Reading and Math Achievement in a Project Based Learning Classroom: A Comparative Quantitative Study

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Abstract

The initial purpose of this comparative, quantitative study was to examine the difference between the math and reading iReady achievement scores of students learning in a Project Based Learning (PBL) instructional setting compared to those that did not learning a PBL setting. An additional purpose of this study was to determine the difference between student perception of self-efficacy scores of students that participated in and did not participate in a PBL instructional setting as reported on the Panorama Survey. The participants in this study include approximately 240 students enrolled in Grade 6 in one suburban Kansas City area school district in the state of Missouri during the 2021-22 school year. At the time of the study, there was limited literature found in which the impact of PBL instruction was measured on the reading, math, and self-efficacy perceptions of middle school students. Independent sample *t*-tests were calculated to determine the relationship between the spring iReady Reading, spring iReady math, and spring Panorama self-efficacy scores of students that did and did not learning a PBL instructional setting. The results revealed that there was little difference in the iReady scores for both math and reading for students regardless of the presence of PBL instruction in the classroom. An additional finding showed that there was an insignificant difference in the self-efficacy Panorama scores of students that learned in a PBL setting compared to students that did not learn in a PBL setting. Evidence from this study supports the need to continue to review the effectiveness of PBL instruction on a broader scale. Determining the impact of PBL instructional practices could be used to serve as a recommendation to districts that are looking at innovative structures for learning.

Dedication

This dissertation is dedicated to educators who strive to continually support student learning and being open to stepping out of their comfort zone to create innovative spaces in their classrooms, schools, and districts. Transitioning from a focus on teaching to a focus on student learning can be transformative. This dissertation is also dedicated to all educators who continued to show up and support learning in spite of tremendous obstacles during the Covid-19 Pandemic. These unprecedented times will impact schools and learning forever, thus calling educators to continue to adapt for student need through innovation.

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Chapter 1

Introduction

Educational leaders have extensive expectations placed on them daily to improve practices and the quality of educational programs (McMillan, 2021). In addition to helping students achieve learning standards, school leaders are asked to maintain students' nutrition, hygiene, mental health, and character education. They seek to do so in ways that create opportunities for students to succeed in an ever changing, demanding world (The Wallace Foundation, 2013). As school leaders work to manage so many components of child development, they also have to maintain a rigorous and varied curriculum to show academic growth. Some think that this is best achieved through technology. The U.S. Department of Education (n.d.) describes how technology supports both teaching and learning, provides opportunities for learning at any time and day, and can accelerate learning by increasing engagement and motivation. Others believe innovative practices spurred by changes in the business world and the business industry will improve education (McMillan, 2021). Districts are charged with finding a way to encapsulate all of those instructional components into strategies that can meet the needs of students while motivating them and preparing them for the real world.

Regarding instructional strategies, some classrooms today look very similar to classrooms from years ago. Although some students may be taught in pods and teams rather than in traditional rows, the teacher continues to do most of the thinking, proving to be ineffective or having little impact on student learning. The vast difference between schools that are innovating education and those that are not is often attributed to inequities in public education (Darling-Hammond, 2001). The inequities that exist in funding, facilities, faculty, and experience can keep some schools from implementing innovative structures, thus limiting

opportunities for student growth. Innovation has been described as a necessary means to generate needed changes in education that support the evolving changes in society (Serdyukov, 2017). “Innovation resembles mutation, the biological process that keeps species evolving so that they can better compete for survival" (Hoffman & Holzhuter, 2012, p. 3). The author implies that any activity with human interference must continually innovate to survive, including education. Looking at the teaching methods used in schools can ensure that instruction continues to evolve as the world around students’ changes (Raja et al., 2018).

One innovative instructional technique utilized in education is Project Based Learning (PBL). In this instructional methodology, students engage in personal, real world projects (Buck Institute for Education, n.d.). Students work to solve a real world or complex problem, learn subject matter content, and apply the content as the problem is solved. Proponents of PBL believe that content knowledge, such as science, can be better understood while students develop critical thinking, collaboration, creativity, and communication skills. Learning is meant to be authentic, meaning that the experiences students have in the classroom can replicate those they may have in the real world. PBL is believed to be a better approach to learning than a student recalling information for a teacher or through textbook generated assessments due to application of learning in a real work setting. A high quality PBL also allows students to share their learning with an authentic and public audience (PBL Works, n.d.).

Some educators may interchange the labels of inquiry based learning (IBL), project based learning, and problem based learning interchangeably (Kimberlin Education, 2018). Inquiry based learning begins with a question that guides the learning process. Project based and problem based learning also starts with a guiding question but have more learning tasks required for learning. Kimberlin Education (2018) defines problem based learning as a strategy in which

students attempt to solve a real world problem through an investigative process to find a solution. Project based learning also attempts to solve an authentic problem but creates a final product and presents it to an authentic audience (Buck Institute for Education, n.d.). Project and problem based learning can both be labeled with the abbreviation of PBL (Campbell, 2014), but some resources may label project based learning PjBL (Kimberlin Education, 2018). In this study, PBL will refer to project based learning. However, many educators will often use the project based learning label even when a final product is missing.

A 2017 study showed that PBL instruction is "promising, but not proven" (Condliffe et al., 2017, p. iii). The authors' noted that PBL impacts science and social studies learning. However, the evidence is lacking for math and literacy to support PBL as an instructional model. "In particular, it has been noted that math teachers have found it difficult to integrate PBL into their instruction" (Condliffe et al., 2017, p. iii). However, the authors identified that the PBL approach does have a positive impact on student efficacy, but this was dependent on the way the PBL instruction was utilized in the classroom. Although there is research that supports and refutes the effects of PBL instruction, finding the impact of PBL instruction on standardized testing and the impact on students' perception is worth investigating.

Self-efficacy and motivation of students have been studied for some time. An influx of research became available after Bandura (1977) began studying self-efficacy. In this research, self-efficacy describes a person's belief toward task performance and goal achievement (Bandura, 1982). Those early studies (Bandura, 1982; Brown & Inouye, 1978) were not linked to student performance in the classroom but more to task completion (Schunk, 1989). Once the concept of self-efficacy gained traction, research findings were made available connecting student self-efficacy related to learning and factors in the classroom that impacted student self-

efficacy (Ahmad & Safaria, 2013; Bandura, 1989; Pajares, 2002; Pajares & Johnson, 1996; Pajares & Kranzler, 1995; Pajares & Miller, 1994; Schunk, 1989). Other more recent studies provided evidence for social emotional learning and the impact on self-efficacy (Agoglia, 2021).

Background

As PBL instruction is utilized in more districts, more and more families and educators look for models of success in schools that promote PBL instruction (Larmer, 2018). The desire for families to seek out PBL schools may be motivated by parents who saw their child succeed in a PBL school and, during a move, choose to find another school to avoid the traditional school model. Additionally, as schools learn more about PBL instruction and move towards implementation, they may seek out places to visit to see PBL in action (Larmer, 2018). When schools work with consultants specializing in PBL instruction, such as the Buck Institute, many names or resources may be offered for a mentorship (Buck Institute for Education, n.d.). PBL Works, a Buck Institute partner, has a long list of districts and schools in the partnership. Additionally, schools and districts that are part of the Deeper Learning Network (DLN) may be recommended as a models of success (Larmer, 2018). PBL instruction is considered one of the components of effective teaching and learning, as identified by the Deeper Learning Network (Deeper Learning, 2022).

The DLN connects districts across the United States that promote deeper learning and thinking. DLN includes ten states, 261 school districts, and over 2800 schools. Six competencies are at the heart of the community: rigorous academic content, thinking critically and problem solving, collaborative work, communication, learning how to learn, and developing a belief in an ability to grow (Deeper Learning, 2022).

In Missouri, three districts are a part of the DLN. Additionally, nearly 20 different Missouri schools are identified independently of their districts as a part of the network. These schools include elementary, middle, high, public, and charter schools (Deeper Learning, 2022). Outside of the DLN, even more schools identified as having a PBL instructional focus.

District A, the focus of this study, initiated a PBL pilot program for sixth graders during the 2019-20 school year in one of its four middle schools. The program was titled, By Design, and advertised as an interdisciplinary, real world approach to learning using the PBL model. This concept was implemented for one team of sixth graders while the other teacher team maintained a traditional approach to learning. Students were allowed to opt into the By Design model. The three other middle schools in the district did not initiate the same PBL model. Comparing data from the By Design team and the other traditional sixth grade team could provide data on the educational impact of the PBL model and the relationship in building student self-efficacy.

Statement of the Problem

While there have been studies conducted about the effectiveness of project based learning structures from a short term perspective, more research is needed to better understand the long term academic growth and achievement in math and reading for students that learn in a PBL setting. Much of the current literature outlines the immediate gains in knowledge on subject matter tests after learning in a PBL structure (Shchetynska, 2020; Raja & Najmonnisa, 2018; Rivet & Krajcik, 2004). As shown in standardized testing, the literature available about PBL effectiveness is limited to high school advanced placement courses (Parker et al., 2013) or standardized testing of middle schoolers in science (Geier et al., 2008). Limited research focuses on standardized testing results of students learning through PBL in middle schools related to

reading and math achievement (Condliffe et al., 2017). Additionally, the author did not find research on general education students learning in a middle level PBL setting. "There is an unevenness of PBL research across K-12 disciplines" (Grant & Glazewski, 2016, p 7).

A survey was conducted to gather data about project based learning impact perceptions from teachers and principals (Project Tomorrow: Speak Up, 2021). The survey of over 10,000 teachers summarized the chief characteristics of PBL instruction that teachers value. A common attribute endorsed by teachers identified that PBL capitalizes on students' strengths, thus building confidence and self-efficacy. Of the teachers surveyed, 64 percent verified this characteristic, making it the third most notable characteristic out of the top ten elements valued by teachers (Project Tomorrow, Speak Up, 2021). However, this study was based on teachers' perceptions of the connection between PBL instruction and self-efficacy. Another study suggested that the PBL experience might positively impact students' self-efficacy. Mataka and Kowalske (2015) gathered data showing a positive perception of self-efficacy for undergraduate chemistry students learning in a PBL setting. A similar quantitative study conducted by Deutsch (2017) with post secondary math students measured the relationship between PBL instruction and students' perceived mathematical self-efficacy. Of the 13 questions that specifically measured perceived math self-efficacy, all 13 displayed a positive increase in the mean response by students. Deutsch (2017) stated that it was unknown if this was statistically significant, but the positive growth for all questionnaire items suggests a positive change was educationally significant. "At minimum, there was clearly no evidence that project based learning decreased mean levels of mathematics self-efficacy" (Deutsch, 2017). However, research on this specific topic is limited. It mainly involves older participants (e.g., college students). Scholars suggested that further research is needed to examine the impact of PBL on students' self-efficacy in various

settings with participants in different grade levels and age groups (Shin, 2018). This study will further the research on self-efficacy in a PBL learning environment regarding middle-level students, specifically sixth grade.

Purpose of the Study

This study aimed to examine the impact of the PBL model of instruction on the achievement scores of students and their perceived self-efficacy. Specifically, the study investigated the difference between the reading and math iReady assessment scores of students that did and did not utilize a PBL model of instruction. Additionally, the study investigated the difference between students' perceived self-efficacy who utilized a PBL model of instruction and the perceived self-efficacy of students who did not utilize a PBL model of instruction.

