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Using Project-based Learning as a Tool for Teaching Mathematics in Urban Elementary Schools

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USING PROJECT-BASED LEARNING AS A TOOL FOR TEACHING MATHEMATICS IN URBAN ELEMENTARY SCHOOLS

by

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ABSTRACT

The purpose of this study was to investigate how the lived experiences and views of fourth- and fifth-grade math teachers who implemented project-based learning (PBL) addressed the needs of their at-risk students in urban schools. The researcher examined the use of PBL in mathematics-impacted instruction, seeking to understand teacher beliefs related to the influence of exposure to PBL experiences on students' academic outcomes. When deliberately planned and embedded into teaching, the implementation of PBL helps students retain content, improve attitudes about learning, and improve their ability to collaborate with others (Cervantes et al., 2015).

A literature review was conducted to explore PBL and its relationship with constructivism, growth mindset, and cooperative learning and the degree to which these teaching methods affect student learning. A growth mindset enables students to consider inquiry, exploration, and student collaboration (Larmer et al., 2015). Also present in PBL are cooperative learning activities, which Slavin (2015) found encouraged students to work together on projects that required the inclusion and student application of content standards.

Qualitative research methodology using the phenomenological method was implemented in this study. The study investigated the lived experiences of fourth and fifth-grade math teachers who implemented PBL in urban schools. The researcher interviewed teachers who have participated in project-based learning with their students. Results and discussion are included for the research question as well as implications of the findings, recommendations, and suggestions for future research.

Keywords- project-based learning, mathematics, urban schools, at-risk

I dedicate this dissertation to my mother, Carol, and my sister Rebecca who have been and will always be my number one encouragers and cheerleaders. Thank you, Mom, for always reminding me that I could do whatever I set my mind to do. The world was my oyster, and the sky was the limit. Thank you to Rebecca for always being there for me, supporting my efforts, and for being my role model for what achievement and hard work look like.

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CHAPTER 1: INTRODUCTION

Statement of the Problem

One of the many challenges that educators face is that of how to engage and prepare students with the skills necessary for success in the 21st century while also being inclusive of students of all genders, races, and abilities. The days of education being a one-size-fits-all proposition have long faded. The U.S. Department of Education, with the passage of the Individuals with Disabilities Education Improvement Act (2004), Free Appropriate Public Education (2010) regulation as outlined under Section 504 (34 C.F.R. Part 104), delineated this as an education deliberately planned to meet the specific needs of students with disabilities as effectively as the essentials needs of nondisabled students. Students come to school with a variety of experiences, levels of ability, and challenges that the educator must address adequately through strategies and practices that improve student achievement (Rubenstein, 2018).

The difficulties in implementing effective instruction for at-risk students arise from a multifaceted set of circumstances. Two main challenges are the lack of knowledge and skill on the part of many teachers and the lack of instructional resources in our schools (Fielding et al., 2007; Torgesen, et al., 2010). Added to those challenges are at-risk students. Achievement gaps among subgroups of students, including at-risk students, occur at the student level, grade level, and school-wide level, where subgroups include racial and ethnic minorities, English-language learners, students with disabilities, and students of low socioeconomic status (Fielding et al., 2007; Torgesen et al., 2010). Achievement gaps are due to low expectations for student achievement, lack of rigor in the curriculum, tracking of students based on expected achievement

potential, and lack of instructional techniques that appropriately engage students in learning (Peterson et al., 2016; Fielding et al., 2007).

To address achievement gaps, educators need an understanding of what causes this phenomenon. With that knowledge, educators must learn how to provide a learning environment that best meets the needs of all students (Jackson, 2009). One issue in any learning environment is lack of motivation. When students are inquisitive, education is not a chore. The motivation that originates from external sources such as tangible reinforcers tends to be poorly organized, unrewarding, and fleeting (Ostroff, 2016). Drive that emanates internally from sincere interest and curiosity is more likely to inspire students to do more than expected (Ostroff, 2016). Slavin (2018) suggests that balance is necessary between instruction, instructional time available, and engagement. The amount of time available for learning depends mainly on the time allocated to teaching and the amount of time that students are engaged and interested in the lesson (Slavin, 2018). Students given a clear sense of purpose and direction, coupled with a well-prepared lesson by the teacher, are provided the time needed to get instruction covered (Slavin, 2018).

Since the implementation of the No Child Left Behind Act (2002), reauthorized as the Every Student Succeeds Act (2015), attention has been focused on the lack of academic success for subgroups across the nation that are not making appropriate achievement gains. Schools may meet state criteria for most of their students, but for the more fragile learner, they fail. The causes are complex and often a school-wide concern. Griner and Stewart (2012) suggested that research in education struggles to provide teachers with the strategies and tools necessary to close the gap between policy, theory, and practice. Teachers need prescribed professional development,

practice, and feedback in strategies and tools to meet the needs of students through instruction that can help close achievement gaps (Griner & Stewart, 2012).

