow students to think critically and apply the content to real-world

contexts. The absence of exemplar models of PBL implementation that demonstrate how to

implement standards-aligned PBL experiences within the time allotted in the scope and

sequence was noted as a moderate challenge to PBL implementation.

Limitations to this study include the use of a convenience sample as well as the use of

a correlation analysis. While the teachers participating in this study were a convenience

sample, both schools have had similar trainings in PBL methods, teachers within both schools

have been working towards implementing PBL for several years and have similar

demographic populations. However, because a convenience sample was used, this sample may not be representative of the entire district population. In correlational research, the researcher can determine the relationship between variables but cannot show that changes to one variable lead to changes in another variable. In other words, this study cannot demonstrate a cause-and-effect relationship between the degree of implementation and the academic achievement of elementary students but can show that there is a weak positive correlation between these two variables. Therefore, at a local level, the district schools not currently using PBL that are looking to determine if PBL is an approach that they would want to use within their own school site might analyze the methods used by the two schools as a way of engaging students in the learning process, creating personalized learning environments for students, and developing students' metacognitive skills.

Quantitative and Qualitative Summary

According to the study findings, both the quantitative and qualitative data showed benefits of PBL implementation on elementary students. In order to answer the first research question, which asked what the relationship is between teachers' reported degree of implementation of PBL strategies and the academic achievement of elementary students in ELA, a Spearman Rank Correlation test was conducted. The Spearman correlation test showed that there is a statistically significant weak positive correlation between the degree of PBL implementation and the ELA academic achievement of elementary students leading me to accept the hypothesis that there is a relationship between the reported degree of PBL implementation and elementary students' academic achievement in ELA. In order to answer the second research question, which asked how teachers rate the benefits, problems, and

challenges associated with implementing PBL, specific questions from the digital survey were critically examined. According to the survey responses, teachers rated teaching skills beyond the academic content (such as collaborative groupwork and the creation of personalized learning environments) as a benefit to implementing PBL. Teachers responded that challenges to implementing PBL include finding and planning projects and meeting standards through PBL practices. In addition, problems to implementing PBL include lacking models of PBL implementation, examples of PBL within their subject area, and time to plan and carry out projects.

In order to answer the third research question, which asked how teachers describe their experiences when implementing PBL within their classrooms, a follow-up interview was conducted that asked participating teachers to elaborate upon the responses provided in the survey. Four themes emerged from the interview responses (1) why teachers choose specific PBL strategies (2) how teachers choose PBL-specific strategies (3) impact on student achievement (4) challenges faced when implementing PBL. Teacher responses included the development of critical thinking, collaboration, real-world and interpersonal skills as reasons for why they chose PBL strategies. Teacher responses for how they chose PBL-specific strategies included content standards, student engagement, student ability, teacher comfort with the topic, and student interest. Teachers noted that interdisciplinary thinking, student engagement, retention of content, and the development of 21st century skills as perceived impacts on student achievement. Lastly, participants stated that challenges when implementing PBL include identifying quality resources, time to plan PBL projects, alignment

within the different subject area standards, and the identification of interdisciplinary and real-world connections within the content.

These findings suggested that a project deliverable such as grade-specific, standards-based PBL curriculum guide could be beneficial for teachers who identified challenges with the lack of exemplar PBL models, content integration and subject-area connections, and time for PBL planning. By identifying potential topics, essential questions, standard/benchmarks, and student targets for each grade level, the challenges that teachers identified with integrating standards-based content, the timing of the scope and sequence, and the lack of time to find and create PBL learning experiences could be diminished. These PBL guides could provide teachers the flexibility to adapt their instruction by identifying overarching topics and scenarios while still allowing them to select the specific activities and resources that best meet the needs of the students in their classrooms that teachers identified as a perceived benefit to PBL implementation. These deliverables would help teachers identify ways that integrated standards-based instruction could take place within their classroom through the organization of PBL unit models and decrease the amount of planning time required for teachers to identify standards-based connections and plan for PBL instruction.

Section 3: The Project

Introduction

In Section 3, I describe the project, the rationale, curriculum guide, a supporting literature review, project evaluation plan, and potential implications of the project. According to the study findings, both the quantitative and qualitative data showed benefits to the implementation of PBL on elementary students. The Spearman correlation test showed that there is a statistically significant weak positive correlation between the degree of PBL implementation and the ELA academic achievement of elementary students. In order to answer the second question regarding how teachers rate the benefits, problems, and challenges associated with implementing PBL, specific questions from the digital survey were critically examined. According to the survey responses, teachers rated teaching skills beyond the academic content (such as collaborative groupwork and the creation of personalized learning environments), the creation of personalized learning experiences, and effective teaching experiences as benefits of implementing PBL. Teachers expressed that they felt unprepared to find existing high-quality projects, design and plan new projects, and meet standards through PBL practices. In addition, teachers described challenges to implementing PBL that included the lack of exemplar models of PBL implementation, examples of PBL within their subject area, and time to plan and carry out projects.

In order to answer the third question regarding how teachers describe their experiences when implementing PBL, a follow-up interview was conducted that asked participating teachers to elaborate upon the responses provided in the survey. Teacher responses included the student development of future-ready skills and the retention of academic content as factors

for choosing to use PBL in their classroom and identified student engagement, the application of content to real-world contexts, and the creation of personalized learning environments as reasons for choosing specific PBL strategies to teach academic content. Teachers noted that the development of interdisciplinary thinking, student engagement, retention of content, and the development of 21st century skills as perceived effects on student achievement. Lastly, teachers stated that challenges when implementing PBL include identifying quality resources, time to plan an integrated curriculum, struggling to develop interdisciplinary projects that allow students to see the overlap in content connections, and time within the scope and sequence to implement PBL.

These findings suggested that a project deliverable such as grade-specific, standards-based PBL curriculum guides could be beneficial for all teachers, including those who identified challenges with the lack of exemplar PBL models, content integration and subject-area connections, and time for PBL planning. Through the creation of these curriculum guides, teachers will not have to spend additional time identifying potential topics, essential questions, standard/benchmarks, and student targets for each grade level. The challenges that teachers identified in their survey responses, such as integrating standards-based content, conflicts with the timing of the scope and sequence, and the lack of time to find and create PBL learning experiences, could be diminished though these already created curriculum guides. These PBL guides could provide teachers the flexibility to adapt their instruction by identifying overarching topics and scenarios while still allowing them to select the specific activities and resources that best meet the needs of the students in their classrooms that teachers identified as a perceived benefit to PBL implementation. These deliverables would

help teachers identify ways that integrated standards-based instruction could take place within their classroom through the organization of PBL unit models and decrease the amount of planning time required for teachers to identify standards-based connections and plan for PBL instruction.

Description and Goals

The goal of the curriculum guides created in this project is to provide a scaffolded framework upon which teachers could provide student-directed learning opportunities focused on essential questions that correlate to content-area standards. This deliverable consists of a total of three 5-week units, one for third grade, one for fourth grade, and one for fifth grade. By identifying potential topics, essential questions, standard/benchmarks, and student targets for each grade level, these guides could assist teachers who are struggling to integrate subject-area content and make connections between standards-based learning and real-world problems and scenarios. The qualitative data collected from the teacher interviews regarding the challenges that teachers face when planning for and implementing PBL in this study informed the creation of each of units. The challenges that the participating teachers identified in integrating standards and learning objectives assisted in the development of the structure for the curriculum guides. In order to make the integration of standards more obvious, I created standard detail statements that not only pinpointed specific aspects of the state standards that were being addressed but explained how aspects of the standards could be used together in order to address the learning objectives of the unit. These standard detail statements were also created to address the challenges that teachers reported of not having knowledge of specific content area topics. These standard details statements provide examples of tasks that students

should be able to perform and main ideas that students should master by the end of the unit. Specific strategies that the teachers identified as beneficial, such as the use of essential questions, were included within the curriculum guide contents. For example, collaborative group work, research and data collection, civic engagement activities, and content connections to real-world contexts were all strategies incorporated into the curriculum guides' standard detail statements.

For each grade, I created a curriculum plan (Appendix A) that highlights the unit topic for each grade level, an essential question connected to that topic, content area standards in each subject area that connect to the unit topic and essential question, standard details that connect the learning standard to content-related learning targets, potential resources for the unit, and an assessment rubric. In the third grade curriculum guide, the unit theme was the History of Science. This unit integrated content area standards from Science, ELA, and Social Studies. The essential question grounding student learning was the following: How can telling stories of scientists help us to better understand our world? In the fourth grade curriculum guide, the unit theme was Solving Local Problems. This unit integrated content area standards from Science, ELA, and Social Studies. The essential question grounding student learning was the following: How can data be used to solve local weather problems? In the fifth grade curriculum guide, the unit theme was Discovering Science. This unit integrated content area standards from Science, ELA, and Social Studies. The essential question grounding student learning was the following: How can your ideas shape your local community? This project deliverable was aimed at helping teachers identify ways that integrated standards-based instruction could take place within their classroom through the

organization of PBL units of instruction. By identifying potential topics, essential questions, standard/benchmarks, and student targets for each grade level, the challenges that teachers reported with integrating standards-based content, identifying exemplar models of PBL, and making real-world connections to the curriculum could be diminished.