Significance of the Study

Implementing a PBL model can require financial support from school districts, such as professional development of teachers, facility updates, and partnership opportunities with the community. "Additionally, education policymakers are increasingly demanding evidence to guide decisions about whether to adopt an educational reform or instructional innovation" (Condliffe et al., 2017, p. 12). Regardless of how innovative an instructional approach is, the ultimate goal of a school district is to show that students are learning and can show their learning in a variety of ways. The easiest way to show this is often through standardized assessments. Little research has been found to show how PBL instruction translates into increased student performance on standardized tests that occurs to track student learning of core skills like math and reading. This study aims to add more information to the current literature on students who learn in a PBL setting. Specifically, the study aims to further the limited research on standardized test scores of middle level suburban students learning in a PBL setting. While the

study may not apply to all groups of students learning in a PBL instructional setting, it will be informative for districts implementing PBL structures for suburban middle school students.

The additional focus of the study on the difference between students perceived self-efficacy in the PBL model and those learning in a traditional setting may contribute to the growing research on middle level PBL instruction. The research examined supported that student achievement and satisfaction are affected by a student's academic self-efficacy (Domenech-Betoret, Abellan-Rosello, & Gomez-Artiga, 2017). If student achievement is connected to self-efficacy, as identified in the study above, it justifies a need to continue to identify factors that promote or enhance self-efficacy. Although this current study will not connect achievement and self-efficacy, it will expand the research about self-efficacy and structures that may influence self-efficacy in learning. More specifically, it may identify whether perceptions of self-efficacy are different by learning in a PBL setting.

Delimitations

"Delimitations are the self-imposed boundaries set by the researcher on the purpose and scope of the study" (Lunenburg & Irby, 2008). The researcher imposed the following delimitations in this study to maintain the purpose and focus of the study.

1) The study participants were from one middle school in one suburban school district.
2) The study gathered data on math and reading summative assessments utilizing the iReady standardized performance program.
3) The study gathered iReady data during the 2021-22 school year on one assessment point from the spring reading and math assessments.

4) The study gathered Panorama data during the 2021-22 school year on one assessment point in the year: spring Panorama survey, to assess student self-efficacy.

Assumptions

Assumptions are postulates or claims used for the study's operational side. "Assumptions include the nature, analysis, and interpretation of the data" (Lunenburg & Irby, 2008). The following assumptions were made by the researcher regarding the study.

1) It was assumed that the PBL team implemented the PBL model with fidelity, following protocols set by a research based PBL instructional model.
2) It was assumed that all teachers involved followed the same set of grade level standards as imposed by the Department of Elementary and Secondary Education (DESE) of Missouri.
3) It was assumed that students were given the same testing conditions.
4) It was assumed that students put forth their best effort on the iReady assessment for accurate results.
5) It was assumed that students completed the Panorama survey with an honest and earnest reflection for efficacious results.

Research Questions

Research questions are a “directional beam for the study” (Lunenburg & Irby, 2008, p.126). The following questions were used to guide the study on students’ math and reading achievement and perceived self-efficacy in PBL classrooms.

RQ1. Is there a difference between reading iReady scores of students who utilized a PBL model of instruction and students who did not utilize the PBL model of instruction?

RQ2. Is there a difference between math iReady scores of students who utilized a PBL model of instruction and students who did not utilize the PBL model of instruction?

RQ3. Is there a difference between students' perceived self-efficacy who utilize a PBL model of instruction and students who do not utilize a PBL model of instruction?

Definition of Terms

To ensure this study's purpose and findings are accurately interpreted, terms specific to this research have been listed and defined. The following definitions are provided for this purpose:

Authentic learning. "A pedagogical approach that allows students to explore, discuss, and meaningfully construct concepts and relationships in contexts that involve real world problems and projects that are relevant to the learner" (Donovan, Bransford, & Pellegrino, 1999).

iReady Assessment. A diagnostic tool to help educators have information to identify strengths and instructional priorities for students, set goals, and track growth when state level assessments are not available. iReady Diagnostics is available for Grades K-12, is online and adaptive, and provides teachers resources for instruction (Curriculum Associates, n.d.).

Panorama. An independent technology company used by districts to support students' social emotional learning and literacy. Feedback is used to help the district better serve students to improve school climate, understand students, families, and teachers, and determine steps to support them (https://www.panoramaed.com/faqs).

Project Based Learning. "A teaching method in which students learn by actively engaging in the real world and personally meaningful project" (PBL Works, n.d.).

Real world learning. "An approach to learning that involves schools working with community partners and industry experts to engage students in authentic, relevant problems,

projects, and experiences that develop career awareness and readiness" (https://realworld.digitalpromise.org/getting-started/).

Self-efficacy. "An individual's belief in his or her capacity to execute behaviors necessary to produce specific performance attainments" (Bandura, 1977, 1986, 1997).

Social emotional learning. The capacity to identify and manage emotions, problem solve, and foster relationships with others. Social emotional learning uses the content, attitudes, and skillset for a person to manage their feelings, care for others, make good decisions, foster positive relationships, and manage difficult situations well (Elias, 2007).

Standardized test. An assessment in which a particular set of students take the same test is scored and analyzed consistently. The participants' scores are compared to the group and used as a standard or benchmark (What is Standardized Testing? - Definition & Types, 2016).

Traditional instruction. A teaching approach in which the teacher typically directs instruction while students learn while sitting and listening (Tularam, 2018). Traditional teaching strategies can describe instruction from the past used by teachers who did not have formal training. Traditional teaching may use drills, memorization, and deemphasize critical thinking, problem solving, and social skills (Green, n.d.).

Organization of the Study

In the first chapter of this study, the following components were introduced: background for the study, statement of the problem, the purpose of the study, the significance of the study, delimitations, assumptions of the study, research questions, definitions of terms, and a description of the methodology used. Chapter 2 highlights the relevant and current literature about the proposed research questions. This chapter includes a definition, background, and the impact and opponents of PBL. Chapter 2 also highlights the advantages and disadvantages of

computer based assessments, more specifically of the impact of iReady assessments. Finally, chapter two describes the background and impact of self-efficacy on learning. Chapter 3 outlines the study's design and the methodology used for the research. The results of the hypothesis testing for all research questions are outlined in chapter 4. Chapter 5 summarizes the findings related to the literature reviewed, and interprets the results of the data analysis, the conclusions drawn from the research, and recommendations for future research.

Chapter 2

Review of the Literature

Project Based Learning

Defining PBL

Project based learning is a “teaching method in which students learn by actively engaging in a real world and personally meaningful project” (PBL Works, n.d.). Different authorities outline the criteria for project based learning. Larmer and Mergendoller-Buck (2015) describe how projects are developed around student learning goals aligned to essential project elements. The elements are identified as a gold standard and include Essential Knowledge, Understanding, and Success Skills; Challenging Problem or Question; Sustained Inquiry; Authenticity; Student Voice and Choice; Reflection; Critique and Revision; and Public Product. The elements are identified from the perspective of the teacher and teacher planning process (Larmer & Mergendoller Buck, 2015).

High Quality Project Based Learning (HQPBL) was founded on the essential design elements of a gold standard PBL but is defined from the student experience perspective while learning in a PBL environment (Olabuenaga, Peletz, & Lathrop, 2022). The HQPBL framework states that the following elements must be present for a high quality PBL: Intellectual Challenge and Accomplishment; Authenticity; Public Product; Collaboration; Project Management; and Reflection.

Regardless of the approach toward PBL instruction, doing so with fidelity is essential. "Studies have proven that when implemented well, project based learning can increase retention of content and improve students’ attitudes towards learning, among other benefits” (Vega, 2015,

para. 1). Exploring the relationship of the skills developed during a PBL, although hard to measure, builds the potential of the strategy (Asbjornsen, 2015).

PBL Background

Educational leaders are continuously searching for instructional strategies to show student achievement growth. Hattie (2009) conducted a meta analysis of over 800 studies to examine which instructional strategies significantly impact student achievement. Many strategies do not hinder or help, but those that can show more than one year's growth in one year are considered significant to student achievement. An effect size of .40 is deemed the marker for this rate of student achievement (Hattie, 2009).

PBL is one strategy that was measured in Hattie's study (Hattie, 2009). The effect size of PBL instruction was .15, well below the desired marker for one year's growth. However, many other instructional strategy components of PBL instruction, like inquiry, have a more significant effect size. Inquiry based learning has an effect size of .31, and higher order thinking and collaboration boast scores of 1.28 (Boss, 2014).

An updated review of Hattie's initial meta-analysis was published based on Hattie's initial meta analysis (Visible Learning Metax, 2021). As more research was conducted on high impact instruction, the impact size of each strategy was adjusted. Based on the newest data, problem based learning currently has an updated effect size of 0.35 from the initial 0.15. Although it is not a highly effective strategy for student achievement in isolation, the newly published results are likely to impact student achievement positively. The research was based on 23 meta analyses of 900 studies and over 95,000 students. These measures give the overall confidence of the effect size a 5 out of 5 (Visible Learning Metax, 2021). The confidence level is based on the number of meta analyses, studies, students, and effects measured.

An influence labeled as problem solving teaching was also published in Hattie's global research database. Problem solving teaching was described as learning in which students solve a problem they do not already know how to solve. Problem solving could be considered one of the components of PBL instruction. Based on 714 studies of over 17,000 students, problem solving teaching has an effect size of 0.67 and can considerably accelerate learning. The confidence level for problem solving teaching is 5 out of 5 (Visible Learning Metax, 2021).

Boss (2011) outlined how the concept of learning began with Confucius, Socrates, and Aristotle and continued as a platform for 20th-century thinking with educational theorists such as John Dewey, Maria Montessori, and Jean Piaget. Problem based learning became a common teaching strategy in medicine, engineering, and economics.

PBL designed instruction became more prevalent in mainstream education when technology was embedded in the curriculum, and it was assumed that the concept of PBL was a relatively new idea (Boss, 2011). More schools developed project based platforms as professional learning opportunities and resources became more readily available. However, projects embedded in solving real-world problems have been a part of the educational forefront for a long time (Boss, 2011).

PBL components of rigor, relevancy, and hands on learning evolved into mainstream K-12 education during the 21st century. When students have a real world context in which they learn, the motivation to find the answer propels learning forward. Real world learning experiences give students learning opportunities that they may experience in the real world. Many educators call real world learning authentic experiences (PBL Works, n.d.). When real world learning is coupled with active, student directed learning, proponents of PBL claim that the skills learned when completing a PBL are essential skills for success later in life (Boss, 2011).

Kingston (2018) reviewed 20 studies over 30 years to determine if PBL could promote more effective learning than traditional instruction in core content areas. The studies reviewed were conducted between 1984-2017. Core content areas include social studies, science, math, and English language arts. Most reviewed studies highlighted how PBL could promote learning in social studies and science. Limited evidence regarding math and literacy exists as only three of the studies focused on these subjects. While the studies on social studies spanned grades 2-12, the science based evidence only came from middle level grades. Math research included eighth grade and above, while evidence from English language arts only came from second grade. Kingston's study summarized many studies about PBL but outlines how there is a lack of depth in any particular area and on the impact PBL has on learning.