Meeting the needs of all students requires a varied approach, one that incorporates appropriate activities, content, assessment, and an environment that supports students by meeting the needs that help them prosper (Thousand et al., 2015). U.S. students must be educated to a level where they can be competitive globally (Becker & Luthar, 2002; Urdan & Bruchmann, 2018). Students also must be prepared to live as learners in the 21st century (Becker & Luthar, 2002; Urdan & Bruchmann, 2018).

Meeting the academic needs of students plays as much a part in the instructional process as does ensuring engagement in the instruction (Slavin, 1991, 2014a). Student engagement in the broad educational experience is linked to academic success and graduation rates. Rumberger (2011) reported that low educational and job-related ambitions, poor academic achievement, absenteeism, transient and low socioeconomic status make up the bulk of the list of reasons why a student might not graduate. Dropping out of school is often a progression rather than a sudden event; students show a pattern of early school failure that includes a lack of academic achievement and engagement (Rumberger, 2011). The lack of mathematical knowledge is an area where students caught in the achievement gap often fail.

Mathematics plays a crucial role in a student's future success and is a vital prerequisite for college-bound students and those who look to pursue employment in a field requiring mathematics; equitable access to mathematics for all students is critical (Boaler, 2016). When working with students who are at risk for academic failure, particularly mathematics, Boaler (2016) suggested that teachers could change the way they present mathematics to students. When

teachers provide learning environments that include problem-solving, critical thinking, cooperation, and creativity, they are providing students with settings open to inquiry and investigation, which are required to meet the rigors of developing 21st-century skills (Anagun, 2018). Problem-based learning activities endorse a deep level of understanding of subject matter that is meaningful to the learner and, using collaborative learning, has shown success for students in the "gap." (Cervantes et al., 2015). As the global economy changes and the use of technology changes over time, education systems must change as well (Hallermann et al., 2011). In his speech on education in 2006, then-Senator Barack Obama observed to his audience about students in United States schools, "Today we are failing too many of our children. We're sending them out into a 21st-century economy by sending them through the doors of 20th-century schools" (Obama, 2006, p. 2).

Standards and their evaluation often leave little time for schools to change instructional practices or measure the use of these standardized practices. Student engagement can be a predictor of achievement and school success (Fredricks et al., 2011). When students are engaged in school, they are less likely to drop out (Torgesen et al., 2009; Fielding et al., 2007).

Educational research looks for ways to make learning more impactful and meaningful for all students. One method that provides students with 21st-century learning experiences is Project-based Learning (PBL) (Hallermann et al., 2011; Larmer et al., 2015). PBL is an inquiry-based approach that provides student-centered learning with conditions and complexities that fully engage students (Anagun, 2018). Through PBL, students at all levels of ability can engage in cross-curricular higher-order thinking, application of standards, more in-depth learning, and development of the soft skills that help to prepare students for college and careers (Hallermann et

al., 2011; Larmer et al., 2015). A well-structured and organized project brings together, through the use of PBL, the components of learning in a way that students find relatable and engaging (Larmer et al., 2015).

With the worldwide economy and high-tech innovations continuing to transform today's world, the present organization of schooling and instruction can often resemble 19th-century practices (Hallerman et al., 2011). Modern mathematics instruction must involve students and provide them with the opportunity to engage in problems without fixed or correct responses. Instruction and lessons that allow students to practice with analysis involving commercial, societal, technical, and scientific progressions that contribute to the resolution of present-day dilemmas provide practice with 21st-century skills (Warner & Kaur, 2017).

PBL provides an occasion for students to learn more deeply than through conventional teaching approaches in preparation for the construction of 21st-century competencies and skills (Hallermann et al., 2011; Larmer et al., 2015). Industries of the 21st century look to hire candidates with both practical and soft skills, oral and written communication skills, resourcefulness, problem-solving, ability to collaborate within a team, and leadership skills (Vogler et al., 2018).

PBL is rooted in the constructivist framework combining the cognitive constructivism theory of Jean Piaget and the social constructivism theory of Lev Vygotsky (Liu, & Chen, 2010; Savery & Duffy 1995). Piaget (1964) summarized three main themes of his cognitive constructivist theory: (a) knowledge is not directly constructed, (b) new knowledge is shaped by adjusting standing views, and (c) assimilation occurs when new knowledge is used. Vygotsky shared that social knowledge emanates before social development and delivers the aptitude to

interrelate with others while guided through instruction (Vygotsky & Kozulin, 1986). Students reveal understanding when they can demonstrate a level of knowledge in different situations; they signify they can appraise complications, synthesize resolutions, and apply and appraise outcomes (Wiggins & McTighe, 2005).