Rationale

PBL involves an active learning process that enables students to solve real-world problems by using their critical thinking and analysis skills and makes the student the driving force within the learning process and the teacher a facilitator of learning (Han et al., 2015). In this student-centered approach to teaching and learning, students are presented with a problem, must conduct research, and must apply knowledge and skills in order to develop viable solutions. This process encourages students to learn new content and material when solving problems and allows them to merge existing knowledge with new knowledge through inquiry, data collection, and evaluation. PBL models empower students to be active participants in the learning process and constructors of meaning. Researchers have shown that students learn and retain more information when they are actively engaged in the learning process (Choi & Lee, 2015; Knaggs & Sondergeld, 2015). Based on the quantitative and qualitative findings, participating teachers reported challenges in integrating standards-based instruction and finding the additional time required to plan PBL instruction. By identifying potential topics, essential questions, standard/benchmarks, and student targets for each grade level, the challenges reported facing with integrating standards-based content and the creating real-world connections to the curriculum could be diminished.

PBL instruction calls for teaching techniques that differ from traditional styles commonly used in most classrooms. For this reason, a curriculum plan for implementing PBL lessons was created to give teachers a scaffolded framework upon they could provide student-directed learning opportunities focused on essential questions and correlated to content-area standards. In order to transform traditional teaching styles into a style that incorporates a more student-centered, real-world approach to teaching and learning, teachers need to feel supported (Ravitz, 2008). When teachers feel supported, they can comfortably take risks, implement new techniques, and develop a growth mindset that allows them to learn from mistakes and persist in the learning process (Bridges, Yiu, & Botelho, 2016).

A curriculum plan was identified as a project deliverable as a result of the study findings. The quantitative and qualitative findings suggested that there is a positive correlation between the degree of PBL implementation and the ELA academic achievement of elementary students. Other benefits identified from the survey and interview results include the student connection to community and global issues and the development of 21st Century skills such as communication, collaboration, critical thinking, and project management. The challenges that the participating teachers identified in integrating standards and learning objectives assisted in the development of the structure for the curriculum guides. I created standard detail statements that not only pinpointed specific aspects of the state standards that were being addressed but explained how aspects of the standards could be used together in order to address the learning objectives of the unit. These standard detail statements were also created to address the challenges that teachers reported of not having knowledge of specific content area topics. These standard details statements provide examples of tasks that students should be able to

perform and main ideas that students should master by the end of the unit. Specific strategies that the teachers identified as beneficial within the study findings were included within the curriculum guide contents. For example, collaborative group work, research and data collection, civic engagement activities, and content connections to real-world contexts were all strategies incorporated into the curriculum guides' standard detail statements. By identifying potential topics, essential questions, standard/benchmarks, and student targets for each grade level, the challenges reported facing with integrating standards-based content and the creating real-world connections to the curriculum could be diminished. These PBL guides could provide teachers the flexibility to adapt their instruction by identifying overarching topics and scenarios while still allowing them to select the specific activities and resources that best meet the needs of the students in their classrooms. These deliverables can help teachers identify ways that integrated standards-based instruction could take place within their classroom through the organization of PBL units and decrease the amount of planning time required for teachers to identify standards-based connections and plan for PBL instruction.

<div align="center">**Review of the Literature**</div>

Decisions for choosing this specific genre were made based on the findings of this study and data collected throughout its qualitative sequence. Three findings of the teacher interviews were that teachers needed support with content integration and subject-area connections, time for PBL planning when developing a PBL curriculum, and a better understanding of how content from multiple subject areas could work together using an interdisciplinary approach. The literature reviewed included peer-reviewed articles and scholarly works from EBSCO, ProQuest, Walden University Library, and national databases.

For the selection criteria, I identified appropriate articles using search terms such as *problem-based learning, elementary, constructivism, implementation, curriculum, instruction*, *student targets, integration, assessment, rubrics,* and *scope and sequence.* The search provided scholarly results that demonstrated key aspects of PBL curriculum models including the characteristics of a PBL curriculum. Grounded in social constructivism, search results also provided teaching and learning models that connect PBL methods with the constructivist educational framework that were used to develop aspects of the curriculum guides.

In developing the framework for this project, the major constructs of PBL were used as a guiding tool to develop the organization and contents of this unit. These constructs are: (1) a connection to the *real world* where learners must deal with an authentic problem that they could encounter outside the classroom environment (2) a *student-centered* environment where learners assume the responsibility for their own learning (3) the opportunity to be *reflective* as students engage in discussions about the problem, the methods used to solve it, and what was learned as a result of their experiences and problem-solving methods. In a PBL curriculum, students need to be provided the opportunity to take charge of their learning with active engagement, work in collaborative and cooperative groups, use essential questions to guide and direct the learning process and develop reasoning skills while deepening their content knowledge (Azer, Hasanato, Al-Nassar, Somily, & AlSaadi, 2013; Bridges, et al., 2016; Dolmans & Schmidt, 1996; Ertmer & Glazewski, 2015; Kolmos, 2017). The curriculum plan developed in this project provides teachers with guiding questions, student tasks that allow them to engage in collaborative learning activities using an interdisciplinary approach, and uses cognitively complex tasks that develop their reasoning skills which align with both

the constructivist framework and the benefits and challenges identified in the qualitative

analysis.

Characteristics of a PBL Curriculum

PBL engages students as stakeholders immersed in a problematic situation, organizes

curriculum around this holistic problem that enables student learning to be relevant and

connected to the world around them, and creates a learning environment in which teachers

guide student inquiry and facilitate learning toward deeper levels of understanding while

entering the inquiry process as a co-investigator (Carrió et al., 2016; Gangwar, 2017; Guerra,

Ulseth, & Kolmos, 2017). In a PBL classroom, the teacher takes on the role of a facilitator, a

guide, and a supporter of the learners in a 21st century learning environment. The teacher, as

facilitator, shares and develops a problem statement supported by the essential question,

scaffolds activities for students to participate in with collaborative groups to assist them in

making meaning, and allows students to conduct research so that student-leaders can uncover

connections that relate the problem, essential question, and content (Ansari, Rahman,

Badgujar, Sami, & Abdullah, 2015; Nurdyansyah, Masitoh, & Bachri, 2018; Sroufe & Ramos,

2015). Teachers do not focus on right and wrong answers, instead the learning emphasis is on

students discovering the content, making meaning of what is learned, and connecting that

learning to the real world (Amalia et al., 2017; Schilling, Ginn, Mickelson, & Roth, 1995;

Vesikivi, Holvikivi, Lakkala, & Hjort, 2015). When developing the curriculum plan, special

care was used in developing student tasks that allow the students to be drivers of the learning

process and permit teachers to be facilitators within the learning process. As a facilitator, the

teacher provides support to the learners so that students feel that they have the ability to think

critically, make errors, and learn from their errors in reasoning so that they can come to

conclusions and find solutions to the problems and questions at hand. Teachers should help

their students to understand their own thinking process and reflect on themselves as learners

(Asyari, Al Muhdhar, Susilo, & Ibrohim, 2016; Neve, Bull, Lloyd, Gilbert, & Mattick, 2018).

Within the unit plan, opportunities are identified within the student targets for students to

reflect and record their understandings as well as explain how their knowledge changes

throughout the unit plan as they are engaged in the work of critical thinking. The assessment

rubrics within the units were used to support the reflective practices of students so that they

can understand how they connected to the learning process and mastered the content related to

the problem and essential question. According to research, traditional assessments provide

little to no feedback to students, answers to open-ended questions are often ill-defined or only

assess rote memorization instead of the application of content, and do not provide information

on the methods used to answer the problem (Dos Santos, 2016; Pierrakos, Anderson, &

Barrella, 2016). With PBL rubrics, performance criteria are well-defined, specific attributes of

student learning and their connection to objectives are reflected, and evidence of student

reflection on the process of learning are commonly used as markers (Brodie & Gibbings,

2019). Within the curriculum plan, unit rubrics are used to assess key elements of PBL as well

as the content. The elements include Representation of Key Knowledge and Understanding,

Connection to Problem or Question, Authenticity of Product, Reflection on the Learning

Process, Integration of Communication and Collaboration, and Use of the Critique and

Revision Processes. These key elements support Barrows' (1996) constructs of PBL in that

the assessment rubrics connect the learning to the real world through authenticity, the creation

of a student-centered learning environment through the integration of critical skills and the use of critique, revision, and voice and choice in representation, and permit the students to be reflective through the use of critique and revision.

A Constructivist Curriculum

In addition to connecting the curriculum plan to the problems identified within the research findings, this plan also connects to the PBL constructivist framework. The PBL approach finds its roots in the constructivist educational philosophy. In constructivist thinking, the learning process includes students engaging in the active process of meaning of the content, which can be different from one learner to another (Hendry, Hays, Challinor, & Lynch, 2017; Henson, 2015; Shen, Zhang, Yin, & Wang, 2015). In a constructivist curriculum, teachers need to have a variety of teaching and learning models that they can choose from in order to create combinations that work best for both the educator and the learner. For this reason, the unit within the curriculum plan provides a wide array of student targets that are connected to specific learning tasks aligned to state standards. Each content area in the unit allows for students to engage in tasks that overlap topic ideas and are scaffolded to not only draw on the cognitive complexity of the standard but allows students to communicate and collaborate with their peers to make meaning and develop a deeper understanding of the content. According to research, constructivist learning happens best when learners can help each other make connections and discover relationships between new and old learning (Amineh & Asl, 2015; Bada & Olusegun, 2015; Kay & Kibble, 2016). Many of the learning targets within the units of instruction require students to collaborate with one another to make content connections, engage in conversations to made deeper meaning of the

topic, and requires learners to revisit tasks and learning targets to connect new and old learning. The responsibilities of the teacher in a 21st century learning environment are different than those in a traditional learning environment. The teacher's primary role in the classroom is to serve as a guide and supporter of the students and requires that teachers modify their own styles of instructing to support the learners in their classroom (Hendry et al., 2017; Hendry, Hays, Lynch, & Challinor, 2016). Teachers in a PBL learning environment understand their students' needs, allow them to guide and direct their own learning, and step in to provide assistance at appropriate times.