Many studies on the use of PBLs have been completed. However, few focus on the impact of standardized testing on middle level American students or identify the impact on self-efficacy, which is the purpose of the study. The PBL model positively impacts higher education (Asad, Iqbal, & Sabir, 2015; Nilson, 2010). Many studies focus on the use of this instructional model in other countries (Asad, Iqbal, & Sabir, 2015) while others focus on short term gains in content area post tests not measured by standardized testing (Speziale, Speziale, Letwinsky, & McCook, 2016).

Impact of PBL Instruction

In an attempt to highlight the differences in students' performance in a traditional school compared to those that learned in a project based school, Boaler (1999) completed a study of two schools in England. The schools had similar student demographics in regard to gender, ethnicity and social class. A national test was used as the measure of student achievement. That data showed that three times as many students earned the highest mark possible in a project based

school compared to the traditional school. Boaler (1999) describes how students in a traditional setting could not apply their learning in math instruction to the real world or unfamiliar scenarios. However, the participants in the study were not randomly selected, implying that the students in the PBL setting may have outperformed their peers regardless of the instructional setting (Condliffe et al., 2017).

Kingston (2018) summarized a large population of studies focused on the impact of PBL instruction on students in a science classroom. Of the eight science studies reviewed, six focused on middle school level students, and five of the studies were conducted in the Detroit, Michigan area. One study of 2,500 Detroit students occurred in a low SES district with a 97 percent African American population and a Free and Reduced Lunch Population of 70 percent (Rivet & Krajcik, 2004). This study was not randomized and used curriculum based measures rather than standardized test scores. Learning outcomes improved, understanding went beyond recall, and students could apply information to new situations within this study group. However, these were uncommon measures which are difficult to compare to other studies.

Detroit Public Schools participated in a study with 8,000 middle level students in which students used the LeTUS science materials, which are based on PBL concepts. The demographics of students include a 95 percent minority rate. Students made statistically significant gains on measures of content knowledge and process skills in the area of science. Although the study highlighted the limitations of high principal and teacher turnover and technology issues, these gains were significant. Additionally, the study was conducted with a non randomized selection of schools, teachers, and students (Marx et al., 2004).

Geier et al. (2008) completed an additional study of the LeTUS curriculum in Detroit schools with over 19,000 students. Although it was a non randomized selection of schools,

teachers, and students, similar gains were highlighted. Students who participated in the LeTUS program significantly outperformed non participants on state standardized tests. Higher scores were seen in all science areas: earth, physical, and life science and in the process skills of constructing and reflecting (Geier et al., 2008).

Established in 2013, under the more extensive George Lucas Educational Foundation, Lucas Education Research combines educational experts and research firms to develop and evaluate project based learning in K 12 schools. The research aims to define principles for rigorous PBL conditions and develop a sustainable approach to learning (https://www.lucasedresearch.org/mission/team/). The foundation describes rigorous PBL as an inquiry based educational approach and has conducted research which show a positive impact on learning.

Knowledge in Action (KIA) is a learning approach for Advanced Placement (AP) students in which the curriculum is embedded in project based learning. A year after the development and implementation of the KIA curriculum, the efficacy of the PBL model, which KIA considers an intervention strategy, was measured. The Lucas Education Research funded this research. Five districts distributed across the nation were used for the study. All five districts had more than 50,000 students, and four of the five were in an urban setting. The fifth district was located in a suburb. The districts in the city had 62% or higher proportions of Black and Hispanic students accounting for data representing greater diversity. Three districts represented low income student populations of 72% or higher (Saavedra, Liu, & Haderlein, 2021).

Two courses were measured; AP U.S. Government and Politics and AP Environment Science. The research measured the likelihood that students earn a three or higher on a scale of 1 through 5, allowing students to earn college credit and lower the overall cost of tuition. The KIA

study measured four research questions. The first question compared the AP test results of students who received the KIA intervention, as described above, to those who had not was most notable after one year of intervention. Students who had received the intervention outperformed students instructed in the control group. Five of six data collections were deemed significant, holding a p value of less than 0.05 as a measure of significance. Year One AP KIA groups that showed significant scores compared to the control group include the qualifying score of the entire sample, exam-takers only, AP Total Score, AP Multiple Choice Score, and AP Free Response Score. Students who learned in a PBL program were 8 percent more likely to earn a three or above on final AP exams. These results were similar for low- and high-income students (Lucas Education Research, 2021). The only area tested that did not represent a level of significance was those students who took the AP exam (Saavedra et al., 2021).

Another three year study funded by Lucas Education Research was conducted to measure the impact of PBL instruction in a middle level science course. Learning Through Performance (LTP) program was aligned with the Next Generation Science Standards. A matched comparison study design compared groups of students based on variables such as race, ethnicity, gender, income status, and prior academic performance (Deutscher et al., 2021). However, the research focused on science achievement and student engagement, and the outcomes spread across various standardized measures. The authors identified better performance on standardized math and English language arts tests when students enrolled in the PBL course. Additionally, students classified as English language learners enrolled in the LTP program outperformed their peers on proficiency tests for the English language (Deutscher et al., 2021).

A 2015 study found PBLs effective for improving college medical students' critical thinking and problem-solving skills (Asad, Iqbal, & Sabir, 2015). Additionally, The Center for

Teaching Innovation (2020) described many components Nilson (2010) identified connected to PBLs as effective instructional tools used in college courses. Both studies confirm the impact of the PBL model on students advancing their education beyond K-12 education.

A high school study on PBL effectiveness examined a comparative study of PBL instruction and traditional teaching models, such as lecturing (Mergendoller, Maxwell, & Bellisimo, 2006). This study was conducted in a large metropolitan area of northern California. The study included five veteran teachers in four different high schools. Two schools were identified as suburban, while the other two were urban. The researchers found that the PBL model was a more effective instructional approach, increasing student interest, verbal ability, and self-efficacy toward problem solving in macroeconomics. The authors identified the study as having strong validity and reliability (Mergendoller, Maxwell, & Bellisimo, 2006).

Another study (Speziale, Speziale, Letwinsky, & McCook, 2016) focused on the math achievement of second and fifth graders in a large suburban district in Illinois. The district worked with Defined Learning, LLC and MIDA Learning Technologies, LLC, in which students utilized the Defined STEM framework for the 2015-16 school year. Defined STEM is a web-based application promoting connections between STEM content and career pathways. This mixed methods study utilized a quasi experimental mixed methods design to determine the effect of project based learning compared students to peers that did not learn in a PBL science setting. The unique aspect of this study was that PBL instruction was given in the science class, but problem solving skills performance was measured in mathematics. The study indicated that students in a PBL setting significantly outperformed their peers on math post tests. The second grade students showed a more significant growth than the fifth grade group. The quantitative

and qualitative data findings indicated that PBL provides a deeper understanding of the content and engagement of students (Speziale, Speziale, Letwinsky, & McCook, 2016).

A 2017 mixed methods study was conducted at a Kentucky middle school to measure the possible impacts of school wide PBL implementation while also obtaining the perceptions of teachers and administrators about the impact of PBL instruction (Trimble, 2017). The study used teacher and administrator attitudinal surveys and data from the school's report card published annually to the Kentucky Department of Education. This data focused on student assessment scores, attendance, and retention rates. The study showed neither a negative nor positive effect on assessment scores when the PBL model was utilized in Kentucky middle schools. There was an increase in scores at the apprentice and proficient level, while scores at the novice and distinguished level fell. Additionally, the data revealed that teachers and administrators positively perceived project-based learning effectiveness. As identified by teachers and administrators, positive associations were also seen regarding student attendance and behavior. Substantial evidence of PBL impact on student retention was not positive or negative (Trimble, 2017).

Opponents of PBL

Although considerable amounts of research compiled data showing the positive aspects of PBL instruction, some studies have shared drawbacks of teaching in an inquiry based format, such as PBL. Kirschner, Sweller, and Smith (2010) describe how less structured, open ended learning experiences are less effective and less efficient ways to learn the material in classrooms. Their research stated that a high level of prior knowledge must be present in a learning model for successful learning and that learners should not determine things like procedures and processes without the support of an instructor.

The researchers continued to describe how instruction with little guidance does not address working or long term memory or how students work together. Kirschner, Sweller, and Smith (2010) share multiple studies that support the belief that work guided by a teachers produces better learning for students. Mayer (2004) stated that the debate around discovery has been measured repeatedly, but the evidence continued to favor learning in a guided approach. Roblyer, Edwards, and Havriluk (1997) stated that teachers believed discovery learning was unsuccessful because students did not have prior knowledge or experiences to connect.

Learning through REAL Projects, described as a specific type of PBL, conducted a randomized control study between twelve intervention schools and twelve control schools. Each group tested had a sample size of roughly 2,000 students. The study occurred between September 2014 and April 2016 (Education Endowment Foundation, 2016). The study aimed to determine the impact of REAL projects on literacy performance, student engagement, and attendance. The study did not find that PBL impacted literacy, engagement, or attendance. However, the study was found to have low validity as several of the participating schools that were measured dropped out during the trial.

A mixed method, quasi experimental study was conducted at Corinne Johnston High School with 10th grade students enrolled in geometry courses. The author did not disclose the location of the high school. This study measured growth scores from a pretest to post test on a summative geometry assessment. The scores compared the growth results of students who had learned in a PBL setting and those that did not. Additionally, the impact on students' creative performance of students who learned in a PBL format was measured. Creativity was measured

on the Torrance Tests of Creative Thinking (TTCT) for those students that participated in geometry PBL activities (Shchetnska, 2020).

Growth in achievement from the pretest to the post test was significant. The average score on the post test grew from a score of 41.21 to an average score of 81.5. Although this number was cited as significant, a second research question compared post test results of students who received PBL instruction and those that did not. There was no significant difference between the two sets of students. The average score of students that received PBL instruction was 81.5 but only one percentage point above the average for traditionally instructed students at 80.5 (Shchetnska, 2020).

Computer Based Assessment

Advantages and disadvantages of computer based assessment. Computer based testing can be used as a way to assess student growth in learning. Due to concerns about an online assessment's accuracy, validity, and quality, districts may wonder about the benefits of a computerized program. Some benefits of a computer based assessment program include personalized, intuitive assessments based on the learner's previous response, immediate feedback, suggested remediation and intervention, use of assistive technology for learners with disabilities, and the lack of limitations for time and space (Burns, 2018).

Gonzalez (2020) studied the advantages and disadvantages of computer based assessment with elementary students. The research referenced studies that compared computer based testing to paper and pencil testing. The researcher surmised that elementary students did equally well on computer-based and paper and pencil assessments. Additionally, students preferred computer based assessments over traditional paper and pencil versions. The only data that showed otherwise was for non English speaking students. This population of students tested better with

paper and pencil assessments than computer based assessments (Gonzalez, 2020). Regardless of the results, there were issues with computer based assessments identified during the study. Concerns with internet connectivity, program glitches, security, and funding hindered computer based assessment as valid forms of data.

Impact of i-Ready Instruction. i-Ready is a computer-based program that combines a diagnostic test and a personalized instruction program and was founded in 1969 (Curriculum Associates, 2021). Designed for students in kindergarten through eighth grade, math and reading standards are measured based on multiple exposures throughout a school year. Curriculum Associates, the proprietor of i-Ready, states that teachers can use the program to plan instruction, set goals, and assess learner progress toward those goals (2021).

i-Ready assessment data of over four million students were examined during the 2016-17 school year to determine the efficacy of i-Ready Instruction. Statistically significant gains were found for students who used reading and math i-Ready Instruction compared to those who did not. These gains were found in subgroups that include students with disabilities, those that speak English as a second language, and those that are economically disadvantaged (District Administration, 2018).