To help address the 21st-century rigor of PBL, students must be comfortable with demonstrating a growth mindset (Larmer et al., 2015). Successful PBL implementation requires a culture of a growth mindset (Larmer et al., 2015). Students who are confident that they can advance intellectually reveal the ability to face challenging content (Yeager & Dweck, 2012). PBL requires instructional structures that endorse inquiry, creativity, and the ability to grapple with an understanding of content (Cooper & Murphy, 2016). Successful PBL implementation requires a classroom culture of inquiry and risk-taking (Cooper & Murphy, 2016).

Cooperative learning and collaboration provide a catalyst for successful learning with PBL. Engagement in PBL requires students to work in groups to share personal knowledge, research a topic, and solve the problem presented (Bell, 2010). Participation in group work with a common goal helps motivate students to learn and helps better prepare them to elaborate on the content (Slavin, 2015). Cooperative learning results in students being able to clarify information and share it in a way that other students can understand, and it helps ensure that all group members contribute (Slavin, 2014b).

Many factors drive student motivation; examples include external rewards, school incentives, and student personal goals and interests (Lin-Siegler et al., 2016). A host of programs, interventions, and instructional strategies compete for the time and effort of teachers and students. Deciding which instructional strategies will be useful and meaningful to students

can be daunting. Ensuring that students are engaged in learning through the exploration of a complex problem or question over time and then producing a public product is a complex undertaking for the educator (Hallermann et al., 2011). Dedicating instructional time to PBL, which can take hours of the school day and weeks to complete, requires careful planning on the teacher's part and a high level of participation on the students' part for it to prove useful (Boss & Larmer, 2018; Larmer et al., 2015; Savery, 2006).

The degree to which teachers perceive PBL as a worthwhile instructional approach and a way to help students retain information must be researched as a way to expose all students to 21st-century skills (Strobel & van Barneveld, 2009). While teachers have found value in implementing PBL in their classrooms, they face the challenges of how to meet district and state curriculum mandates and standardized testing requirements through the process, challenges that can limit the time available for PBL. Engaging in activities that abandon traditional teacher-led school instructional structures are challenging to implement (Cervantes et al., 2015). Instruction based on PBL requires that the teacher have the confidence to let students engage independently in learning, becoming a facilitator in the process (Hallermann et al., 2011; Larmer et al., 2015). Within this instructional method, students work to question and respond to authentic tasks that are relevant to their lives while engaging in a process that includes a focus on standards-based content, student voice and choice, reflection, critique, and revision (Hallermann et al., 2011; Larmer et al., 2015). However, Hallermann et al. (2011) stated that, when implemented ineffectively, PBL can lead to wasted time for students and educators.

Purpose of the Study

This study's purpose was to investigate the lived experiences of fourth- and fifth-grade mathematics teachers who are implementing PBL.

Research Question

The following research question guided this study:

What are the lived experiences of fourth- and fifth-grade teachers in urban schools who use project-based learning during mathematics instruction?

Research Design

This study explored the lived experiences of fourth and fifth-grade teachers that have used PBL during mathematics lessons in urban elementary schools through a qualitative research design using the phenomenological research approach (Ary, Jacobs, Sorenson & Walker, 2018). Phenomenology is devoted to accounts of practices rather than explanations or analyses with explanations that recall, as closely as possible, the original quality of effects, their remarkable assets, and factual properties (Moustakas, 1994). The goal of phenomenological research is to define experiences from the participants' standpoint (Slavin, 2007). The phenomenological approach to research interprets the meaning of the experiences of a group of individuals involved in a similar experience (Ary et al., 2018; Slavin, 2007).

This research study sought the meaning fourth and fifth-grade teachers attached to the experience of using PBL during mathematics instruction in an urban school setting. The subjects for this study were from an urban school district. This district has 131 schools in which students in grades four and five are instructed. Teachers from 16 of these schools received professional

development in the use of PBL and were asked to participate in a demographic survey. Survey results determined which candidates met the criteria for participating in the study and were eligible for semi-structured interviews. To be considered for the study, teachers had to be certified to teach elementary grades by the Florida Department of Education, attended training on PBL at the district or school level, and use PBL instruction with their students that included mathematics standards. The study sample included eight fourth- and fifth-grade teachers. The research methodology included conducting semi-structured interviews until saturation was reached, whereby no new information was forthcoming.

A Delphi panel consisting of individuals who were knowledgeable in PBL, elementary school education, and the development of qualitative interview questions convened to review qualitative questions developed by the researcher. The group engaged in two rounds of question review, which helped the researcher formulate questions that were both valid and reliable (Iqbal & Pippon-Young, 2009). These probing questions formed to guide the researcher in gaining a deeper understanding of the ideas, themes, and theories found in the responses subjects provided (Moustakas, 1994; Plano Clark & Creswell, 2015; Slavin, 2007).