Project Description

The study findings showed that teachers noted challenges when implementing PBL in a classroom setting including time for planning, allotted time for subject area blocks/curriculum scope and sequence, and a better understanding of how content from multiple subject areas could work together using an interdisciplinary approach. These PBL curriculum guides would help teachers identify ways that integrated standards-based instruction could take place within their classroom through the organization of PBL units and decrease the amount of planning time required for teachers to identify standards-based connections and plan for PBL instruction. Based on the qualitative findings, teachers needed to be informed as to how a PBL curriculum might look in an elementary classroom when connected to content area standards from multiple subject areas. For this reason a 5-week unit was created for third, fourth, and fifth grade teachers (Appendix A) that demonstrated how multiple subject area standards could connect to an essential question but also showed how student targets and standard details could work together to create classroom tasks that not only

addressed that standards but used PBL strategies that develop and strengthen the 21st century skills of participating students. This curriculum plan also included potential resources that could support the learning experiences including books, literature, and websites that might support the implementation of this unit as well as an assessment rubric that students could use to assess their content mastery and reflect on their learning experience. Because teachers within the two schools studied had already attended professional development to some degree to learn about what PBL is, the curriculum plan developed as a result of the study findings could support teachers by providing them needed resources that were not made available during the training.

Potential Barriers

The first identified barrier is content area block scheduling within the instructional day. In order to implement these PBL units, flexibility in scheduling needs to be provided by school-based administration that would allow teachers the extra time needed to implement PBL within their classroom day. Currently, most schools within the district have scheduled blocks of instructional time by subject area for each grade level (e.g. 45-minute reading block, 30-minute math block, etc.). Teachers and schools implementing the curriculum plan would need the flexibility to adjust and shift instructional blocks based on the standard details being addressed during instructional time. For example, if a teacher is implementing a PBL unit that integrates math, science, and ELA and the standard detail being addressed calls for students to conduct research on the growth rate of algae during their science block but the analyzation of data is taking longer than the allotted 30 minutes for science and the class needs to transition to their math block. The teachers would need the flexibility to adjust their block schedules so

that the data analyzation could continue knowing that students are also addressing their math

standards while evaluating their data.

The second identified barrier is district-recommended formative and summative

assessment scheduling. To address this barrier, teachers might need some flexibility in the

administration of district-recommended formative and summative assessments. These

assessments take place within specific administration windows that coincide with district-

created scope and sequences. Based on how teachers organize their PBL units and choose to

integrate standards in order to make content area connections, teachers would need to make

adjustments to when they administer the district-recommended formative and summative

assessments. If teachers choose to move the order in which they teach specific standards

within the school year, this new order may no longer align with the district-created scope and

sequence or the assessments' administration window. Teachers would need the flexibility to

adjust when the formative and summative assessments are administered in order to ensure that

they have taught the content being assessed and that the content that they are teaching can be

assessed during the district-recommended formative and summative assessment window.

Proposal for Implementation and Timetable

Teachers will be provided the curriculum plan at the beginning of the 2020-2021

school year during the teacher pre-school week. This will allow teachers to meet before school

begins to view and analyze components of the curriculum plan, meet by grade level group to

discuss thoughts, ideas, resources, and implementation, and gather any necessary resources for

its implementation. After implementing the curriculum plan as their first unit of the school

year, teachers should meet by grade level group to discuss success and challenges experienced

when implementing the unit, decide on necessary adjustments that need to be made to future units, and begin planning future PBL units of their own. Teacher flexibility and open-mindedness will be required throughout this learning process. As teachers become more confident and comfortable with PBL implementation, teachers within the schools can develop a classroom-modeling schedule that allows teachers who are struggling with specific aspects of PBL implementation to observe other teachers who have identified these aspects as strengths within their teaching practice. As the overall efficacy of teachers implementing this PBL curriculum increases, teachers from the other 113 schools within the district should be invited to be observers of its implementation in order to determine if this specific teaching style would be appropriate for their school site. These new schools could attend PBL workshops, similar to the ones the two participating schools attended, to learn more about PBL strategies and its implementation. From there, both new and experienced teachers could form a PLC group that spans the district to support and develop PBL implementation within the district to grow and strengthen the professional practice of teachers implementing this teaching style.

Roles and Responsibilities

According to the constructivist learning theory, the responsibility of the student is to learn (Hein, 1991). In order to promote a student-led learning experience, teachers should create a culture for learning in their classroom that allows students to be drivers of their learning experience, reflect on the learning process, and provide opportunities within the curriculum for students to engage in optimal learning experiences. The teachers' role shifts to facilitator of learning instead of being the deliverer of content as students engage in student-

led learning opportunities. The role and responsibility of the principals and district leadership is to offer freedom and support to teachers engaged in the work of PBL, provide guidance to teachers struggling with its implementation, and create opportunities for teachers to learn more about implementing effective PBL experiences.

Project Evaluation Plan

In order to determine if the project has met its intended outcomes, an outcomes-based evaluation plan will be conducted. The outcomes to be measured are student achievement, teacher comfort level, and teacher perception of the PBL implementation. Teachers engaged in the project will be surveyed before, during, and after the project's implementation. The teachers will be surveyed during the preschool week to collect feedback from teachers and baseline student achievement data via performance assessments. The survey can be used to learn more about teachers' perceptions and comfort level before they begin implementation as well as collect baseline data to measure growth in student achievement. Once the first unit is completed, teachers will again be surveyed to determine the challenges and benefits they observed during the implementation and student achievement data will again be gathered to determine the impacts of PBL implementation on student achievement. This student achievement data could also be compared to comparable student groups not engaged in PBL curriculum to assess the effects of PBL strategies on academic growth. Student work throughout this PBL should be kept in portfolios to show progress in content mastery and the development in 21st century skills. Based on the data gathered, modifications should be made to future units to help increase PBL implementation effectiveness. The outcome measures can

then be evaluated again at the end of each unit implementation to determine outcomes and make adjustments to the implementation plan as needed.

According to Schalock (2001), outcomes-based evaluations help identify specific contributions of programs being implemented, help future implementers make more rational decisions regarding the effectiveness and impacts of the intervention, and helps improve educational decision-making as a result of the use of outcome data. This type of evaluation aligns with the constructivist framework in that it incorporates sense-making for the learners engaged in the program's implementation, allows learners to glean insights about their experiences and interactions within the implementation, and assists the learners applying what they have learned to future contexts. The outcome measures being utilized relate to the effectiveness of PBL implementation on the academic achievement of students, the effectiveness of the implementation on the development of 21st century skills in students, teacher efficacy in the implementation of PBL curriculum over time, and teacher efficacy in the development of future PBL units.

Major stakeholders include the third, fourth, and fifth grade students participating in the PBL curriculum, as they will be given the opportunity to learn and develop new skills. In addition, the teachers involved are also considered major stakeholders as they will be learning about new techniques and challenging themselves to take risks, be flexible, and change educational practices.

Project Implications

In response to continued drops in state assessment scores, the district being studied has implemented a strategic plan focused on increasing student achievement. As a result, some of

the 113 elementary schools within the district are considering implementing PBL strategies as a way of increasing achievement. This research could promote social change within the local setting by helping educators not currently using PBL strategies determine if this approach is something that they would want to use within their own school site and to assist both teachers and administrators in identifying and overcoming potential challenges and problems related to the implementation of PBL strategies with elementary students. As a result of the study findings that showed that there is a weak positive correlation between PBL implementation and student achievement, third through fifth grade students could potentially benefit from utilizing a PBL curriculum to develop future-ready skills, the creation of personalized learning environments, and an increase student engagement and concept understanding. In addition, PBL implementation could support students in fostering future-ready skills and assist them in developing making connections between the content they are learning and connections to the real-world.

In addition, study findings identified challenges and potential obstacles to the implementation of PBL. If teachers who are working in schools that have been engaged in the work of PBL over several years faced these challenges and obstacles, both administrators and teachers who are new to PBL could benefit information that might offer insights about effective instructional strategies and PBL implementation. The project deliverables could be used to support PBL implementation by planning and accounting for potential issues that might arise during implementation while outcome evaluation findings could be used to tailor future PBL curriculum to differentiate for other learner groups and profiles. In the larger context, third through fifth grade teachers across the state could use this curriculum plan and

study findings to design a PBL implementation plan within their own local context. As a result of its implementation, students might foster 21st century skills, like critical thinking, collaboration, communication, and personal reflection and might better understand how the content they are learning relates to the real-world. Through PBL, students could be provided new opportunities to participate in engaging curriculum that develops a context for the real-world application of content.

Section 4: Reflections and Conclusions

Project Strengths and Limitations

The purpose of this sequential mixed methods study is to determine the correlation between the reported degree of implementation of PBL strategies and elementary students' academic achievement in ELA and to explore teachers' experiences when implementing PBL in order to learn more about PBL's effect on student achievement. According to study findings, both the quantitative and qualitative data revealed benefits to the implementation of PBL to elementary students. These benefits included a weak positive correlation between the degree of PBL implementation and the ELA academic achievement of elementary students; teacher-perceived impacts on student behaviors, including a connection to community and global issues; influence on 21st Century skills such as communication, collaboration, and critical thinking; and an improved ability to manage project roles and responsibilities. Although beneficial, teachers noted challenges to implementing PBL in a classroom setting, including time for planning and developing new projects, the ability to develop interdisciplinary projects with real-world connections, and the establishment of time within the curriculum to carry out PBL projects. As a result of these identified challenges, a PBL curriculum plan, including grade-level specific scope and sequences, was created to offer teachers a PBL curricular option to go along with more traditional scope and pacing guides. These PBL curriculum plans could provide teachers the flexibility to adapt their instruction and incorporate PBL strategies into content-based curriculum, increase the amount of student-led learning opportunities, and decrease the amount of planning time required for teachers to identify resources and plan for PBL instruction. The following section addresses the strengths

and limitations of the project, recommendations for alternative approaches, a reflection on the importance of the work, and lessons learned as a scholar practitioner, as well as implications for future research.