The above evidence recognized i-Ready as a program that meets federal funding requirements for the Every Student Succeeds Act (ESSA). ESSA has four levels of evidence used to determine the amount of rigor in study design. Level 1 is the most rigorous, and Level 4 is the least rigorous in design standards. Although the research above was statistically significant, the rigor only puts i-Ready as a Level 3 study for evidential data (District Administration, 2018). Level 3 is defined as Promising Evidence due to one correlational study. A Level 3 label means that the research cannot say that the program caused learning to happen

but that there may have been a relationship between the program and changes in outcome (Curriculum Associates, 2021).

A review of over ten studies was included in a research summary by Curriculum Associates (2021). All of the studies mentioned occurred in 2018 or after. Of the twelve studies, ten included a large sample size of 350 or more students. All twelve had a positive, statistically significant result for some or all of the grade levels measured. Eleven of the studies were conducted by independent or third-party authors. Ten studies qualified i-Ready as having Level 2 evidence towards ESSA standards, while the other two were Level 3 evidence bases. Seven of the studies included reading data, while nine of the studies included math data. There was an even distribution of K-5 and 6-8 data sets (Curriculum Associates, 2021).

The summary of studies mentioned above included a mix of authors, including Curriculum Associates, the developer of i-Ready. Examining studies not published by the company owning i-Ready was also considered. Two third party research firms, The Human Resources Research Organization (HumRRO) and Century Analytics, examined data from the 2018-19 school year. A quasi experimental design was used to determine the impact of i-Ready on students' reading and math achievement from kindergarten through eighth grade (Curriculum Associates, 2021). The reading research focused on elementary aged students, and the math research focused on middle school students in grades 6-8.

The HumRRO and Century Analytics study involving elementary students was a quasi-experimental design that reviewed students' achievement scores in grades K-5 during the 2018-19 school year. The i-Ready diagnostic test was used to compare the growth of students who had used i-Ready Instruction with students who had not used i-Ready Instruction. Data came from students of all genders and measured students of various languages, disabilities, and economic

statuses. A minimum of 400 students was identified as the required number to reject the null hypothesis that there was no difference in students' achievement on reading assessments between the treatment and comparison groups. The effect size for all grade levels fell between 0.03 to 0.17, which is the suggested range for educational intervention (Kraft, 2019). The effect size for kindergarten exceeded this range at 0.20 (Swain, Randel, & Dvorak, 2020b).

The HumRRO and Century Analytics study involving middle school math students used the i-Ready diagnostic test to compare the achievement of students who used the i-Ready Instruction program with students who did not use the i-Ready Instruction program (Swain, Randel, & Dvorak, 2020a). Students with a similar demographic were used in the comparison study for each grade level. This sampling included gender, language, disability status, and socioeconomic status. A sample size of 400 students was deemed necessary to reach statistical power, but all grades measured exceeded the standard (Swain, Randel, & Dvorak, 2020a). The data reflected that students who had been using i-Ready Instruction performed statistically significantly better on math performance of the diagnosis test than those who did not use i-Ready instruction. The mean difference for statistical significance was a=.05. An effect size range of 0.03-0.17 was identified as typical for an educational intervention (Lipsey et al., 2012). This study showed an effect of 0.31 for grade 6 and 0.33 for grades 7 and 8. All three grades were above the recommended range for interventions.

Self-Efficacy of Students

Background information on self-efficacy. For some time, determining factors that impact student success has been a significant concern of educators (Hayat, Shateri, Amini, & Shokrpour, 2020). Researching the role of self-efficacy on learners has been one factor that generates interest. Self-efficacy is a person's belief regarding performing a task and their

perception of their ability to achieve the goal (Bandura, 1982). Bandura began this work in 1977, and various studies have been conducted around self-efficacy since. However, many of these early studies were not based in educational settings but used the variables of fear, phobia, and anxiety, known as coping behaviors, in the studies (Schunk, 1989). Self-efficacy was measured after participants were involved in desensitization techniques around fearful situations such as exposure to a snake.

Another study inspired by Bandura's work focused on self-efficacy and achievement (Schunk, 1989). Additionally, a study by Brown and Inouye (1978) measured the confidence of the ability of participants to solve anagrams based on the success of a model the participant observed. The perceptions of students of the competency of the model related to their own perceived ability were noted. A connection was reported between self-efficacy and persistence for the participants (Brown & Inouye, 1978). It was found that regardless of the condition in which subjects were observed, those with a higher efficacy persisted longer while exerting effort in solving anagrams. The finding was strengthened as more trials were conducted.

While the above research was completed with male college students, a study by Zimmerman and Ringle (1981) was conducted with children. However, the model in which the children based their self-efficacy judgments was based on an adult mentor rather than a peer model. The adult mentor would provide the language for judgment to the student. One hundred primary Black and Hispanic lower-class students from an urban school were monitored. It was found that the confidence statements of adults significantly affected the children's self-efficacy estimates.

Additional research focusing on behaviors in children was also being conducted at this time, in which studies began to focus on the effort exerted by children. The effort of children

being measured depended on the type of feedback they received from adults (Rosenthal & Zimmerman, 1978). The findings from this research led to the belief that effort can impact perceived self-efficacy and thus result in achievement on the tasks being measured (Schunk, 1989).

“The identified research highlighted self-efficacy for task completion but not to measure student learning or self-efficacy for learning, or the student's beliefs about their capabilities to apply their knowledge to acquire new skills effectively" (Schunk, 1989, p. 5). This type of perception requires the learner to be aware of what they already knew, needed to know, and how they used that information to have new learning experiences. When students had similar successes in the past, they could better assess their ability to follow instructions from the teacher.

“In school, students routinely acquire self-efficacy information in diverse ways" (Schunk, 1989, p. 19). Students can gain efficacy through their accomplishments and see their peers experience success. When students resolve any discrepancies between their poor performance and the successful performance of their peers, they can enhance their self-efficacy for learning (Schunk, 1989). Working in collaborative settings, such as a PBL, could contribute to the growth of student self-efficacy.

The research identified three factors that promote self-efficacy in students (Bandura, 1989; Schunk, 1989). First, the past performance of a student impacted their self-efficacy. Secondly, the teacher's message impacted if a student had a positive or negative perception of achievement. Finally, recognizing the success and failures of others played a part in perceptions of self-efficacy. This study laid the groundwork for future research about self-efficacy.

By 2002 additional strategies were identified or modified as crucial factors in increasing self-efficacy perceptions (Pajares, 2002). Where Bandura (1989) and Schunk (1989) identified past performance as an indicator of self-efficacy, Pajares described how success in those tasks was the most critical factor in growing self-efficacy. Any performance improvement prompted feelings of efficacy in the participants, prompting students to tackle more challenges. Pajares (2002) describes this as a mastery experience and that success raises self-efficacy. Conversely, failure lowers it.

Where Bandura (1989) and Schunk (1989) identified the importance of the language a teacher used on self-efficacy, Pajares (2002) found that peer modeling had a more effective influence. The level of confidence that a teacher had of students, even if a misconception, was hindering to student self-efficacy. However, seeing a peer struggle, persist, and achieve helps boost the self-efficacy of those around them, which is called a coping model (Pajares, 2002). A coping model is more effective than a participant that achieves on the first try or in which learning appears to be easy, which is called a mastery model. If the teacher highlights the strategies the coping model used to be successful, the efficacy for others can increase.

Several studies supported the idea that one's perceived self-efficacy can predict academic performance, even more so than prior performance (Pajares, 2002; Pajares & Johnson, 1996; Pajares & Kranzler, 1995; Pajares & Miller, 1994). Pajares and Miller (1994) found that self concept, prior experience, and perceived usefulness were less likely to directly affect math problem solving ability than a student’s self-efficacy in math. A similar result was found for research regarding self-efficacy and writing performance (Pajares & Johnson, 1996).

Impact of Self-Efficacy Research

Determining if self-efficacy impacts student success outcomes based on different goals has been the focus of another study (Bouffard, Goulet, Denoncourt, & Couture, 2005). This study was designed to determine if a learning or performance goal changes when the conditions for success are based on high or low self-efficacy statements. A group of 140 college students were the volunteer subjects of the study. Subjects were given a learning or performance problem and a high or low self-efficacy condition.

Results of the study indicated that high self-efficacy conditions preceded a more significant number of positive student expectations than those in a low self-efficacy condition. The conditions did not impact gender. The researchers indicated that these results confirmed that the goal and manipulations of self-efficacy were successful. Results also indicated that students assigned to the learning condition shared more self regulatory statements than those in a performance condition (Bouffard et al., 2005).

Bouffard et al. (2005) also measured a student's concern for work time and persistence with manipulated self-efficacy conditions. Students in a high efficacy learning environment were more concerned with monitoring their work time. They persisted longer than those in the low efficacy learning environment, which the author labeled as a condition. Students in a performance approach condition showed little difference in persistence when in a high or low efficacy condition. High efficacy's impact on mental attitude positively impacted learning and performance conditions. Finally, more students stated that they would choose higher difficulty problems with high self-efficacy. The vast number of variables measured and the outcomes of high self-efficacy conditions validate the impact of efficacy on meeting goals, specifically learning goals (Bouffard et al., 2005).

Ahmad and Safaria (2013) conducted a study measuring the effects of self-efficacy on students' academic performance. The study confirmed that self-efficacy does impact achieving a goal, a belief in achievement, and that self-efficacy can impact the complexity of the courses that students take in the future. However, the subject size of 15 students completing mathematical problems warrants a more significant sampling of students and a more varied context to determine if the results were duplicable.

Studies on the impact of self-efficacy have continued to be completed in more recent years. Agoglia (2021) completed a study to analyze the self-efficacy of students when exposed to a curriculum that includes social emotional learning skills compared to those students who have not had this exposure. A little over 1,000 high school juniors were used in the study. The students represent a large urban school district in Florida's Southeast region and have a demographic representative of roughly 80 percent minority. A Likert scale was used on survey questions involving five social emotional learning competencies. The researcher used a modified version of The U.S. Department of Education School Climate Survey as the data collection tool. The researcher concluded that students with a greater self-efficacy due to social emotional learning skills correlate to success in and out of school. Greater self-efficacy translates into more significant potential for success in life and as a community member (Agoglia, 2021).

Summary

Chapter 2 included a definition and background information on project based learning. The impact of PBL learning and opponents of PBL learning were also presented. Research was outlined regarding the advantages and disadvantages of computer-based assessment and, more specifically the impact of the iReady assessment platform. Self-efficacy was also defined, and

the research background and impact of self-efficacy in learning were also of focus in this chapter.

Chapter 3 outlines information about the research methods and design for the current study. The selection of participants and the use of iReady and Panorama as the measurement tools are defined. Data collection procedures, data analysis, and hypothesis testing are presented to determine the effect of PBL instruction on math and reading standardized testing and student perception of self-efficacy. Finally, the limitations of the study are examined to outline the factors that may have impacted the data analysis collection processes.

Chapter 3

Methods

This study was conducted to evaluate student performance on standardized testing in a public school setting in which participants learned in a PBL model of instruction or in a traditional model of instruction. Additionally, students' perceived self-efficacy when learning in a PBL model of instruction was examined. This chapter includes an overview of the research design, selection of participants, and measurements used. This chapter will also include the data collection procedures, data analysis, and limitations of the study.