A proposal for research was submitted to the researcher's dissertation committee for feedback and approval. During the defense, committee members made suggestions about the qualitative questions and the demographic survey. A request for authorization to conduct the study was submitted to the University of Central Florida Institutional Review Board. Upon receipt of approval of the University, the school district's Research and Evaluation department were contacted, and a request to the school district to conduct the research was made. Upon approval from the school district, the study commenced. Because of the COVID-19 pandemic in

the Spring of 2020, both the University of Central Florida Institutional Review Board and school district removed from the study request the ability for in-person one-on-one interviews. This was done out of an abundance of caution for the health and welfare of the research participants and the researcher. The study was permitted to continue contingent on changing in-person interviews to interviews via a digital meeting platform. Interviews conducted were conducted via an online digital platform.

Definitions of Terms

For this study, the following terms are defined:

Authenticity – Making learning meaningful for students (Larmer et al., 2015).

21st Century Skills – A set of skills addressing content-area knowledge, learning skills, information, media, technology, life, and career skills (Larmer et al., 2015).

At-risk students – Students with achievement gaps of 1 to 3 years; students facing obstacles such as transient socioeconomic status, disability, lack of schooling, lack of school attendance, or other extenuating circumstances which may prevent students from grade-level achievement (Fielding et al., 2007).

Constructivist Theories of Learning – A theory based on building learning by doing. Students develop understanding through reflection, personal experiences, and new knowledge (Slavin, 2018).

Engagement – The level of student involvement in learning. Purposeful interaction with complex tasks in which the students demonstrate comprehension of the material (Boss & Larmer, 2018; Larmer et al., 2015; McDowell, 2017).

Gold Standard PBL – A research-informed model for measuring, calibrating, and improving the practice of project-based learning implementation. (Larmer et al., 2015).

Growth mindset – The belief that essential abilities are developed through dedication, hard work, and a willingness to continue to attempt a task (Dweck, 2006).

High performing students- Students who perform above grade level (Cervantes, Hemmer, and Kouzekanani, 2015).

Student collaboration – Illustrated when groups of students work together to search for understanding or for solutions to create an artifact or product of their learning (Slavin, 2015).

Piaget's Theory of Cognitive Development-Child development depends on children's interaction with their environment (Slavin, 2018).

Problem-based learning – Used in the medical profession to presents real-world problems to interns in a collaborative setting. (Savery & Duffy, 1995).

Project-based learning (PBL) **–** An instructional method that actively engages students in the learning process through the application of 21st-century skills. Students research information to develop solutions to problems that exist in the school, community, and world (Boss & Larmer, 2018; Larmer et al., 2015; McDowell, 2017).

Public product – Making the final product of the project available for others to see (Larmer et al., 2015).

Reflection- Review of the process used to complete the project and the learning experience. Examination of how a problem was solved and consideration of ways to improve the process (Boss & Larmer, 2018; Larmer et al., 2015; McDowell, 2017).

Social and emotional learning- is the process in which humans go through to acquire the necessary skills to understand and manage emotions (Becker and Luthar, 2002; Jones, et al., 2017;).

Student voice and choice – Students' ability to make decisions about the course of the project as it progresses (Boss & Larmer, 2018; Larmer et al., 2015).

Sustained inquiry – The work of the project. Identifying the investigation, conducting research, completing tasks, and planning the public product (Boss & Larmer, 2018; Larmer et al., 2015; McDowell, 2017).

Traditional teaching methods – Instructor-driven, lecture-based delivery of curriculum that addresses subject areas in isolation. (McParland et al., 2004; Strobel & van Barneveld, 2009).

Urban schools – Schools that are within densely populated urban centers, serving ethnically diverse students, students from lower socioeconomic backgrounds, and students with high rates of mobility (U.S. Department of Education Office of Educational Research and Improvement: National Center for Education Statistics, 1996).

Vygotsky's social development theory – Intellectual development can be understood in terms of a child's experiences and depends on what the child has been exposed to throughout development (Vygotskii & Kozulin, 1986).

Limitations

Researcher bias was a potential limitation because the research was conducted in the school district in which the researcher was employed. This study has transferability in that

teachers with similar training and exposure to project-based learning could provide similar responses to the questions posed about their experiences with the phenomenon.