Project Strengths

The project created as a result of the study findings addresses the specific challenges identified by teachers. These challenges included (a) adequate time for the planning of an integrated, standards based PBL curriculum, (b) the lack of exemplar PBL models that demonstrate the connection of content to its real-world application, and (c) a lack of time within the scope and sequence to implement PBL strategies. The curriculum plan that was created merges standards from ELA, science, and social studies into an integrated scope and sequence curriculum plan focused on a real-world topic or problem. Through the lens of an open-ended essential question, students are challenged to apply the content area standards in meaningful ways that address the real-world focus of the unit. The creation of these scope and sequence curriculum plans allows teachers to see how content area standards can work together to support student-centered instruction and limit the amount of time needed to plan and arrange standard details and learning tasks. In addition, literary resources are provided in each unit to support the implementation of ELA curriculum that aligns with the essential question and unit focus.

Project Limitations

Project limitations include teacher efficacy in implementing differentiated small-group instruction during PBL. While the curriculum plan provides a framework for PBL implementation in a classroom setting, it must be noted that additional steps need to be taken

by the teacher to ensure a successful PBL implementation. Student discovery and interest play a vital role in a PBL curriculum; therefore, students participating in the same PBL unit may interact with and investigate the content in different ways. Because of this difference, teachers may need support in implementing small group differentiated instruction within a classroom setting. Professional development sessions focused on fostering the necessary skills to teach using a differentiated approach will allow teachers to develop efficacy in leading a student-centered learning environment where student interest and personal discovery are drivers in the learning process as all students work toward a common goal.

Another limitation is teacher buy-in to the PBL learning process and resistance to change. As teachers become comfortable with their personal teaching practice, they tend to become complacent and may not feel the need to challenge themselves to reflect on personal practice and consider a model of continuous improvement (Sánchez-Prieto, Olmos-Miguel$\tilde{a}$ñez, García-Peñalvo, & Teo, 2019). Through the project evaluation plan, teachers will be constantly challenged to reflect on the implementation of units throughout the school year and be encouraged to apply lessons learned to future contexts; however, this encouragement may not be enough to actually induce a change in teacher practice. Because of this potential resistance, administration within the school sites should be encouraged to foster a culture of constant personal and professional growth on the campus so that teachers feel empowered to take risks and challenge themselves as they try new strategies that result from their reflections within the project evaluation plan (Ely, Murphy, Rattan, & Savani, 2019).

Recommendations for Alternative Approaches

Besides the creation of a curriculum plan, alternative approaches could be taken to solve the local problem of decreasing test scores and assist in schools in engaging in PBL work. The two schools participating in the study have had extensive professional development in PBL. A recommended alternative approach includes professional development opportunities for teachers not currently engaged in PBL work or schools never having received extensive professional development on this topic so that they could learn more about effective instructional practices to learn more about what PBL is and how to implement it effectively. This professional development could provide the groundwork for teachers to develop a common language regarding the practices, strategies, and techniques used in PBL. This common language would provide a framework to then build upon through the use of the curriculum plan developed in this project study. In addition, a larger PLC could be developed that facilitates the collaboration between the schools currently implementing PBL and the schools looking to learn how to implement PBL in the local setting. This PLC could form a network for both new and veteran teachers to the PBL process to reflect on their practice, provide support for its implementation, and create a forum in which like-minded professionals can work alongside one another as they move towards a common vision.

Scholarship, Project Development and Evaluation, and Leadership and Change

As I engaged in this research and project study development, I learned that the participating teachers within the two schools studied are on a continuum of understanding and the internalization of the art of teaching PBL. The results of both the surveys and the interviews led me to better understand that each classroom teacher faces unique challenges

and opportunities to create personalized learning environments that allow students to explore the content in diverse ways and help them to make connections to the real world. As a curriculum developer, this understanding allowed me to reflect on my practice as a writer and create content that is more open-ended to allow for student-led learning opportunities as well as opportunities for teachers to personalize those learning experiences for their classrooms.

As a scholar, this study challenged me to collect and analyze data using methods that were new to me. It required that I step out of my comfort zone of quantitative data and expand my experience in qualitative research. I learned that reading, coding, and categorizing themes requires a great deal of patience and a keen ability to organize information and that, as a researcher, a small shift in the lens in which you look at data can completely change your perspective of the conclusions you have formed. The integration of both qualitative and quantitative data in this study provided me a much richer context upon which I could form conclusions and make connections. The quantitative data helped me to better understand the relationship between PBL and academic achievement, while the qualitative data provided me keener insights into the challenges, benefits, and problems that the participating teachers face when implementing PBL in an elementary setting. For example, the survey results showed me the varied art and style of teaching practices employed by teachers in the same school. The teachers' responses demonstrated the personalization that every teacher brings to their classroom curriculum as they consider the needs of the students in their charge as well as the challenges and stresses that teachers face every day as they do what they do for children in their care. These factors and considerations made me think about the way I crafted the units within the curriculum plan, encouraged me to incorporate the reflection process within the

evaluation plan, and motivated me to analyze my own personal practice as I engage with teachers and district leadership in discussions about curriculum development.

Reflection on Importance of the Work

This study revealed that there is a weak positive correlation between PBL implementation and the academic achievement in ELA of elementary students at two elementary schools. It also demonstrated that the implementation of PBL was perceived by teachers to foster a connection to community and global issues and developed students' skills in communication, collaboration, critical thinking, and project management. In addition, the project created as a result of study findings serves as a model for the way that standards-based curriculum can be integrated and set in a real-world context. This scope and sequence can serve as a template upon which teachers develop and build their own units of study focused on essential questions and develop targeted skills centered on core content.

Implications, Applications, and Directions for Future Research

At an organizational level, this project study could lead to positive social change within the local setting by helping educators not currently using PBL strategies determine if this approach is something that they would want to use within their own school site by guiding teachers and members of administration in other school sites overcome potential challenges related to the implementation of PBL and assisting both teachers and administrators in creating a culture of inquiry and student-centered discovery within their school site. At an individual level, teachers could benefit from these study findings through the use of the curriculum plan that was created. This guide could cut down on the amount of time needed for teachers to plan their instructional units by providing a template that scaffolds

student understanding and learning skills within its identified context. This curriculum plan could serve as a framework upon which future units could be built that develop students' 21st Century skills as well standards-based integrated practices.

The results of this study could inspire future research to be conducted in other curricular areas such as math, science, or social studies. While the scope of this study was limited to ELA, the potential for PBL work to influence the academic achievement in other content areas should be studied to learn more about how this integrated approach to standards-based instruction influences students' academic success. Another possibility for future research could be to determine how the number of years that students engage in PBL affects the academic achievement of students. A longitudinal study could be conducted to analyze how multiple years of exposure to PBL strategies influences the academic achievement of students over time.

Conclusion

According to the study findings, both the quantitative and qualitative data revealed benefits to the implementation of PBL on elementary students. The Spearman correlation test showed that there was a statistically significant weak positive correlation between the degree of PBL implementation and the ELA academic achievement of elementary students. In addition, the qualitative data showed that teachers perceived other benefits to student achievement when implementing PBL strategies, including a connection to community and global issues and influence on 21st Century skills, such as communication, collaboration, critical thinking, and project management. Although beneficial, teachers noted challenges to implementing PBL in a classroom setting, including time for planning and the allotted time

for subject area blocks/curriculum within the scope and sequence. As a result of these findings, a curriculum plan was created to address the challenges identified in the data. These curriculum plans could serve as a foundation upon which future curriculum units could be developed that scaffold student understanding grounded in a student-centered, constructivist learning environment. Continued research and collaboration is necessary for ongoing organizational change within the local setting as well as in the broader context.

References

Agustiningsih, A., Bektiarso, S., Mutiah, A., & Ahmad, A. (2017). The impact of problem
based learning on the students' learning outcomes toward critical thinking skill in
elementary school. *Pancaran Pendidikan*, *6*(4), 133-139.
https://doi.org/10.25037/pancaran.v6i4.120

Alrababah, F. (2017). The effectiveness of problem–based learning strategy in the acquisition
of scientific concepts in physics and the development of science operations among the
ninth grade female students. *British Journal of Education, 5*(2), 19-22. Retrieved
from: https://api.semanticscholar.org/CorpusID:173176290

Amalia, E., Surya, E., & Syahputra, E. (2017). The effectiveness of using problem-based
learning (PBL) in mathematics problem solving ability for junior high school students.
International Journal of Advance Research and Innovative Ideas in Education, 3(2), 2-
6. https://doi.org/ IJARIIE/2395.4396

Amineh, R. J., & Asl, H. D. (2015). Review of constructivism and social constructivism.
Journal of Social Sciences, Literature and Languages, 1(1), 9-16. Retrieved from:
https://www.semanticscholar.org/paper/Review-of-Constructivism-and-Social-
Constructivism-Amineh-Asl/38903f4a7255496f75124d639e14e9b810c17370

Ansari, M. T., Rahman, S. A., Badgujar, V. B., Sami, F., & Abdullah, M. S. (2015). Problem
based learning (PBL): A novel and effective tool of teaching and learning. *Indian
Journal of Pharmaceutical Education and Research, 49*(4), 258-265.
https://doi.org/10.5530/ijper.49.4.3