Research Design

The research was a quantitative study. A quasi-experimental design using archival data was utilized for this study. According to Lunenburg and Irby (2008), this design is appropriate when there is no ability to select the participants randomly. The independent variable for this study was participation status in a PBL model of instruction. The dependent variables were the iReady Mathematics and Reading Assessment Scores and the Panorama Student Survey Self-Efficacy scores.

Selection of Participants

The population for this study included sixth grade middle school students enrolled in School A of District A, which is one of four middle schools in District A. The sample was from the 2021-22 school year. The 2021-22 school year was chosen, as it was the first full year of PBL implementation after the Covid 19 Pandemic which required some schools to shut down and included hybrid models. The previous year, students learned in a hybrid setting only getting face to face instruction two days a week. Students in the 2021-22 school year received face to face instruction five days a week. Quota sampling was used to select participants in the group of

students who received PBL instruction and those that did not. Lunenburg and Irby (2008) describe the need to use quota sampling when it is not possible to include all members of a population. Although all sixth grade data at School A was utilized, a specific set of criteria had to be met for participation in the study. More specifically, only the students, who submitted a valid assessment for the spring iReady Mathematics and Reading Assessments and completed the self-efficacy section of the spring Panorama Student Survey, were included in this study.

The study sample included two groups of participants, and both groups of participants were sixth grade students from School A. The first group consisted of a sample size of approximately 108 students whom received PBL models of instruction; the other group of participants of approximately 130 students were in a traditional class setting that did not utilize a PBL model of instruction.

Measurement

iReady reading scores. Students' iReady Reading scores were measured by the iReady Assessment. The iReady Assessment is an adaptive diagnostic test, published by Curriculum Associates that is utilized by school districts to offer suggestions for teacher instruction and for predicting student performance on state and national tests. For this study, the reading portion of the iReady Assessments was used. The assessment is meant to inform teacher instruction with quantitative feedback and to track individual student growth on content standards over time.

There are four domains in the reading assessment: vocabulary, comprehension, comprehension: literature, and comprehension: informational text. For the reading assessment, students are categorized into one of the placement categories for each of the domain subcategories based on their performance. There are five placement levels that students are given based on the results of their testing. The highest placement category that students can earn

is Mid or Above Grade Level. In descending order, students earn a placement level of Early on Grade Level, One Grade Level Below, Two Grade Levels Below, or the lowest placement category of Three or More Grade Levels Below. "A student's assessment score is not based on the number of items answered correctly. A student's score is determined by making adjustments after each item to determine their proficiently level estimate" (iReady FAQ, 2019, para. 6).

Students receive a variety of prompts including multiple choice, selected response, and drag and drop to assess reading ability in each domain. Students may read passages or look at diagrams and charts to show understanding of the domains. The number of questions given to each student is dependent on the student successfully answering prompts as the program is designed to adjust each domain's difficulty to match student understanding (iReady, 2018). A sample question is as follows: "Which word means the same as abundant? Idle, scarce, heavy, ample" (iReady Diagnostic & Instruction, n.d., p. 8).

Curriculum Associates hired Education Research Institute of America (ERIA) to evaluate the iReady tool and have not yet published research in a peer-reviewed journal (Bjorklund-Young & Borkoski, 2016). The research available on the validity of iReady focuses on construct validity to establish if iReady measures what it purports to measure (Bjorklund-Young & Borkoski, 2016). A benchmark of 0.70, indicating a strong correlation, was used by Curriculum Associates and stated that iReady is strongly correlated with several standardized tests, including the New York State (NYS) test, Smarter Balanced Assessments (SBA), and PARCC. The iReady Assessment and NYS correlation ranges from 0.74 - 0.86 (ERIA, 2016a); correlation between iReady and SBA range from 0.82 – 0.85 (ERIA, 2016c); and correlations between iReady and PARCC range from 0.77 – 0.84 (ERIA, 2016b).

The research was also completed to identify the high accuracy of predictive rates on future standardized tests. iReady was predictive of proficiency at rates above 81% for the NYS, SBA, and PARCC in reading and math (EIRAa; ERIA, 2016a; ERIA, 2016c; ERIA, 2016b).

In 2019, Curriculum Associates collected data across the country to determine a relationship between the iReady Diagnostics test and national and state assessments. A correlation above .70 was identified as being strong and is the standard recognized by the National Center on Intensive Intervention. The correlation coefficient between iReady reading assessment and state assessments in Missouri for English Language Arts is .82 (n = 27,000). This validity test confirmed the iReady reading assessment as a predictor of students' achievement on the Missouri Assessment Program (MAP) test.

Reliability studies were completed by The Center on Response to Intervention at American Institute (2018), and the results suggested that the measurement is reliable. The marginal and test-retest median coefficients for reliability are outlined in Table 1. However, evidence from an external review of the iReady assessments was lacking to further establish validity and reliability.

Table 1

Reliability Statistics from iReady Diagnostic Reading Summary

Type of Reliability	Sample Size	Median Coefficient
Marginal Grade 6	249454	0.97
Test-retest Grade 6	144272	0.86
Marginal Grade 7	224530	0.97
Test-retest Grade 7	126128	0.86
Marginal Grade 8	222503	0.97
Test-retest Grade 8	119647	0.85

Note. Adapted from: *iReady Diagnostic Reading Summary: Reliability*, by National Center on Intensive Intervention, 2018.

iReady math scores. Students' iReady math scores were measured by the iReady Assessment. For this study, the mathematics portion of the iReady Assessments was used. In the mathematics assessment, four domains are measured: numbers and operations, algebra and algebraic thinking, measurement and data, and geometry. For the math assessment, there are five placement levels that students will be given based on the results of their testing. The highest placement category that students can earn is Mid or Above Grade Level. In descending order, students can earn a placement level of Early on Grade Level, One Grade Level Below, Two Grade Levels Below, or the lowest placement category of Three or More Grade Levels Below.

The math assessment is adaptive and can be taken in one or more settings if needed and therefore does not have a set number of question prompts that all students answer. The questions are given to each student to adjust each domain's difficulty to match student understanding (iReady, 2018). "The Diagnostic is designed for students to get about 50% of the questions correct and 50% incorrect to help identify their precise abilities on a range of skills" ("iReady

FAQ," 2019, para.5). A sample question is as follows: "What is the value of the expression shown? 7 x [(7 + 7) – 7]" (iReady Diagnostic & Instruction, n.d., p. 13).

The validity and reliability of the iReady Math assessment is similar to the validity and reliability results of the iReady Reading assessment as outlined in the section above. Regarding predictive validity, the correlation coefficient between iReady Math assessment and state assessments in Missouri for Mathematics is .84 (n = 24,000). The Center on Response to Intervention at American Institute (2018), a group that was hired by Curriculum Associates conducted the reliability studies for iReady assessments, and the results suggested that the Math measurement is reliable. The marginal and test-retest median coefficients for reliability are outlined in Table 2.

Table 2

Reliability Statistics from iReady Diagnostic Math Summary

Type of Reliability	Sample Size	Median Coefficient
Marginal Grade 6	276255	0.96
Test-retest Grade 6	160344	0.87
Marginal Grade 7	254216	0.97
Test-retest Grade 7	141754	0.87
Marginal Grade 8	238758	0.97
Test-retest Grade 8	130054	0.87

Note. Adapted from: *iReady Diagnostic Math Summary: Reliability*, by National Center on Intensive Intervention, 2018.

Self-Efficacy. Students perceived self-efficacy was measured by the Panorama Student Survey. The survey was developed by a group at Harvard Graduate School of Education under the leadership of Dr. Hunter Gehlbach, a methodologist and educational researcher (Feuer, n.d.).

This survey is used to measure students' social-emotional growth over multiple data collection points.

The Panorama Student Survey measures student perceptions in twenty four different subcategories. District A measures five of those areas: self-management, social awareness, emotion regulation, self-efficacy, and growth mindset. This study focused on student perceptions scores in the area of self-efficacy. There were five questions in this subcategory. All five questions ask the participants confidence in their ability to complete, understand, learn, and remember the material taught in class. An example question includes: How confident are you that you can complete all the work that is assigned in your classes? (Panorama Education (n.d.).

Students respond on a Likert scale with the following options: 1) not at all confident, 2) slightly confident, 3) somewhat confident, 4) quite confident, and 5) extremely confident. A score of 5 represents a positive response. Panorama then averages all responses for a question for school wide data. The average represents the percentage of students that respond favorably to each question. That percentage is reported through an online portal for district use. Although school data is averaged and available, individual student responses are available for districts to better identify student need (Panorama Education, n.d.). The mean scores of PBL participants will be calculated in the spring and compared to the mean scores of the non-PBL participants in the spring.

Evidence of validity was developed through Panorama's six-step development process. The design process ensures both content and substantive validity in the survey scale. Specifically, structural validity was identified, showing that each subcategory item belongs in a single construct (Panorama Education, 2020.). Panorama reliability, using Cronbach’s alpha,

measured how consistently students respond to prompts of the same subcategory. The alpha measures the internal consistency of a subcategory, such as self-efficacy. A threshold to meet or exceed a typical sufficiency threshold is .70. The Cronbach's alpha for self-efficacy was .78 (Panorama, 2020). Based on the 2020 update for reliability and validity, Panorama defines its instrumentation as valid.

PBL Participation. All students were given the opportunity to participate in the PBL instructional program, which is called By Design. Students who participated in the PBL program were recorded through a Google Survey. All students in By Design had the same science, social studies, English language arts, math, and physical education teacher which taught with a PBL model of instruction. All students who did not participate in By Design and the PBL model of instruction received a different set of content teachers, as listed above, that did not partner to teach with PBL instruction. The reliability of the measure can be established in the way School A recorded participants through their enrollment in the programs in PowerSchool, District A's student information system, since the same system was used during the time the data were collected. For this study, student participation in PBL instruction will be pulled by enrollment in the English language teacher that taught in a PBL model of instruction. All students in English language class A that meet the quota sampling requirements will represent PBL models of instruction. All students who were not enrolled in English language class A that meet the quota sampling requirements will represent students that did not learn in a PBL model of instruction.

Data Collection Procedures

Before data collection, the Director of Assessment, Evaluation, and Testing from District A gave written consent (see Appendix A) for this study to be conducted on May 6, 2022 with the condition of having the study approved by Baker University's Institutional Review Board (IRB).

The Director of Assessment, Evaluation, and Testing at District A approved the Application to Conduct Research as required by District A. On June 28, 2022, a request for permission to conduct the study was submitted to Baker University IRB committee, which was approved on July 1, 2022 (see Appendix B). Archival test score data and student sample data were collected. The data were collected by the Director of Assessment, Evaluation, and Testing and provided to the researcher in a Microsoft Excel spreadsheet before being imported into IBM SPSS Statistics Faculty Pack 28 for PC for data analysis.

Data Analysis and Hypothesis Testing

This study utilized quantitative, archival data from District A. Independent-samples *t*-tests were chosen to analyze the data. This type of test was used because "one group cannot be subjects in the other. The groups have to be mutually exclusive" (Tanner, 2012, p. 148).

RQ1. Is there a difference in reading iReady scores between students who utilized a PBL model of instruction and students who did not utilize the PBL model?