Summary

This study explored the lived experiences of fourth and fifth-grade teachers who used PBL with at-risk students in an urban setting during mathematics lessons. The researcher interviewed teachers with exposure to PBL experiences to determine their beliefs regarding whether or not PBL influenced their students' knowledge and skill in mathematics. The researcher questioned teachers to reveal if, when deliberately planned, the use of PBL helped students retain content, improve attitudes about learning, and develop the ability to collaborate with others (Hendry et al., 1999; Strobel & van Barneveld, 2009). The study also explored whether PBL not only provided students with exposure to 21st-century skills but also allowed students to engage in practice with content-area knowledge (Larmer et al., 2015; Savery, 2006; Savery & Duffy, 1995).

CHAPTER 2: LITERATURE REVIEW

Introduction

The purpose of this literature review is to examine research on project-based learning (PBL). “Project-based learning can be described as student-centered instruction that occurs over an extended time period, during which students select, plan, investigate and produce a product, presentation or performance that answers a real-world question or responds to an authentic challenge” (Holm, 2011, p. 1). Boaler (2016) notes that many students either like mathematics or find it daunting. Mathematics is different from other content areas because it is taught in ways not used in other subjects; instructors often hold beliefs about mathematics instruction that differ from beliefs instructors hold for other content areas (Boaler, 2016). The basis of this review will examine the constructs of PBL through its relationship with instruction of 21st-century mathematical skills, the theory of constructivism, growth mindset, cooperative learning, and PBL strategies that impact mathematics achievement of at-risk students in urban schools.

Project-based learning requires that students consider inquiry, exploration, and collaboration, which challenge them to demonstrate the characteristics of a growth mindset (Lamar et al., 2015). These characteristics are present in PBL along with cooperative learning activities, which encourage students to work together to apply the skills of PBL to the content that is taught (Slavin, 2015). The instructional techniques embedded in PBL, such as inquiry, exploration, and collaboration, provide students with the opportunity to apply skills and strategies in a more meaningful manner by helping them gain an understanding of the abstract and learn to use knowledge. (Lamar et al., 2015).

Fredricks et al. (2011) suggested that when students have a sense of belonging, feel enjoyment, and experience attachment in school, they are more invested in learning, which leads to more perseverance when presented with challenging content. Classrooms in which direct teaching and worksheets dominate provide a haven for students to interact only indirectly with the content while pretending to be learning (Rollins, 2017). Students who are low-achieving or at risk of failure often are bored in school because they are not directly interacting with the content. As they progress through the grades, their engagement consistently decreases, as does their learning of the content (Fredricks et al., 2011). As achievement and engagement decrease, the likelihood of a student dropping out of school increases; a high level of engagement in learning leads to better school success (Fredricks et al., 2011).

The goals of the Every Student Succeeds Act (ESSA, 2015) have brought national attention to subgroups of learners who are not making adequate achievement gains. Subgroups are defined as populations of students used in calculating and reporting student performance. ESSA subgroups include major racial and ethnic groups, students with disabilities, English language learners, and economically disadvantaged students (ESSA, 2015). The Florida ESSA state plan was approved in September 2018 and used the Florida school grade accountability model as a foundation. Its purpose is to close the achievement gap for subgroups of students. There were no changes to the Florida school grades accountability system, and an additional component was added to satisfy ESSA requirements (ESSA State Plan, 2018)

Martin et al. (2016) shared that in some countries, the law requires equal opportunities for education for all students. The challenge for most educators is to provide an equitable classroom environment where students can learn through investigation and make sense of their learning,

rather than relying on teacher-directed knowledge (Villa & Baptiste, 2014). Schools may meet state criteria for the majority of their students, but for the more fragile learner, they fail (McEwan, 2009; Fielding et al., 2007). Subgroup requirements for accountability under the No Child Left Behind Act were designed to focus on the performance of disadvantaged students and their lack of meeting grade-level standards. According to the Florida ESSA Plan (2018), overall, students made significant gains in achievement from 1999 to 2015. However, the achievement gap continues to grow between overall student achievement and achievement by special-needs students. Griner and Stewart (2012) suggested that schools struggle with meeting the needs of all students because of the gaps between policy, theory, and practice. A disproportionate number of minority students are referred to special education classes and given a program label (Lerma & Stewart, 2012). This phenomenon often occurs because teachers need prescribed professional development, practice, and feedback on strategies and tools to meet the instructional needs of students and help close achievement gaps (Griner and Stewart, 2015). Providing educators with the strategies and tools that they can easily use that go outside the research remains difficult (Griner and Stewart, 2015). To succeed in the global economy, students must feel more than once the urgency to graduate; a high school diploma followed by an advanced degree is indispensable for becoming an informed citizen and productive member of society (Betances, 2013). “It is not just about how much you can get out of education, but how much you can give in return” (Betances, 2013, p. 252).