Asyari, M., Al Muhdhar, M. H. I., Susilo, H., & Ibrohim, J. (2016). Improving critical
thinking skills through the integration of problem based learning and group
investigation. *International Journal for Lesson and Learning Studies, 5*(1), 36-44.
https://doi.org/10.1108/IJLLS-10-2014-0042

Azer, S. A., Hasanato, R., Al-Nassar, S., Somily, A., & AlSaadi, M. M. (2013). Introducing
integrated laboratory classes in a PBL curriculum: Impact on student's learning and
satisfaction. *BMC Medical Education, 13*(1), 71-83. https://doi.org/10.1186/1472-
6920-13-71

Bada, S. O., & Olusegun, S. (2015). Constructivism learning theory: A paradigm for teaching
and learning. *Journal of Research & Method in Education, 5*(6), 66-70. Retrieved
from:

Barrows, H. S. (1996). Problem-based learning in medicine and beyond: A brief overview.
New Directions for Teaching and Learning, 1996(68), 3–12.
https://doi.org/10.1002/tl.37219966804

Bashith, A., & Amin, S. (2017). The effect of problem based learning on EFL Students'
critical thinking skills and learning outcome. *Al-Ta lim Journal, 24*(2), 93-102.
https://doi.org/10.15548/jt.v0i0.271

Baysal, Z. N. (2017). The problem-based learning process: Reflections of pre-service
elementary school teachers. *Educational Research and Reviews, 12*(4), 177-188.
https://doi.org/10.5897/ERR2016.3045

Brassler, M., & Dettmers, J. (2017). How to enhance interdisciplinary competence—
Interdisciplinary problem-based learning versus interdisciplinary project-based

learning. *Interdisciplinary Journal of Problem-Based Learning, 11*(2), 12-21.

https://doi.org/10.7771/1541-5015.1686

Bridges, S., Yiu, C. K., & Botelho, M. G. (2016). Design considerations for an integrated,

problem-based curriculum. *Medical Science Educator, 26*(3), 365-373.

https://doi.org/10.1007/s40670-016-0255-6

Brodie, L., & Gibbings, P. (2019). Comparison of PBL assessment rubrics. In *Proceedings of

the Research in Engineering Education Symposium (REES 2009),* University of

Melbourne, 1-9.

Buck Institute for Education. (2018). *What is PBL?* Retrieved from

http://www.bie.org/about/what_pbl

Burkholder, G., Cox, K., & Crawford, L. (2016). *The scholar-practitioner's guide to research

design*. Slaton, Tx: Laureate Publishing.

Carrió, M., Agell, L., Baños, J. E., Moyano, E., Larramona, P., & Pérez, J. (2016). Benefits of

using a hybrid problem-based learning curriculum to improve long-term learning

acquisition in undergraduate biology education. *FEMS Microbiology Letters*, *363*(15)

22-35. https://doi.org/10.1093/femsle/fnw159

Choi, S., & Lee, Y. H. (2015). Enhancing preservice teachers' science self-efficacy beliefs

and pedagogical content knowledge (PCK) through scientific investigations. *Journal

of Korean Elementary Science Education, 34*(4), 406-418.

https://doi.org/10.15267/keses.2015.34.4.406

Dolmans, D., & Schmidt, H. (1996). The advantages of problem-based curricula.

Postgraduate Medical Journal, 72(851), 535-538.

https://doi.org/10.1136/pgmj.72.851.535

Dos Santos, S. C. (2016). Pbl-see: An authentic assessment model for pbl-based software engineering education. *IEEE Transactions on Education*, *60*(2), 120-126. https://doi.org/10.1109/TE.2016.2604227

Ely, R., Murphy, M., Rattan, A., & Savani, K. M. (2019). Growth mindsets transform organizational cultures: Impact on collaboration, burnout, bias, & equity. *Academy of Management Proceedings*, *1*(1), 17187-18123. https://doi.org/10.5465/AMBPP.2019.17187symposium

Ertmer, P. A., & Glazewski, K. D. (2015). Essentials for PBL implementation: Fostering collaboration, transforming roles, and scaffolding learning. *Essential readings in problem-based learning,* 89-106.

Firdaus, F. M., Wahyudin, G., & Herman, T. (2017). Improving primary students' mathematical literacy through problem based learning and direct instruction. *Educational Research and Reviews, 12*(4), 212-219. https://doi.org/10.5897/ERR2016.3072

Gangwar, S. (2017). Effectiveness of project based learning (constructivist learning approach) on students achievement in science at secondary level. *Educational Quest, 8*(3), 737-741. https://doi.org/10.5958/2230-7311.2017.00129.5

Gijbels, D., Dochy, F., Van den Bossche, P., & Segers, M. (2005). Effects of problem-based learning: A meta-analysis from the angle of assessment. *Review of Educational Research,* 75(1), 27–61. https://doi.org/10.3102/00346543075001027

Guerra, A., Ulseth, R., & Kolmos, A. (Eds.). (2017). *PBL in Engineering Education:*

International Perspectives on Curriculum Change. Springer.

https://doi.org/10.1007/978-94-6300-905-8

Han, S., Capraro, R., & Capraro, M. M. (2015). How science, technology, engineering, and

mathematics (STEM) project-based learning (PBL) affects high, middle, and low

achievers differently: The impact of student factors on achievement. *International*

Journal of Science and Mathematics Education, 13(5), 1089-1113.

https://doi.org/10.1007/s10763-014-9526-0

Hannafin, M. J., & Land, S. M. (1997). The foundations and assumptions of technology-

enhanced student-centered learning environments. *Instructional science, 25*(3), 167-

202. https://doi.org/10.1023/A:1002997414652

Hein, G. (1991). Constructivist learning theory. *Institute for Inquiry.* Retrieved

from:/http://www. exploratorium. edu/ifi/resources/constructivistlearning. Htmls.

Hendry, A., Hays, G., Challinor, K., & Lynch, D. (2017). Undertaking educational research

following the introduction, implementation, evolution, and hybridization of

constructivist instructional models in an Australian PBL high school. *Interdisciplinary*

Journal of Problem-Based Learning, 11(2), 7-14. https://doi.org/10.7771/1541-

5015.1688

Hendry, A., Hays, G., Lynch, D., & Challinor, K. (2016). Enhancing student learning through

Project Based Learning (PBL) in a secondary school integrative STEM course. *In 27th*

Annual Conference of the Australasian Association for Engineering Education: AAEE

2016, 337-356. Lismore, AU: Southern Cross University Press

Henson, K. T. (2015). *Curriculum planning: Integrating multiculturalism, constructivism, and education reform.* Long Grove, IL: Waveland Press.

Hung, W. (2016). All PBL starts here: The problem. *Interdisciplinary Journal of Problem-Based Learning, 10*(2), 16. https://doi.org/10.7771/1541-5015.1604

Ibrahim, M. M., Arshad, M. Y., Rosli, M. S., & Shukor, N. A. (2017). The roles of teacher and students in self-directed learning process through blended problem-based learning. *Sains Humanika, 9*, 1-4. https://doi.org/10.11113/sh.v9n1-4.1121

Kay, D., & Kibble, J. (2016). Learning theories 101: application to everyday teaching and scholarship. *Advances in physiology education, 40*(1), 17-25. https://doi.org/10.1152/advan.00132.2015

Knaggs, C. M., & Sondergeld, T. A. (2015). Science as a learner and as a teacher: Measuring science self‐efficacy of elementary preservice teachers. *School Science and Mathematics, 115*(3), 117-128. https://doi.org/10.1111/ssm.12110

Kolmos, A. (2017). PBL Curriculum Strategies: From Course Based PBL to a Systemic PBL Approach. *In PBL in Engineering Education.* Brill Sense, 2017. 1-12. https://doi.org/10.1007/978-94-6300-905-8_1

Lozinski, D., Poon, A., & Spano, M. (2017). Effectiveness of problem-based learning prior to lectures on learning and retention. *In Discussions on University Science Teaching,* 1(1), 12-22. Retrieved from: https://ojs.lib.uwo.ca/index.php/wcsedust/article/view/3771

Mohammadi, F. S. (2017). The effect of authentic problem-based vocabulary tasks on vocabulary learning of EFL learners. *International Journal of Education and Literacy Studies, 5*(3), 35-40. https://doi.org/10.7575//aiac.ijels.v.5n.3p.35

Mustaffa, N., Ismail, Z., Tasir, Z., & Said, M. N. H. M. (2016). The impacts of implementing problem-based learning (PBL) in mathematics: A review of literature. *International Journal of Academic Research in Business and Social Sciences, 6*(12), 490-503. https://doi.org/10.6007/IJARBSS/v6-i12/2513

Nariman, N., & Chrispeels, J. (2015). PBL in the era of reform standards: Challenges and benefits perceived by teachers in one elementary school. *Interdisciplinary Journal of Problem-Based Learning, 10*(1), 5-23. https://doi.org/10.7771/1541-5015.1521

Neve, H., Bull, S., Lloyd, H., Gilbert, K., & Mattick, K. (2018). Evaluation of an innovative, evidence guided, PBL approach. *The clinical teacher, 15*(2), 156-162. https://doi.org/10.1111/tct.12656

Nurdyansyah, M., Masitoh, S., & Bachri, B. (2018, February). Problem Solving Model with Integration Pattern: Student's Problem Solving Capability. *In 1st International Conference on Education Innovation (ICEI 2017).* Paris, France: Atlantis Press. https://doi.org/10.2991/icei-17.2018.67

Piaget, J. (1950). *The Psychology of Intelligence.* New York: Routledge.