H1. There is a statistical difference in reading iReady scores between students who utilized a PBL model of instruction and students who did not utilize the PBL model.

An independent-samples *t*-test was conducted for RQ1. The mean of sixth grade reading iReady scores for students taught in a PBL model was compared to the mean of sixth grade reading iReady scores of students not taught under the PBL model. This hypothesis testing was conducted because the hypothesis compares the mean difference between two mutually exclusive groups. The level of significance was set at .05. The effect size, when appropriate, is reported.

RQ2. Is there a difference in math iReady scores between students who utilized a PBL model of instruction and students who did not utilize the PBL model?

***H2*.** There is a statistical difference in math iReady scores between students who utilized a PBL model of instruction and students who did not utilize the PBL model.

An independent-samples *t*-test was conducted for RQ2. The mean of sixth grade math iReady scores for students taught in a PBL model was compared to the mean of sixth grade math iReady scores of students that were not taught under the PBL model. This hypothesis testing was conducted because the hypothesis compares the mean difference between two mutually exclusive groups. The level of significance was set at .05. The effect size, when appropriate, is reported.

RQ3. Is there a difference between students' perceived self-efficacy who utilized a PBL model of instruction and students who did not utilize a PBL model of instruction?

***H3*.** There is a statistical difference in students' perceived self -efficacy between students who utilized a PBL model of instruction and students who did not utilize a PBL model of instruction.

An independent samples *t*-test was conducted to address RQ3. The mean of perceived self-efficacy for sixth grade students taught in a PBL model was compared to the mean of perceived self-efficacy for sixth grade students that were not taught under the PBL model. This hypothesis testing was conducted because the hypothesis compares the mean difference between two mutually exclusive groups. The level of significance was set at .05. The effect size, when appropriate, is reported.

Limitations

Lunenburg and Irby (2008) describe limitations as variables in the study that the researcher cannot control. Stating limitations allows misinterpretations of findings to be avoided. Limitations of this study included:

1. Teachers may have different years of teaching experience, different levels of experience instructing in Project-Based Learning classrooms, and different amounts of participation in professional development.
2. External or individual differences affecting student achievements like motivation, absences, testing environment and technology access, or preparation might exist.
3. Research design is a quasi-experiment method and should not reach a conclusion about causality.
4. Since the current study used archival data, data collection measures and reports are out of the control of the researcher, including the number of participants that were Hispanic, which was identified as zero.

Summary

The design process, including research methods, participants, and data collection methods were explained in this study. Participants in the study were selected based on specific criteria. Chapter 4 includes the results of the study.

Chapter 4

Results

The iReady and Panorama scores of students who utilized PBL instruction and the iReady and Panorama scores of students who did not utilize PBL instruction were compared to examine the difference between the two groups of students. In previous chapters, the background of the study was identified, literature was reviewed, methodology was stated, and the research questions, hypotheses, and hypotheses testing were stated. This chapter includes the descriptive statistics and the results of the hypothesis testing.

Descriptive Statistics

The participants in this study were 6th Grade students at School A in District A during the 2021-2022 school year and there were 238 students in total. Among the 238 students, 109 (45.8%) were male students and 129 (54.2%) were female students. The sample comprised of 209 (87.8%) White students, 9 (3.8%) Black students, 3 (1.3%) Asian students, and 17 (7.1%) students identified with two or more races. In addition, 108 (45.4%) students received PBL instruction and 130 (54.6%) students did not receive PBL instruction.

Hypothesis Testing

The analysis of the hypothesis testing for each research question are discussed in this section. The results of the analysis are described within the section.

RQ1. Is there a difference in reading iReady scores between students who utilized a PBL model of instruction and students who did not utilize the PBL model?

H1. There is a statistical difference in reading iReady scores between students who utilized a PBL model of instruction and students who did not utilize the PBL model.

Outliers were detected and 11 outliers were found. The outliers were excluded from the following analysis. The results of the independent samples *t* test indicated no statistically significant difference between the two means, $t(225) = -1.68$, $p = .095$. The mean reading score for the PBL participant group ($M = 590.91$, $SD = 39.87$, $n = 106$) was not different from the mean reading score for the non PBL participant group ($M = 599.77$, $SD = 39.54$, $n = 121$). The research hypothesis was not supported, as there was not a significant difference between the two groups of students. Reading iReady Assessment scores were not impacted by the participation in the PBL model of instruction.

RQ2. Is there a difference in math iReady scores between students who utilized a PBL model of instruction and students who did not utilize the PBL model?

***H2*.** There is a statistical difference in math iReady scores between students who utilized a PBL model of instruction and students who did not utilize the PBL model.

Outliers were detected and six outliers were found. The outliers were excluded from the following analysis. The results of the independent samples *t* test indicated no statistically significant difference between the two means, $t(229) = -1.37$, $p = .171$. The mean math score for the PBL participant group ($M = 491.63$, $SD = 25.84$, $n = 106$) was not different from the mean math score for the non PBL participant group ($M = 496.71$, $SD = 29.78$, $n = 125$). The research hypothesis was not supported, as there was not a significant difference between the two groups of students. Math iReady Assessment scores were not impacted by the participation in the PBL model instruction.

RQ3. Is there a difference between students' perceived self-efficacy who utilized a PBL model of instruction and students who did not utilize a PBL model of instruction?

***H3*.** There is a statistical difference in students' perceived self -efficacy between students who utilized a PBL model of instruction and students who did not utilize a PBL model of instruction.

Outliers were detected and 18 outliers were found, however the outliers were not excluded from the following analysis due to the survey results were deemed to be valid. The results of the independent samples *t* test indicated no statistically significant difference between the two means, $t(236) = -.49$, $p = .627$. The mean self-efficacy score for the PBL participant group ($M = 3.48$, $SD = 0.78$, $n = 108$) was not different from the mean self-efficacy score for the non PBL participant group ($M = 3.53$, $SD = 0.74$, $n = 130$). The research hypothesis was not supported, as there was not a significant difference between the two groups of students. Panorama self-efficacy scores were not impacted by the participation in the PBL model of instruction.

Summary

Results indicated there was not a significant difference between the Reading iReady scores and Math iReady scores of students who did and did not participate in PBL instruction. Additionally, there was not a difference between the Panorama Self-Efficacy scores of students regardless of participation in PBL instruction. Chapter 5 includes an overview of the study, major findings, findings related to the literature, implications for action, recommendations for future studies, and concluding remarks.

Chapter 5

Interpretation and Recommendations

Finding a way to best support student learning is critical to the future of education. Using innovative practices while also focusing on the social emotional needs of students has been of increased conversation, especially since the beginning of the COVID-19 pandemic. Social emotional learning (SEL) can help students gain the skills they need to be successful in life. COVID-19 raised greater awareness to ensuring that students are emotionally due to the many stresses that the pandemic caused. Looking closely at the impact of innovative structures on student learning can help school districts improve, as well as state and federal policymakers, determine how to best fund student learning. Chapter 5 contains a summary of the study, findings related to the literature, and conclusions.

Study Summary

This section includes a summary of the current study, which aimed to examine the impact of the PBL model of instruction on the achievement scores of students and their perceived self-efficacy. The summary provides an overview of the problem as well as the purpose statement. A review of the methodology used in the study is provided. Finally, the major findings are presented.

Overview of the problem. Project based learning is an instructional strategy that has been used in classrooms for many years. However, research on the impact on student learning has been limited to certain grade levels and subjects, leaving gaps in available data to determine the effectiveness of PBL instruction (Grant & Glazewski, 2016). Additionally, determining factors that prove effectiveness are varied from classrooms tests or end of course assessments (Shchetynska, 2020; Raja & Najmonnisa, 2018; Rivet & Krajcik, 2004), and standardized tests

(Deutscher et al., 2021; Lucas Education Research, 2021; Saavedra et al., 2021; Geier et al., 2008; Boaler, 1999).

Although performance on content information on end of unit tests is one way to measure the impact of an instructional strategy, academic performance is not the only way to measure effectiveness. Proponents of PBL emphasize the skills and habits that are impacted by the use of PBL instruction (Boss, 2014). Measuring self-efficacy of learners is one way to determine the impact of student learning.

District A began training teachers in PBL models of instruction during the 2015-16 school year. School A, a middle school in District A, piloted a PBL program for sixth graders during the 2019-20 school year. This initiative encouraged an increase in PBL programs throughout the district, specifically at the middle level. At the time of the current study, limited literature could be found stating the impact of PBL models of instruction on student performance on math and reading standardized tests or in the area of self-efficacy as reported by students through their own perceptions in middle school settings. A study by Project Tomorrow (2021) shared measures of student self-efficacy but the data was an interpretation of teacher observations of student self-efficacy rather than a self reflection by students the students themselves.

Purpose statement and research questions. The first purpose of this quantitative study was to investigate the impact of learning through PBL instruction on the Reading iReady scores of students compared to students who did not learn through PBL instruction. A second purpose was to determine the impact of learning through the PBL model of instruction on the math iReady scores of students compared to those who did not learn in a PBL model of instruction. A third purpose was to determine the impact of learning in a PBL instructional model on students'

self reported perceptions of their own self-efficacy as measured through the Panorama survey compared to those that did not learn in a PBL model of instruction. To address the purposes of this study, three research questions were proposed and three hypotheses were tested.

Review of the methodology. The research was a quantitative study using a quasi-experimental design of archival data of student performance for the 2021-22 school year at School A in District A. The participants in this study were enrolled in Grade 6 during the 2021-22 school year. The independent variable in this study was the exposure to PBL models of instruction. The dependent variables were the 2021-22 spring Reading and Math iReady scores as well as the 2021-22 spring self-efficacy Panorama scores. An independent sample *t* test was used to analyze the data.

Major findings. Reviewing the data measured regarding the three research questions in the current study revealed the following findings. The results of the data analyses related to all three research questions in the current study revealed that there is no significant difference in the reading or math iReady score of students regardless of their exposure to PBL models of instruction. Additionally, the results displayed that the self-efficacy scores of students, as identified on the Panorama survey, showed no significant difference between students that did have PBL models of instruction when compared to those who were not exposed to PBL models of instruction.

Findings Related to the Literature

The following section contains the findings of the current study related to the findings of previous studies about the impact of PBL models of instruction on student achievement in math and reading and their perceived self-efficacy. There was limited literature found in which studies had been conducted to determine the impact of PBL instruction on standardized reading

scores, standardized math scores, or self reported perceptions of self-efficacy of students in a middle school setting. However, there were examples of similar research related to PBL instruction not related to math and reading. Studies were also conducted at both upper and lower grade levels. Additionally, much of the research measured the impact of PBL instruction on immediate content area tests rather than standardized assessments. Although research exists regarding student self-efficacy, only one research study was found determining PBLs direct impact on self perceptions of self -efficacy.

The literature reviewed in this current study related to PBL models of instruction could be divided into different categories: studies that utilized standardized test scores for analysis, studies that measured immediate content understanding, and studies outside of middle level grades or outside of math and reading achievement. The most common studies focused on the impact of PBL instruction in science classrooms or the impact of PBL instruction at the high school and collegiate level. Research studies that directly connected to the current study were limited, making comparisons between studies more difficult.