When students fail in mathematics, they are failing at a necessary life skill. Children are not born with an achievement gap in mathematics, as infants differ very little in ability regardless of race (Delpit, 2012). Student race does not cause students to fall behind; it is the potential or

lack thereof that educators see in minority students that creates gaps between racial subgroups (Delpit, 2012). Students whom educators perceive as being from impoverished backgrounds do not have a genetic problem but, rather, a culture problem (Payne, 2019). The educator's perception of a student's background can affect how a child relates to his or her situation and how he or she can create a mindset (Payne, 2019). According to Payne (2019), teachers must be able to reach these students with "down-to-earth, relevant strategies in addition to theory" (p. 3). Historically, teacher preparation provides teachers with the skills and practice that conveys information to students through direct instruction rather than building a setting where learners generate knowledge, critical thinking, and inquiry (Villa & Baptiste, 2014).

History and Characteristics of Project-based Learning

Project-based learning (PBL) and problem-based learning have a long history in education, reaching as far back as the 1500s with the beginnings of project work at architectural schools in Europe (Knoll, 1997). During the 16th century in Italy, architects, painters, and sculptors were thought of as expert craft workers (Larmer et al., 2015). Institutions of that time had lecture-based instruction, but skilled artisans had to be able to apply what they learned in the classroom (Larmer et al., 2015; Knoll, 1997). The assignments that architects completed were known as *progetti* (projects), made up of scale models that could be created in the real world (Larmer et al., 2015; Knoll, 1997). William Heard Kilpatrick described in detail and conclusively defined a more modern version of PBL for the first time in 1918 (Knoll, 1997). Kilpatrick (1918) described this project method as a way for children to participate in projects that included purpose, planning, execution, and judgment.

Project-based learning hearkens back to the work of Charles Richards (1901) and John Dewey (1899), who devised industrial arts programs, in the 1900s (Knoll, 1997). These early scholars of PBL all had one thing in common: a belief that learning was propelled through engagement and through sharing a finished product (Boss & Larmer, 2018). In the 1960s, the medical profession adopted the process of problem-based learning to engage students in real-life scenarios, an approach widely used today in education (Larmer et al., 2015). Problem-based learning developed for use in Canada as a means to for interns to advance their analytic diagnostic abilities though working on medical problems of patients (Barrows & Tamblyn, 1980). Medical students are given facts and figures about the patient and guided by a facilitator to construct and diagnosis the patient's issue using the information collected (Barrows & Tamblyn, 1980). Other professional training programs have also adopted problem or project-based learning approaches, which include architecture, business, social work, law, and engineering (Mergendoller et al., 2005).

Project-based learning also includes teachings from Outward Bound and the Learning Expedition (Udall & Mednick, 1996). Expeditionary learning engagement resembles the learning engagement of PBL (Udall & Mednick, 1996). Springfield et al. (1996) describe expeditionary learning design as bringing together individual growth and academic knowledge to encourage students to acquire insight into their character to build upon knowledge. This journey has a purpose that takes into consideration the diverse learning styles of students while connecting their natural craving to learn. (Springfield et al., 1996).

Modern-day definitions of PBL include the following characteristics: student-centered learning; small group interaction; the teacher as a facilitator or guide; an authentic, real-world

problem under investigation; and previously taught information practiced while new information is learned (Boss & Larmer, 2018; McDowell, 2017; Larmer et al., 2015). Researching the topic of study plays a role in PBL that helps involve typically underrepresented students, potentially leading to innovation and rigorous design of project implementation (Connors-Kellgren et al., 2016). The goal of PBL is to engage students in more inquiry-based active learning (Holm, 2011). Larmer et al. (2015) outline the Gold Standard PBL process as a research-informed model to help teachers improve their practice by following seven design elements:

a. A challenging problem or question at a level appropriate to the students' level that is framed by meaning and meant to be solved or answered.
b. Sustained inquiry that engages students in an extended rigorous process of asking questions, locating resources, and applying the information discovered.
c. An authentic project that has tasks and that is based on a real-world scenario including personal issues or concerns that students are interested in addressing.
d. Students have a voice and choice about some decisions about the project that can include the work the engage and the product they create.
e. Students and teachers reflect on the learning that occurs through the inquiry and focus on how to improve quality and overcome obstacles that may occur.
f. Students provide and receive critique on their work and engage in revision.
g. Students have the opportunity to share and explain their work to audiences that extend beyond the classroom. (p. 37–45)

These design elements help guide the work of students and the teacher to help ensure a quality product that includes standards-based content, critical thinking, problem solving,

communication, self-regulation, and peer collaboration (Boss & Larmer, 2018; Larmer et al., 2015).