Pierrakos, O., Anderson, R., & Barrella, E. (2016, October). A developmental and adaptive Problem Based Learning (PBL) model across the curriculum: From theory to practice in integrating and assessing PBL experiences across the James Madison University

engineering curriculum. *In 2016 IEEE Frontiers in Education Conference (FIE)*, 1-2.
IEEE. https://doi.org/10.1109/FIE.2016.7757338

Ravitz, J. (2008). Project based learning as a catalyst in reforming high schools. *Buck Institute for Education.*

Sánchez-Prieto, J. C., Olmos-Migueláñez, S., García-Peñalvo, F. J., & Teo, T. (2019). Exploring the unknown: The effect of resistance to change and attachment on mobile adoption among secondary pre-service teachers. *British Journal of Educational Technology, 50*(5), 2433-2449. https://doi.org/10.1111/bjet.12822

Savery, J., & Duffy, T. (2001). *Problem based learning: An instructional model and its constructivist framework.* Bloomington, IN: Center for Research on Learning and Technology.

Schalock, R. L. (2001). *Outcome-based evaluation.* Springer Science & Business Media.

Schilling, K., Ginn, D. S., Mickelson, P., & Roth, L. H. (1995). Integration of information-seeking skills and activities into a problem-based curriculum. *Bulletin of the Medical Library Association, 83*(2), 176-193. Retrieved from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC226024/

Scott, K. S. (2014). A multilevel analysis of problem-based learning design characteristics. *The Interdisciplinary Journal of Problem-Based Learning*, 8(2), 56-68. https://doi.org/10.7771/1541-5015.1420

Shen, Y., Zhang, Y., Yin, W., & Wang, J. (2015). Problem-based learning based on constructivism in medical education. *Chinese Journal of Medical Education Research,* (2), 172-175.

Sroufe, R., & Ramos, D. P. (2015). Leveraging collaborative, thematic problem-based

    learning to integrate curricula. *Decision Sciences Journal of Innovative Education,*

    13(2), 151-176. https://doi.org/10.1111/dsji.12063

Statistics Laerd (2018). *Statistics.* Retrieved from https://statistics.laerd.com/

Tandogan, R. O. (2007). The Effects of problem-based active learning in science education on

    students' academic achievement, attitude and concept. *Learning Online Submission,*

    3(1), 71-81. https://doi.org/10.12973/ejmste/75375

Vesikivi, P., Holvikivi, J., Lakkala, M., & Hjort, P. (2015). Adoption of a new project-based

    learning (PBL) curriculum in information technology. In *Proceedings of the SEFI*

    2015 Annual Conference. European Society for Engineering Education, SEFI.

    Retrieved from: https://www.sefi.be/wp-content/uploads/2017/09/56474-J.-

    HOLVIKIVI.pdf

Wijnen, M., Loyens, S. M., Wijnia, L., Smeets, G., Kroeze, M. J., & Van der Molen, H. T.

    (2017). Is problem-based learning associated with students' motivation? A quantitative

    and qualitative study. *Learning Environments Research,* 1-21.

    https://doi.org/10.1007/s10984-017-9246-9

Wilder, S. (2015). Impact of problem-based learning on academic achievement in high school:

    a systematic review. *Educational Review, 67*(4), 414-435.

    https://doi.org/10.1080/00131911.2014.974511

Appendix A: The Project

3rd-Grade

Unit 1: The History of Science		**Suggested Pacing:** 5 weeks
Essential Question: How can telling stories of Scientists help us to better understand our world?		
	Benchmarks:	**Standard Details:**
Science	SC.3.N.1.1 - Raise questions about the natural world`, investigate, and generate appropriate explanations based on those explorations	• Explain different ways scientific questions can be answered • Explain how different fields of science look to answer questions about the natural world
	SC.3.N.1.2 - Compare the observations made by different groups	• Compare and contrast observations and measurements made by different teams or scientists • Explain conclusions based upon evidence that has been gathered
	SC.3.N.1.3 - Keep records as appropriate, such as pictorial, written, or simple charts and graphs	• Record observations accurately and in appropriate ways • Describe tools that are used to enhance the ability to make observations
	SC.3.N.1.4 - Recognize the importance of communication among scientists	• Describe various ways scientists record and display data in order to communicate results • Communicate results with other groups and explain any differences
	SC.3.N.1.5 - Recognize that scientists question, discuss, and check each others' evidence and explanations	• Identify the activities of scientists, including questioning, discussion, examination of others' evidence, and explanations
	SC.3.N.1.7 - Explain that empirical evidence is information that is used to help validate explanations of natural phenomenon	• Communicate results with other groups, explain any differences, and explain that data is evidence that can be used to explain a conclusion

ELA	LAFS.3.RL.1.1 - Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers	• Cite specific examples of scientists, inventors, and their contributions to our world
	LAFS.3.RL.1.3 - Describe characters in a story (e.g., their traits, motivations, or feelings) and explain how their actions contribute to the sequence of events	• Cite specific characteristics from the text that the scientists and inventors shared • Explain how the characters' actions led to innovations and discoveries that shaped our understanding of the natural world
	LAFS.3.W.1.3 - Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences	• Write narratives explaining how scientific innovation has affected our understanding of the natural world • Use clear event sequences, details and descriptive techniques to tell a story, either real or imagined
	LAFS.3.W.2.5 - With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, and editing	• Use feedback to guide and improve writing • Use the planning, revision, and editing processes to strengthen writing
	LAFS.3.W.4.10 - Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences	• Create a narrative that explains how scientific innovation has affected our understanding of the natural world • Explain how scientists or groups of scientists have contributed to our understanding of the natural world
Social Studies	SS.3.A.1.1 - Analyze primary and secondary sources	• Analyze personal artifacts (such as autobiographies) as primary sources • Analyze personal accounts and historical texts as secondary sources • Connect historical text with primary sources

	SS.3.A.1.2 - Utilize technology resources to gather information from primary and secondary sources	• Conduct research to gather information from primary and secondary sources
Unit Resources		
They Laughed at Galileo: How The Great Inventors Proved Their Critics Wrong by Albert Jack Oh, The Things They Invented: All About Great Inventors by Bonnie Worth		

4th-Grade

Unit 1: Solving Local Problems		**Suggested Pacing:** 5 weeks
Essential Question: How can data be used to solve local weather problems?		
	Benchmarks:	**Standard Details:**
Science	SC.4.N.1.1 - Raise questions about the natural world, use appropriate reference materials that support understanding to obtain information, and conduct investigations	• Ask and attempt to answer questions about natural phenomenon • Make observations, gather data, ask questions and conduct investigations • Use appropriate reference materials to support investigations and explorations • Record data in tables and charts based on the purpose of the data
	SC.4.N.1.2 - Compare the observations made by different groups and seek reasons to explain the differences across groups	• Gather measurement data using appropriate tools • Explain the importance of accuracy when measuring and why differences in measurements may occur
	SC.4.N.1.4 - Attempt reasonable answers to scientific questions and cite evidence in support	• Answer questions with a reasonable conclusion • Justify conclusions using evidence
	SC.4.N.1.6 - Keep records that describe observations made, carefully distinguish actual	• Record data in tables and charts based on the purpose of the data

	observations from ideas and inferences about the observations	• Communicate that data gathered are based on measurement and observations, not inferences
	SC.4.N.1.7 - Recognize and explain that scientists base their explanations on evidence	• Recognize that scientific knowledge requires evidence
	SC.4.N.2.1 - Explain that science focuses solely on the natural world	• Describe that science focuses on answering questions or solving problems that take in the natural world
	SC.4.N.3.1 - Explain that models can be 3-dimensional, 2-dimensional, an explanation in your mind, or a computer model	• Use models that is appropriate to the subject being studied • Identify the differences between examples of models such as pictures, replicas, or animations
ELA	LAFS.4.RL.1.1 - Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text	• Refer to specific details from a piece of literature that explains the impacts of severe weather • Draw inferences about the mood, setting, and theme and how they relate to the meaning of the text
	LAFS.4.RL.1.2 - Determine a theme of a story, drama, or poem from details in the text; summarize the text	• Determine the theme of a text and how it relates to the driving question • Summarize the text, citing specific details to support your claim
	LAFS.4.RL.1.3 - Describe in depth a character, setting, or event in a story or drama, drawing on specific details in the text (e.g., a character's thoughts, words, or actions)	• Describe details from the text (character, setting, or event) and how they connect to a story's theme
	LAFS.4.W.1.1 - Write opinion pieces on topics or texts, supporting a point of view with reasons and information	• Write an opinion piece that shares your point of view on how we can protect Florida from potential weather impacts • Provide evidence that supports your point of view

	LAFS.4.W.2.5 - With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, and editing	• Use feedback to guide and improve writing. • Use the planning, revision, and editing process to strengthen writing
	LAFS.4.W.4.10 - Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences	• Create a narrative that explains how weather related issues impact Florida and ways Floridians can protect themselves from severe weather occurrences • Create weather safety plan for Florida's severe weather occurrences
Social Studies	SS.4.G.1.3 - Explain how weather impacts Florida	• Name and locate important bodies of water, as well as the Everglades, on a map of Florida • Identify how Florida's features are impacted by weather
	SS.4.G.1.4 - Interpret maps using map elements	• Use a compass rose to describe position and movement on a map

Unit Resources
https://www.weatherwizkids.com/weather-links.htm   Kids' Book of Weather Forecasting   Hurricanes by Seymour Simon   Flash, Crash, Rumble and Roll by Franklyn Branley

5th-Grade

Unit 1: Discovering Science	**Suggested Pacing:** 5 weeks
Essential Question: How can your ideas shape the local community?	