Findings from the current study indicate that there is no significant difference in the standardized reading and math test scores of middle schoolers in a PBL model of instruction. The research regarding the impact of PBL instruction on standardized test scores had conflicting results. The majority of the studies reviewed displayed a positive impact on standardized test scores when using PBL instructional practices. For example, national tests were used to measure student achievement in traditional and PBL based classrooms (Boaler, 1999). Boaler reported students learning in a PBL setting had marks three times as high as those learning in a traditional school. Geier et al. (2008) shared similar results of students that learning through PBL based concepts significantly outperformed non participants in the same state standardized test. The

impact of PBL instruction in a middle level science course was conducted over a three year period (Deutscher et al., 2021). Although the research in this study focused on PBL instruction in science classrooms, the authors identified that in addition to gains on science achievement tests, students performed better on both math and English Language Arts standardized tests when they were enrolled in a science PBL based course. The finding of the current study challenge the findings in all of these studies.

A 2017 study of Kentucky middle schoolers analyzed the impacts of PBL instruction on student assessment, in addition to attendance and retention rates (Trimble, 2017). This study more closely aligns to the current study because the ages of the students more closely mirror those in the current study. Additionally, this study also measured impact on standardized assessments. Trimble (2017) shared how data from assessment scores showed neither a positive or negative effect on achievement when in a PBL based school. The current study supports these findings showing that there was no difference between the scores of students that did or did not learning through PBL structures.

Many studies focused on measuring the impact of PBL instruction through content post tests rather than through standardized tests and are being reviewed by the author for the connection to PBL instructional practices. One study of second and fifth graders measured the impact of learning in a PBL science setting (Speziale, Speziale, Letwinsky, & McCook, 2016). Although instruction occurred in a science class, performance skills were measured on math posttests. The authors indicated a deeper understanding of content knowledge was observed in the data for students learning in a PBL setting. Rivet and Krajcik (2004) found that in middle level science classrooms, the curriculum based assessment showed an increase in learning outcomes and ability to apply to new situations when science learning occurred through PBL

instruction. An additional study of the students in Detroit Public Schools identified statistically significant gains on content knowledge and process skills when PBL instruction occurred in a science classroom (Marx et al., 2004). This study included 8,000 middle school students that predominantly represent minority populations. It included a non randomized grouping of schools, students, and teachers. Although the assessment measures are different compared to the current study, the results of the current study suggest a different conclusion from the claims made in these studies.

Several studies focused on the impact of PBL instruction in high school and collegiate settings. Many consistencies occurred in the results of these studies. The studies reviewed showed a positive impact of using PBL instructional practices with secondary and post secondary students. One study for college medical students found that PBL instruction was effective for promoting critical thinking and problem solving (Asad, Iqbal, & Sabir, 2015). Nilson (2010) completed a similar study with similar results. Lucas Education Research (2021) showed that students in a PBL group for Advanced Placement instruction revealed significant score increases compared to students in a control group. Although the ages of the students observed in these studies do not match those of the current study, the author deemed it necessary to review findings. The results of the current study challenge the claims of these studies of students which represent an older population than in the current study.

Research studies to determine the impact of PBL models of instruction on student perceptions of their self-efficacy are extremely limited due to the lack of studies available. Although there are many studies involving self-efficacy, the author only found one study that directly examined the impact of PBL instruction on student perceptions of self-efficacy. Mergendoller, Maxwell, and Bellisimo (2006) conducted a study to determine PBL effectiveness

through a comparative study of PBL instructional methods compared to traditional teaching models. The authors noted an increase in self-efficacy towards problem solving when learning in a PBL setting. This study had both strong validity and reliability. However, the research was conducted in a high school macroeconomics class, not in a middle level setting. This was the only study directly connecting PBL instruction and self-efficacy. The current study suggestions a different conclusion compared to the findings of this study.

Conclusions

School districts must determine the instructional approaches, resources, and professional development that will best support student learning and growth. Because there are many factors that impact student learning, it is difficult to determine which of these factors have impact on measurable student achievement. Measuring achievement can be both formative and summative, but summative, standardized test are often used to determine learning due to the consistency of the test given and the number of participants which can increase the reliability of the assessments. The following subsections include implications for action, recommendations for future research, and concluding remarks.

Implications for action. The current study shows that there is no significant difference between student achievement in reading and math and perceptions of self-efficacy when learning in a PBL setting. These data should not be misunderstood as having a negative impact. District A should understand that based on current information, students learning in either a PBL or traditional environment can get similar experiences when considering which setting provides better performance in academic achievement and self-efficacy. In the past, students and families were given the choice as to whether their child would learn in the PBL classroom. This has created inequities for the number of students learning in either environment. School A placed

students in classes that did not match their preference to ensure equal class sizes. The data from this study could provide reassurance to families that students will have similar academic performance regardless of the environment which is an alternate benefit which was not measured. This is also true of student perception of self-efficacy due to the current study showing no difference in self-efficacy perceptions for students who did or did not learning in a PBL setting.

Recommendations for future research. At the time of this study, a lack of research existed that analyzed the impact of PBL instruction on math and reading standardized testing. The current study attempted to narrow the gap in literature; however, future studies should investigate further the impact of PBL instruction on student achievement to increase test validity and reliability. This could be accomplished by repeating the current study to increase study participants. There was also a lack of research regarding the impact of PBL instruction on student perceptions of self-efficacy. The current study narrowed the gap in the literature. Future studies should address the growth of student learning on standardized test when learning in a PBL models rather than looking at a single measure in time to compare students who did and did not learn in a PBL model as conducted by Shchetynska (2020). Shchetynska (2020) measured growth scores from pretest to post test on a summative geometry assessment. Considering the results of Shchetynska's finding and combining with the standardized scores used in the current study could provide better understanding of the impact of PBL models of instruction. Future studies should also address the limitations of the current study. Specific recommendations for future research include the following:

- Quota sampling was used to select participants in the group of students who received PBL instruction and those that did not. The participants in this study included students in

Grade 6 who were enrolled in one school in one district in Missouri. A stronger impact on learning may be produced using data from more than one grade level, more than one school, or more than one district which participates in PBL models of instruction.

- The current study measured achievement of students who received PBL instruction in sixth grade at School A. These students have the opportunity to continue learning in a PBL model of instruction throughout their three years in middle school. Following students that learn in PBL models of instruction over their entire middle school career allow those students to be compared to those students that do not learn in a PBL model of instruction. The mean growth scores on reading and math as well as self-efficacy could be compared between the two groups.
- The current study used data from iReady Diagnostic Tests as the standardized test to determine the impact on reading and math scores. The Missouri Assessment Program (MAP) is given to all middle school students across the state of Missouri. The MAP test could provide the data for all participants in a statewide study to ensure a consistent, and broader model of measurement.
- The Panorama Survey was used to determine self perception scores of self-efficacy for students in the current study. Four other areas are measured on the Panorama survey. These include grit, growth mindset, self management, and social awareness. To have greater knowledge on student social emotional learning, all five points of measure could be analyzed in future research.

Additional recommendations should be considered by District A, based on the findings of the current study. Because there was not a significant difference on student achievement or in student perceptions of self-efficacy in either a PBL setting or traditional classroom, the district

may have a desire to learn what does have an impact on learning. The author recommends that a deep study of high impact instructional strategies be the focus of professional learning for teachers regardless of the setting in which teachers instruct. Whether students are learning through a project based format or through a highly engaging task that would not be considered project based, student learning could be greatly impacted by the components of high impact strategies.

Concluding remarks. With the myriad of instructional programs, curricula, and structures being targeted and proposed to districts for high impact on student learning, it can be difficult to determine which are worthy of the financial and time commitment by districts. PBL has been one of the structures that has gained popularity over the years, but remains difficult to implement with fidelity. "The lack of a uniform vision complicates efforts to determine whether PBL is being implemented with fidelity and to evaluate its effect" (Condliffe et al., 2017, p. iii). Because the challenges can be vast, districts should determine the cost benefit and tradeoff of investing district funds for such programs. Although the findings in this study do not claim that PBL instruction is impactful, it does not mean that it isn't worthy of the time and investment for learning. However, a top priority that districts should remember when considering any resource or structure is that people always matter more than programs. If District A or any district wants to implement any program well, it must first prioritize people. The beliefs, mindsets, and clarity around anything that is taught can produce bigger gains regardless of the resource or structure teachers are asked to use. It is the belief of the author that prioritizing the needs and ability of people over initiating programs will always produce the gains a district is looking for.

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Appendices

Appendix A: Approval of Research (District A)

[redacted] PUBLIC SCHOOLS
Empowering Excellence

Research Checklist and Approval

Date: May 6, 2022

Submitted to: Christopher B. Hand - Director of Assessment, Evaluation, and Testing

Submitted by: Carrie Gabriel

Research Proposal Title: Reading + Math Achievement in a PBL Classroom: A comparative Quantitative study

Principal Investigator(s): Carrie Gabriel

Checklist

- ☑ Completed "Application to Conduct Research in [redacted] Public Schools"
- ☑ Copy of "Informed consent" letter to study population/parents
- ☑ Copies of measurement instruments
- ☑ Approval from university human subjects committee (IRB) if applicable
- ☑ Three (3) copies of your complete application package

Approval of this research is contingent on adherence to district procedures as outlined in the document entitled "Application to Conduct Research" and the information provided with the application. The district must be notified of any substantive changes to the information contained in the application. The district reserves the right to withdraw approval of research if the research is deemed to no longer be in the best interests of the [redacted] Public Schools students, staff, or the district.

Research Application: ☒ Approved ☐ Denied Date: 5/9/22

Signatures

Director of Assessment, Evaluation, and Testing

X _____
Principal

X _____
Principal

5

[redacted]

Application to Conduct Research in LPS 53

Name	Organization	Department
Carrie Gabriel	Baker University	Doctoral Program

Address	City	State	Zip Code
825 Scott Drive	Liberty	MO	64068

Phone Number	Fax Number	E-mail
816.645.1109		Carriegabriel@stu.bakeru.edu

I have read and understand the process of application to conduct research in Liberty Public Schools. I also verify that the information provided in this application is accurate to the best of my knowledge.

Signature

X Carrie Gabriel

Date May 6, 2022

Is this study part of your work for a degree?

☒ Yes ☐ No

If Yes, complete the following:

☐ Ph.D. ☒ Ed.D. ☐ M.A./M.S

☐ Undergraduate ☐ Other

University or College Baker University

Date of IRB Approval (or date of application if pending) May 6, 2022

Advisor's Name Dr. James Rotramel

Advisor's Telephone Number 816.604.8045

Attach a concise, yet thorough, response to each of the following items.

1. **Title and purpose of study**
   See IRB Attached (SIRBA)
2. **Timeline**
   (SIRBA)
3. **Benefits to the district**
   (SIRBA)
4. **Research Design Summary**
   (SIRBA)
5. **Assurance of anonymity of Liberty Public Schools students & staff**
   (SIRBA)
6. **Risks of the research**
   (SIRBA)
7. **District involvement**
   (SIRBA)
8. **Funding Sources**
   (SIRBA)
9. **IRB approval**
   See IRB attached

CH

[redacted]

[redacted] PUBLIC SCHOOLS
Empowering Excellence

Application to Conduct Research

Research includes all studies of educational programs in which pupils, teachers, principals, records, buildings, equipment, and other school facilities are used for the purpose of securing new information about educational and related programs.

Employees of the [redacted] Public Schools who wish to conduct research as part of their normal job responsibilities (such as action research) are not required to obtain formal approval from the Director of Assessment, Evaluation, and Testing. Nevertheless, such research must have the approval of the building principal.