Project-based Learning and 21st Century Mathematics Skills

The global economy and technological advancements of today's world are in constant change, but the current system of education and pedagogy can often resemble 19th-century practices (Hallerman et al., 2011). To accommodate 21st-century students, teachers must use 21st-century instructional methods (Marzano, 2009). Needed in modern mathematical instruction is student engagement in ways that help them to solve problems for which there are no fixed or correct responses. Thinking must supplement analysis about commercial, societal, technical, and scientific progressions, for which there are a series of substitutes that can contribute to resolving present-day dilemmas (Warner & Kaur, 2017).

Research supports that PBL provides an opportunity for students to learn more deeply than through traditional teaching methods in preparation for building competency for 21st-century skills (Larmer et al., 2015; Hallerman et al., 2011). Villa and Baptiste (2014) remark that each time a student engages in activities, the new connections made help build on prior knowledge and adjustments made to accommodate new information and its application. Project-based learning helps prepare students for success after high school by helping strengthen critical thinking, communication, and collaboration through application of the content taught and engagement in open-ended, real-world problem solving (Larmer et al., 2015; Hallerman et al., 2011). Businesses of the 21st century look to employ individuals with both procedural and soft skills, which include verbal and written communication skills, ingenuity, problem solving, and ability to work on a team, and leadership characteristics (Vogler et al. 2018).

Larmer and Boss (2015) point out that the rigor of the Common Core Standards (CCS) in mathematics requires that students be engaged in challenging, high-quality, and in-depth activities. These essential tools will better prepare students for the rigors of 21st-century skills. Little (2009) shared that of increasing importance is the instruction of number sense, problem-solving skills, use of calculators, computers, and software programs that improve opportunities for advancement in mathematics. Metacognitive strategies help students think about what they are learning, which can include paraphrasing, monitoring for understanding, analyzing their responses, and evaluating tasks (Little, 2009). Boaler (2016) adds that mathematics requires defined thinking, but when combined with ingenuity, flexibility, and variety of ideas, learning mathematics can start thriving in students. Characteristics such as ingenuity and flexibility are all part of the PBL process (Boaler, 2016). Project-based learning in mathematics equips students to see the application of their learning and makes them less likely to see math in terms of the traditional isolation of lessons taught. Students who learn through project-work instead of textbooks and workbooks see mathematics learning as less about memorization and more about thinking and working through situations (Boaler, 2016).

Project-based Learning and the Constructivist Framework

Problem-based learning finds its roots in a constructivist framework. Initially used to prepare doctors for the rigors of the medical profession, problem-based learning presented real-world problems to interns in a collaborative setting (Larmer et al., 2015). Problem-based learning served as an example of combining the cognitive constructivism theory of Jean Piaget and the social constructivism theory of Lev Vygotsky (Liu & Chen, 2010; Savery & Duffy 1995). As the

predecessor to problem-based learning, project-based learning finds its roots also in the constructivist framework (Liu & Chen, 2010).

Piaget (1964) concluded that assimilation and accommodation, which enable learners to build schema about information, requires an active learner in which problem-solving skills are not acquired through instruction but rather through discovery. Piaget (1964) outlined three main points of his cognitive constructivist theory: knowledge is not constructed directly, new knowledge is shaped by adjusting standing views, and assimilation occurs when new knowledge is use. Wiggins and McTighe (2005) suggest that to adapt intellectual structures, learners use prior knowledge and experiences to change thinking to accommodate and make sense of new information.

Villa and Baptiste (2014) note that Vygotsky knew how social interaction played a role in students' ability to construct knowledge. Vygotsky (Vygotskii, & Kozulin, 1986) believed that social knowledge comes before social development and provides the ability for one to interact with others while being guided through instruction. Students reveal understanding when they can demonstrate a level of expertise in different situations. When students show different levels of knowledge in different situations, they are signifying that they can evaluate problems, synthesize solutions, determine applications, and appraise outcomes (Wiggins & McTighe, 2005). Deeper understanding results from revisiting information, which allows for the construction of knowledge to occur. Across their respective theories, Piaget (Piaget, 1964) and Vygotsky (Vygotskii & Kozulin, 1986) both suggested that relevant and meaningful hands-on experiences provide learners with a broader view of the world around them (Liu & Chen, 2010; Savery & Duffy, 1995).

From the constructivist perspective, learners participate in determining how they learn.by taking information in and working it into their understanding (Schcolnik et al., 2006). Students are active rather than passive in learning as they build an understanding of the world (Schcolnik et al., 2006). If student participation is passive or marginal, their level of standard and skill acquisition is nominal. The essential project design elements outlined by Larmer et al. (2015, p. 34) are related directly to the factors described in constructivism, which engage students in hands-on, relevant, and meaningful learning (Savery & Duffy, 1995).