	Benchmarks:	**Standard Details:**
Science	SC.5.N.1.1 - Define a problem, use appropriate reference materials, plan and carry out a scientific investigation, collect and organize data, interpret data	• Identify a problem or issue within your local community that you can work towards the development of a solution or fix • Research the problem or issue to

	in charts, tables and graphics, analyze information, make predictions and defend conclusions	determine what has been done and to identify viable solutions • Design an investigation, exploration, or controlled experiment to determine if your potential solution might help address the problem or issue • Collect and analyze data • Form and defend conclusions based on data
	SC.5.N.1.2 - Explain the difference between an experiment and other types of scientific investigations	• Recognize that there are many different ways to investigate phenomena • Compare various forms of investigations and determine which type is best for specific purposes • Record observations and explain why some investigations can only be conducted by observation
	Sc.5.N.1.5 - Recognize that authentic investigations frequently do not parallel the steps of the "scientific method"	• Recognize that there are many different ways to conduct investigations • Recognize that scientists must sometimes need to be creative when designing an experiment or investigation • Explain that the traditional scientific method is often altered in true scientific investigations • Explain that the scientific method does not always follow a strict linear path and that sometimes steps will need to be repeated or changed as more information is discovered
	SC.5.N.1.6 - Recognize and explain the difference between personal opinion/interpretation and verified observation	• Recognize that there is a difference between personal opinion, inferences, and observational data • Identify that personal bias and opinion should not be a part of scientific investigations

ELA	LAFS.5.RL.1.1 - Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text	• Compare and contrast the stories of two or more young people from the text • Provide specific examples from the text to support your analysis
	LAFS.5.RL.1.2 - Determine a theme of a story, drama, or poem from details in the text, including how characters in a story or drama respond to challenges or how the speaker in a poem reflects upon a topic; summarize the text	• Using proper structure, write a personal narrative describing ways that you can contribute to your local community by solving a problem or identifying potential solutions to an issue
	LAFS.5.RL.1.3 - Compare and contrast two or more characters, settings, or events in a story or drama, drawing on specific details in the text (e.g., how characters interact)	• Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience
	LAFS.5.W.1.1 - Write opinion pieces on topics or texts, supporting a point of view with reasons and information	• Use feedback to guide and improve writing • Use the planning, revision, and editing processes to strengthen writing
	LAFS.5.W.2.4 - Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience	• Create a personal narrative describing ways that you can contribute to your local community by solving a problem or identifying potential solutions to an issue
	LAFS.4.W.2.5 - With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, and editing	• Compare and contrast the stories of two or more young people from the text • Provide specific examples from the text to support your analysis
	LAFS.4.W.4.10 - Write routinely over extended time frames (time for research, reflection, and	• Using proper structure, write a personal narrative describing ways that you can contribute to your local

	revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences	community by solving a problem or identifying potential solutions to an issue
Social Studies	SS.5.G.1.2 - Use latitude and longitude to locate places	• Explain why lines of latitude and longitude might be helpful in describing the location of something • Identify the longitude and latitude of the location where you are working to solve a local problem • Find landmarks with either the same longitude or latitude and describe their locations
	SS.5.G.1.4 - Construct maps, charts, and graphs to display geographic information	• Identify major physical features and incorporate them into a map, chart, and/or graph • Use maps, charts, and graphs to display geographic information related to the local problem you are solving
Unit Resources		
Generation Fix by Elizabeth Rusch		

Assessment Rubric

Essential Project Design Elements	Below Standard	Approaching Standard	At Standard
Building Knowledge, Understanding & Skill	▪ I still need to learn how to use information from different sources to help show my understanding of the topic or the skill that I have been studying ▪ I still need to think more about how my information is relevant or if I have enough	▪ I can use information from different sources to help show my understanding of the topic or skill that I have been studying but may still have trouble putting it together	▪ I can use information from different sources to help show my understanding of the topic or skill that I have been studying ▪ I have some information that is relevant and shows

	information to show that I understand the topic or have the skills to accomplish my goals	▪ I may have some information that is relevant but still need more to show that I understand the topic or have the skills to accomplish my goals	that I understand the topic or have the skills necessary to accomplish my goals
Connection to Problem or Question	▪ I cannot explain my product or its connection to the problem or essential question ▪ I still need to learn how another person might think differently about the essential question or problem we are studying	▪ I can explain a few things I know about my solution or answer to the essential question and explain its connection to the problem or question we are learning more about ▪ I can understand how another person might think differently about the essential question or problem we are studying	▪ I can fully explain my solution or answer to the essential question and explain its connection to the problem or question we are learning about ▪ I can explain how other people might think differently about the essential question or problem we are studying
Authenticity of Product	▪ I still need to learn how to explain my ideas in an order that makes sense ▪ I still need to learn how to explain the ways that my product, solution, or answer that I have created addresses a real-world need or connects to some real-world application ▪ I still need to learn how to ask questions	▪ I can use some facts and details to support my ideas but they are not always appropriate or relevant ▪ I can explain a few ways that my product, solution, or answer that I have created addresses a real-world need or connects to some real-world	▪ I can explain my thinking in an order that makes sense and is appropriate to my audience ▪ I can fully explain how the product, solution, or answer I have created addresses a real-world need or connects to some real-world application

	about what our audience or product users might want or need	application but still may need some more information or have some errors ▪ I can ask a few questions about what our audience or product users might want or need	▪ I can ask lots of questions about what our audience or product users might want or need
Reflection on the Learning Process	▪ I still need to learn ways to ask questions of others so that I can better understand the topic or skill we are learning about ▪ I need help in setting goals to help me improve and learn what I have to do to get me there ▪ I still need help in using my time constructively to accomplish tasks complete projects ▪ I still need help in making good decisions and in taking responsibility for my actions	▪ I sometimes ask for help when I don't understand ▪ I sometimes set my own goals and think about how I am doing ▪ I sometimes use my time constructively so that I accomplish tasks and complete projects but other times I may become distracted ▪ I sometimes make good decisions related to the learning process and at times take responsibility for my actions	▪ I always ask for help when I need it or when I don't understand ▪ I set my own goals, think about ways that I can improve and how I am doing in the learning process ▪ I can use my time constructively to accomplish tasks complete projects ▪ I often make good decision related to my learning and take responsibility for my actions
Integration of Communication and Collaboration	▪ I still need to learn ways to communicate with others in a helpful and productive way ▪ I still need to learn ways that I can be a better listener and hear the viewpoints of others ▪ I still need to learn how to work with	▪ I can sometimes communicate effectively with others in a way that is helpful and productive ▪ I sometimes use good listening strategies so that I can hear and understand the	▪ I can effectively communicate with others in a way that is helpful and productive ▪ I consistently use good listening strategies so that I can hear and understand the

	others to accomplish a task or work towards a goal	- viewpoints of others - I sometimes use strategies and skills to work with others to accomplish a task or work towards a goal	- viewpoints of others - I effectively use strategies and skills to work with others to accomplish a task or work towards a goal
Use of the Critique and Revision Processes	- I still need to learn how to use feedback from other students and adults to improve my product, solution or answer to the question I have been studying - I still need to learn how to provide feedback to other students so that they can improve their product, solution or answer to the essential question	- I can sometimes use feedback from other students and adults to improve my product, solution or answer to the question I have been studying - I can sometimes provide feedback to other students so that they can improve their product, solution or answer to the essential question but may still need to work on some feedback and critique procedures	- I can use the feedback from other students and adults to improve my product, solution or answer to the question I have been studying - I can provide feedback to other students to help them improve their product, solution or answer to the essential question in a helpful and productive way

Appendix B: Survey Questions

Thank you for your help with this survey. It will provide valuable information about how teachers are using problem-based learning, the perceived benefits, challenges, and problems they face with its implementation, and how teachers can be better supported. There are no correct or incorrect answers, and all answers will be kept confidential.

Demographics Questions (used to identify the representativeness of our sample):

9. How many years have you been teaching, counting this year? _____

10. What is your age range (circle one): 22-35   36-49   50+

11. What grade level do you currently teach? _____

12. Is your class departmentalized or is your classroom self-contained? _____

a. If your class is departmentalized, what subjects do you teach? _____

13.   Are you in the same school now as you were last school year? _____

Teaching Climate:

6. How often were these policies or procedures in place at your school this year?

	Not At All	Sometimes	Always
Block or flexible scheduling allowing extended periods for working on project planning or other activities			
A school-wide emphasis on problem-based, project-based, or inquiry learning			
School-wide rubrics for assessing student work across different subjects or grades			
A grading or reporting system that included students' projects or portfolios			
A school-wide emphasis on skills beyond academics (e.g., collaboration, presentation, or other "21st century" skills)			

General Teaching Practices:

7. Last trimester, how often did you use the following methods to measure student performance?

	Never	A few times	Once or twice a month	Once or twice a week	Almost every day
Multiple choice or short answer tests					
Essay (extended written response) tests					
Open-ended problems					
Portfolios of student work					
Group projects					
Individual projects					
Student peer reviews					
Hands-on demonstrations, exhibitions, or oral presentations					

8. Last trimester, how often did most of your students do the following?

	Never	A few times	Once or twice a month	Once or twice a week	Almost every day
Collected, organized and analyzed information and data					
Solved real-world problems					
Decided how to present what they had learned					
Evaluated and defended their ideas or views					
Orally presented their work to peers, staff, parents, or others					
Researched topics deeply enough to become subject matter experts					
Worked on multidisciplinary projects					
Participated in community or career-based project topics					

Problem-Based Learning:

This survey defines problem-based learning (PBL) as an approach to instruction that:

- engages students in an extended investigation

- requires inquiry into a topic in depth

- includes some student self-direction or choice, and

- requires presentation of findings, results, or conclusions

9. To what degree would you say that you implement problem-based learning?

a. I do not do anything like this
    Do you have any interest in using PBL, as it was described, or have you tried using PBL in the past?
    Not interested. Please specify why: _____
    I'm interested, but have never tried PBL → skip to question # 21
    I have tried PBL → skip to question # 21
b. I do something like this – and use the term problem-based learning (PBL)
c. I do something like this – but prefer to call it something else (inquiry, project-based, expeditions, etc.) Please specify: _____
    For the remaining questions, please answer the questions about PBL as if we had used the term that you prefer.