Other persons wishing to conduct research in [redacted] Public Schools, including employees conducting research that extends beyond their normal job responsibilities, must make their request in writing. Research may not be initiated within the district without formal written approval from the Director of Assessment, Evaluation, and Testing. The research must provide direct benefit to [redacted] Public Schools District that outweighs potential risks and be approved by the principals and teachers of any classrooms to be involved.

Timeline for Application Process

The request will be reviewed and a written response will be sent to the principal investigator typically within 2-6 weeks, depending on the scope of the request. All applications to conduct research or to request data must be submitted prior to the [redacted] Public School's spring break to be considered for the current academic year. The review process will resume in August prior to the opening of school the following academic year.

Administrative Charge

Charges may be incurred if approved projects require additional district personnel time to provide data (e.g., merging test score files, extracting student demographics, etc.). These data-management tasks will be charged at a rate of $50.00 per hour. Applicants will need to arrange payments before data will be released.

Other Conditions

- Persons conducting research in [redacted] Public Schools must comply with Family Educational Rights and Privacy Act and guarantee the anonymity of individual children, schools, and school personnel in reporting the results, unless written approval is obtained from the parents of participating children, from the school principal, or the school personnel involved. All copies of written approvals from said parties must be copied and sent to the Director of Assessment, Evaluation, and Testing for district record keeping purposes.
- Final approval of any study will not be made until all measurement instruments have been reviewed and approved.

[redacted]

- Publications emanating from studies in the schools should acknowledge the contribution of [redacted] Public Schools unless requests to the contrary are made, or unless the identification of the system would jeopardize future research efforts or school programs.

- If applicable, approval will be contingent upon Institutional Review Board (IRB) approval. [redacted] Public Schools is aware that the IRB may require district approval prior to granting their IRB approval. The review committee will issue a letter stating that the letter can be used as verification of your project's approval contingent upon receipt of the IRB approval letter. A current copy of the IRB approval letter must be on file for the duration of the study.

- Upon completion of the study, a copy of the final report must be sent to the Director of Assessment, Evaluation, and Testing and relevant school principal(s). If your project spans one year or less, only the final report will be required.

- For projects lasting more than one year, at the end of each project year, a progress summary report is required. Please submit all progress reports to the Director of Assessment, Evaluation, and Testing.

Failure to comply with the above stipulations places the researcher at risk for continuing to conduct research within the Liberty Public Schools or approval of future projects.

An application to conduct research in the Liberty Public Schools may be obtained from:

Mr. Christopher B. Hand
Director of Assessment, Evaluation, and Testing
[redacted]
Phone: (816) 736-5320
Email: christopher.hand@lps53.org
https://www.lps53.org/Page/3443

[redacted]

[redacted] PUBLIC SCHOOLS
Empowering Excellence

Research Approval Process

The Director of Assessment, Evaluation, and Testing is the district designee for approving all proposed research studies, surveys, and internal evaluations within [redacted] Public Schools. The district welcomes the opportunity to collaborate, conduct, and implement ongoing research that will benefit the lives of our students, staff, and community. However, as a district it is also important to ensure that our employees and students are not subjected to ancillary requests that do not have a direct or lasting benefit to [redacted] Public Schools.

The Liberty Public Schools will review each application to conduct research and consider:

1) the rights and welfare of the students and employees involved
2) the appropriateness of the methods used to secure informed consent
3) the balance of risks and potential benefits of the investigation

Research is the systematic and objective analysis and recording of controlled observations that may lead to the development of generalizations, principles, or theories resulting in prediction and possibly control of events. Elements of quality research include:

- Reliable observation procedures
- A hypothesis that gives focus to the investigation
- Use of sampling methodology (a deliberate selection of participants or observations)
- Measurement procedures that are operationally defined

The review process may occur at two levels, depending on the scope of the project and degree of risk involved. An initial screening is completed by the Director of Assessment, Evaluation, and Testing to determine scope and whether there is potential for low, moderate, or high risk to students, staff, or the district. A district-wide review board selected by the Director of Assessment, Evaluation, and Testing may review selected research proposals. Criteria used to determine scope and risk are listed below:

- The number of staff, schools, and departments involved
- The level of public exposure to the research findings
- The potential for negative impact on students, staff, or the district
- The time and labor required of the district and its staff and/or students
- Alignment of the research with the district's mission

These criteria are only examples and are not intended to be an exhaustive list of issues related to determining the level of risk. Additional criteria may be used to evaluate the need for review by a review board. The district-wide review board will meet as needed to review and discuss selected projects. Meetings will be held to discuss the merits of the study, benefits to the district, and design and methodological concerns. The Director of Assessment, Evaluation, and Testing will handle all responses to the research proposals.

If the research request is not referred to a district-wide review board, the Director of Assessment, Evaluation and Testing will handle, who will make the recommendation for approval or

[redacted]

disapproval. The estimated response time for proposals requiring review by a review board is 4 – 6 weeks. The estimated response time for proposals not requiring review by a review board is 2 – 4 weeks.

Send the application with all required information to:

Mr. Christopher B. Hand
Director of Assessment, Evaluation, and Testing
[redacted]
Phone: (816) 736-5320
Email: christopher.hand@lps53.org

Ms. Lisa Johnston
Administrative Assistant - Department of Academic Services
[redacted]
Phone: (816) 736-5320
Email: lisa.johnston@lps53.org

BAKER UNIVERSITY

IRB Request

Date May 6, 2022

IRB Protocol Number _____ (IRB use only)

I. Research Investigator(s) (students must list faculty sponsor)

Department(s) Graduate School of Ed.

	Name	Signature	
1.	Carrie Gabriel	Carrie Gabriel	Principal Investigator
2.	Dr. Jim Robins	Jim Robins	☑ Check if faculty sponsor
3.	Dr. Li Chen-Bouck	Li Chen-Bouck	☐ Check if faculty sponsor
4.			☐ Check if faculty sponsor

Principal investigator contact information

Phone (816)645-1109

Email CarrieRGabriel@stu.baker

Address 825 Scott Drive, Liberty, MO 64068

Note: When submitting your finalized, signed form to the IRB, please ensure that you cc all investigators and faculty sponsors using their official Baker University (or respective organization's) email addresses.

Faculty sponsor contact information

Phone (816)604-8045

Email jrobins@bakeru.edu

Expected Category of Review: ☑ Exempt ☐ Expedited ☐ Full ☐ Renewal

II. Protocol Title

Reading and Math Achievenment in a Project Based Learning Classroom: A Comparative Quantitative Study

III. Summary:

The following questions must be answered. Be specific about exactly what participants will experience and about the protections that have been included to safeguard participants from harm.

A. In a sentence or two, please describe the background and purpose of the research.

This study is aimed to examine the impact of the PBL model of instruction on the achievement scores of students and their perceived self-efficacy. Specifically, the study investigated the difference between the reading and math iReady assessment scores of students that did and did not utilize a PBL model of instruction. Additionally, the study will investigate the difference between the perceived self-efficacy of students who utilized a PBL model of instruction and those that did not utilize a PBL model of instruction.

B. Briefly describe each condition, manipulation, or archival data set to be included within the study.

There are no conditions or manipulation in this study as archival data will be used.

IV. Protocol Details

A. What measures or observations will be taken in the study? If any questionnaire or other instruments are used, provide a brief description and attach a copy.

Math and reading iReady and Panorama archival data will be used. There are no questionnaires in this study.

B. Will the subjects encounter the risk of psychological, social, physical, or legal risk? If so, please describe the nature of the risk and any measures designed to mitigate that risk.

There are no psychological, social, physical, or legal risk to the participants of this study.

C. Will any stress to subjects be involved? If so, please describe.

There will not be any stress placed on subjects as a result of the study as archival data will be used.

D. Will the subjects be deceived or misled in any way? If so, include an outline or script of the debriefing.

The participants in this study will not be decieved or misled in any way.

E. Will there be a request for information which subjects might consider to be personal or sensitive? If so, please include a description.

The are no participants in this study, only archival data. Student names will not be available, but student data will be collected via their district student identification number issued by PowerSchool, a Student Information System (SIS).

F. Will the subjects be presented with materials which might be considered to be offensive, threatening, or degrading? If so, please describe.

Participants will not be exposed to offensive, threatening, or degrading material.

G. Approximately how much time will be demanded of each subject?

There is no time demanded of each subject as the information is archival data.

H. Who will be the subjects in this study? How will they be solicited or contacted? Provide an outline or script of the information which will be provided to subjects prior to their volunteering to participate. Include a copy of any written solicitation as well as an outline of any oral solicitation.

Participants in this study will not be contacted as archval data is being used.

I. What steps will be taken to insure that each subject's participation is voluntary? What if any inducements will be offered to the subjects for their participation?

There is no issue of voluntary participation as the information is archival data.

J. How will you insure that the subjects give their consent prior to participating? Will a written consent form be used? If so, include the form. If not, explain why not.

A consent form is not necessary as the information is archival data.

K. Will any aspect of the data be made a part of any permanent record that can be identified with the subject? If so, please explain the necessity.

No permanent record will be kept to identify any subject.

L. Will the fact that a subject did or did not participate in a specific experiment or study be made part of any permanent record available to a supervisor, teacher, or employer? If so, explain.

No, there will not be a permanent record of subject participation.

M. What steps will be taken to insure the confidentiality of the data? Where will it be stored? How long will it be stored? What will be done with the data after the study is completed?

Student names will be substituted with numbers. Information will be secured on a password protected computer. The data will be in a Microsoft Excel file and will be password encyrpted. After the study is completed, the raw data will be stored on a password protected computer and then deleted five years after the completion of the study.

N. If there are any risks involved in the study, are there any offsetting benefits that might accrue to either the subjects or society?

There are no risks involved in this study.

O. Will any data from files or archival data be used? If so, please describe.

Math and reading iReady data from the 2020-21 and 2021-22 school year from sixth graders at School A of District A will be used from archival data. Additionally, self-efficacy Panorama data from the 2020-21 and 2021-22 school year from the same set of students will be used.

Appendix B: Approval of Research (Baker University)

BAKER UNIVERSITY
Own Confidence

Baker University Institutional Review Board

August 26th, 2022

Dear Carrie Gabriel and Jim Robins,

The Baker University IRB has reviewed your project application and approved this project under Expedited Status Review. As described, the project complies with all the requirements and policies established by the University for protection of human subjects in research. Unless renewed, approval lapses one year after approval date.

Please be aware of the following:

1. Any significant change in the research protocol as described should be reviewed by this Committee prior to altering the project.
2. Notify the IRB about any new investigators not named in original application.
3. When signed consent documents are required, the primary investigator must retain the signed consent documents of the research activity.
4. If this is a funded project, keep a copy of this approval letter with your proposal/grant file.
5. If the results of the research are used to prepare papers for publication or oral presentation at professional conferences, manuscripts or abstracts are requested for IRB as part of the project record.
6. If this project is not completed within a year, you must renew IRB approval.

If you have any questions, please contact me at npoell@bakeru.edu or 785.594.4582.

Sincerely,

Nathan D. Poell

Nathan Poell, MLS
Chair, Baker University IRB

Baker University IRB Committee
Tim Buzzell, PhD
Nick Harris, MS
Scott Kimball, PhD
Susan Rogers, PhD