10. Here are a few of the kinds of projects your students may have done. Were your students

    involved in any of these activities?

	Yes	No
Interviewing family or community members or documenting their experiences or local history		
Creating or running a business or offering a service to the school or community		
Researching competing views on an issue and/or holding a debate		
Creating a museum-type display or exhibit for others to experience		
Researching an issue in the community in order to make recommendations or create a plan of action		
Developing a written product to be shared with others (e.g., letters to newspapers politicians, brochures, posters, etc.)		

Developing artistic performances or products (e.g., pieces of music, art, drama, videos, etc.)

Constructing simulations, or models, (e.g., physical or computerized models of buildings, vehicles, bridges, weather, populations, etc.)

Making observations or collecting data (e.g., about water quality, animal or plant populations, traffic patterns, etc.)

Sharing data or interacting with students in other schools, professional experts, or outside organizations

Developing relationships or working with people via the Internet (e.g., ThinkQuest, WebQuests, ePals, etc.)

Role-playing as stakeholders to solve simulated problems based on the real-world

Writing a research paper or creating a scientific experiment

Creating a working version of a physical object, structure, device, etc.

Creating a computer-based product or program (e.g., webpage, blog, games, etc.)

If your students did another type of project, not listed above, please describe it briefly.

---

11. Rate each of the following reasons for your use of PBL. I use PBL…

	Not an important reason for me	A somewhat important reason for me	An important reason for me	An especially important reason for me
To make teaching, learning more varied, challenging, or fun				
To teach academic content knowledge and skills more effectively				
To teach skills beyond academic content (group work, presentations, project managements, 21st century skills)				
To promote students' civic engagement, contributions to the community or world				
To make learning more personalized, tailored to students' individual interests or needs				
To promote students' international or cross-cultural understanding				

12. How often do you teach using the following strategies? In class, I use…

	Not at all	Some-times	About half the time	Most of the time	All of the time
Direct instruction (e.g., textbooks, whole class discussion, content lessons, lectures, etc.)					
A flexible approach to content depending on what students were doing					
Team teaching, with another teacher					
Interdisciplinary projects, service learning, or solving real world problems					

13. Last trimester, when you conducted projects in your classroom, how often did you..

	Never	Rarely	Some-times	Freque ntly	Almost always
Teach students what they would need to know before the project started					
Use a planning form or template to design the project					
Use a driving question, essential question or problem statement to focus the project					
Specify content standards that projects were designed to meet					
Assess skills beyond academic content that students would demonstrate or learn (e.g., team work, presentations, etc.)					
Require students to create knowledge, answer questions or solve problems that had not already been solved or answered					
Assess content for accuracy, thoroughness, or depth of understanding					
Develop a map of the project, a timeline, or a checklist to monitor progress					
Have students answer questions about the project, the work that went into it, or their learning					

Have students reflect on the quality of the project, the work that went into it, or their learning

14. How many different projects have/will students complete this school year? _____

15. For a typical student in your class, about how much of their overall time was spent

on problem-based learning? (select one)

Almost none   less than ¼   about ¼   about ½   about ¾   all or almost all

16. How many years have you been using PBL strategies in your teaching or in your

classroom?_____

17. Compared to previous years of teaching, how much did you use PBL last trimester?

(select one)

Much less use of PBL than in the past

Somewhat less use of PBL than in the past

No change – or did not teach using PBL before last semester

More use of PBL than in the past

Much more use of PBL than in the past

18. What are the reasons for changes in your use of PBL? (check all that apply)

I am new to this school

I am teaching a new subject or grade level

I am teaching different students, with different needs

The climate or emphasis at my school has changed

Policies or expectations set outside of the school have changed

There are new or different accountability requirements for my teaching

My perception of the efficacy of PBL has changed

My understanding of how people learn or understand things has changed

I participated in professional development that increased my ability/capacity to implement PBL

Other (please specify): _____

Preparedness for Conducting PBL:

19. How well prepared do you feel to do the following PBL-related activities in your classroom?

	Not important/not a goal	Not prepared at all	Somewhat prepared	Well prepared	Very well prepared
Find existing projects that are high quality					
Plan and design new projects					
Meet state standards using PBL					
Assess individual students' content learning using PBL					
Promote depth or quality in student work during projects					
Facilitate and manage students' work in groups					
Structure student presentations so the whole class learns					

Teach and assess skills beyond academic content (e.g., collaboration, presentation, 21st century skills)
Assess students working in groups

20. Over the last 5 years, how much total professional development have you had that supported your use of PBL – including workshop days or parts of days receiving coaching for PBL-related practices? (select one)

None	4-5 days
½ day	6-10 days
1 day	more than 2 weeks
2-3 days	

Challenges for PBL:

21. To what extent were the following challenges that limited your use of PBL, or your sense of its effectiveness?

	Not a challenge	A minor challenge	A moderate challenge	A major challenge
Too many students, or too large a class size				
Teaching blocks (periods) are too short				
Classroom space was limited (e.g. students couldn't leave projects set up, etc.)				
My students lacked skill or experience for PBL implementation				
Students have poor attendance and/or behavior problems				
Parents or students expected me to use direct instruction, not projects				
Too many testing and accountability requirements				
Lack of funds, materials, or resources (e.g., technology, art supplies, library, etc.)				
I lacked the models or examples for using PBL in my subject area with my students				

I lacked time to find, create, or plan projects

I lacked time in the curriculum to carry out
projects

I lacked professional development or coaching in
PBL

22. Are there any other additional comments or ideas you would like to share related to PBL or

    would you like to suggest other issues about the use of PBL, which you believe, are important

    to consider.

    Thank you for completing this survey. If you are willing to participate in a follow-up in-
    person interview to elaborate on your responses and provide more insight into your personal
    experiences related to PBL implementation in your classroom, please provide your name and
    personal email contact below (your personal email information is being requested as your
    work email is available as public record).

Appendix C: Interview Questions

Thank you for participating in this interview. This follow-up information will provide valuable information about how teachers are using problem-based learning, the perceived benefits, challenges, and problems they face with its implementation, and how teachers can be better supported. There are no correct or incorrect answers, and all answers will be kept confidential.

1. In question #7 of the survey, you indicated that you used the following methods to measure student performance in your classroom: _____. Why did you choose to use _____ method more (or less) than another method?

2. Of the strategies that you indicated that you use in question #7, which do you think is the most impactful on the academic achievement of your students? Why?

3. In question #10 of the survey, you indicated that you used the following kinds of projects in your classroom: _____. Why did you choose those types of projects over other forms of projects?

4. In question #12, you indicated that you teach using the following strategies: _____. How do you decide when and how often to use the teaching strategy you indicated?

5. Of the strategies that you indicated that you use in question #12, which do you think is the most impactful on the academic achievement of your students? Why?

6. In question #13, you indicated that when conducting projects in your classroom, you used the following methods within your project implementation: _____. Which strategy/strategies do you think are the most impactful on the academic achievement of students in your classroom? Why?

7. In question #19, you indicated that you feel more (or less) prepared to do the following PBL-related activities in your classroom: _____. Why do you feel that you are more

(or less) prepared to do those activities (what do you think were the contributing factors to that comfort level)?

8. In question #20, you indicated that you had _____ of professional development to support the implementation of PBL. Do you think that this PD amount plays a role on the comfort level you indicated you felt in the last question? Why/why not?

9. In question #21, you indicated that experienced the following challenges that limited your use of PBL in the classroom: _____. Why do you feel that the challenges that you experienced had more (or less) of an impact than the others? How do you think that these challenges could be overcome?

Appendix D: Consent for Use and Modification of Survey Tool

Jason Ravitz   January 13, 2019 at 1:46 PM

Re: PBL AIR Index   Details

To: Eva Cwynar, Cc: Jason Ravitz

Eva,
I am very pleased to hear of your interest in using the measures. Please feel free to modify and use for your study.   If possible let me know how it goes!

Best wishes with your study. ~ Jason

p.s. You might want to check out the WVDE study too, if you haven't seen it.

On Sat, Jan 12, 2019, 2:14 PM Eva Cwynar <eva.cwynar@gmail.com wrote:
Good afternoon,

My name is Eva Cwynar and I am currently enrolled as a graduate student at Walden University. I am currently writing my dissertation on The Relationship Between Problem-Based Learning and the Academic Achievement of Elementary Students. I am interested in using the AIR Index Survey that you used in Project Based Learning as a Catalyst in Reforming High Schools (2008). I would need to omit a few questions as they do not pertain to the study that I am conducting and I would like to add a few interview questions related to the way that the teachers implement PBL strategies in their classrooms so that I may probe further into how their implementation effects the academic achievement of students.

My URR explained that I must get your consent in order to use the index and to proceed with my study. May I have your permission to use and modify the AIR Index that you used in your 2008 research?

If you would like to discuss the matter further or have questions about how I intend to use the survey in my research, feel free to reach out via email or call me at (561) 254-6793.

I appreciate your time and consideration in this matter.

Many thanks,

Eva Cwynar