Project-based Learning and Growth Mindset

To help students meet the rigor of PBL, they need a firm grasp of the constructs of a growth mindset (Larmer et al., 2015). Challenges in school are omnipresent, so a level of resilience is essential for improved academic achievement (Yeager & Dweck, 2012). To set the stage for successful PBL implementation, a culture of a growth mindset is necessary (Larmer et al., 2015). Students must understand that they will cycle through revision and critique as opportunities to improve their work, which requires a growth mindset (Larmer et al., 2015). Students who believe that they develop intellectual ability demonstrate higher achievement levels and the ability to face challenging content (Yeager & Dweck, 2012). Students who live in poverty, find success in school when exposed to the constructs of a growth mindset (Claro et al., 2016). When students believe in their ability to be successful, their self-efficacy increases, and so does their level of achievement (Bandura, 2000).

As Dweck (2006) describes, individuals with a growth mindset feel that success is equal to stretching oneself and becoming smarter. Comfort with struggle takes practice, and a student's self-efficacy or belief in their ability to deal with situations plays a role in the success of

achieving goals in school and life (Bandura, 2000). Project-based learning requires a classroom atmosphere that promotes risk-taking through inquiry and creativity (Cooper & Murphy, 2016). Students must engage in a productive struggle to uncover an understanding of the content (Cooper & Murphy, 2016). If a teacher is to be able to implement successful PBL, there must be a culture of inquiry and risk-taking (Cooper & Murphy, 2016). When students are encouraged to explore their curiosity, they exhibit enhanced cognitive skills (Ostroff, 2016). The brain's desire to learn and interest is satisfied; the brain releases dopamine, which helps a person remember the information about which they were curious (Ostroff, 2016).

Project-based Learning and Student Collaboration

Constructivist learning may indicate an improvement in students' knowledge, but one of the most important aspects of project-based learning is collaboration. Larmer et al. (2015) shared that the ability to cooperate and collaborate with peers is an essential part of launching PBL in a school setting. Larmer et al. (2015) also mentioned that students accustomed to instruction that primarily involves lecture, teacher-directed activities, and a quest for getting the right answer would find launching into PBL difficult. Teachers need preparation that includes the ability to work in teams, collaborative discussion, active listening, sharing, building on ideas, respecting other's viewpoints, and creating a plan that provides for sharing the workload before starting PBL in the classroom (Larmer et al., 2015). Cooperative learning goes beyond students' desks pushed into groups of four or five and advanced and grade conscience students doing the lion share of the work (Rollins, 2017). Cooperative learning provides a balance of organization, student self-sufficiency, and interdependence that helps prevent disorder and an imbalanced workload for some students (Rollins, 2017).

Considerable research demonstrates that cooperative learning enables students to clarify content to other students in ways they can understand as well as ensuring that all group members contribute (Slavin, 2014a). Students need considerable modeling and practice to to function appropriately as a team (Slavin, 1981). Cooperative structures help reduce the isolation students can feel in school and can make learning fun (Slavin, 1981). Collaborative groups must have work-based incentives that ensure the success of all group members (Slavin, 2014). Motivation to learn and help others to learn is a by-product of collaboration. Low-achieving students, like all students, can contribute their thoughts and how they synthesize the content (Slavin, 2014, 1981).

Collaborative groups provide opportunities for students to work with other students of all ability levels, races, and ethnicities, where each group member gets the chance to participate equally (Slavin, 1981). Students who engage in group discovery participate in higher-order understanding and create higher-quality solutions (Slavin, 2014, 1981). Cognitive elaboration is a result of cooperative learning that gives students the chance to develop more elaborative answers to questions or problems (Slavin, 1995).

The opportunities for cooperative learning provide a springboard to success with PBL. While engaged in PBL, students work in groups to share personal knowledge, research their topic, and solve the problem presented (Bell, 2010). Students who participate in groups with a common goal are more motivated to learn and better equipped to elaborate on content and experience enhanced learning (Slavin, 2015). Students who have the chance to ask questions exhibit learning at higher levels (Ostroff, 2016). Project-based learning encourages social interaction as students rehearse and become skilled in 21st-century forms of communication, negotiation, and relationships (Bell, 2010). Bandura (2000) suggested that students who engage

effectively in cooperative learning show improved ability to succeed in school and have improved levels of self-efficacy.

Project-based Learning Strategies and At-risk Students

The National Council of Teachers of Mathematics (NCTM, 2008) postulates that all students should have a chance to cultivate meaning of mathematical conceptions and processes by engaging in challenging math instruction. Goldman and Hasselbring (1997) state that in 1989 the NCTM recommended that mathematics instructors engage students in problems requiring extended effort that engage them in cooperative problem solving emphasizing complex open-ended results. Engaging students in an instructional environment that provides these types of opportunities is what helps improve student achievement (Agrawal & Morin, 2016).

Students with mathematical disabilities have problems with both conceptual and procedural knowledge of math concepts across grade levels (Agrawal & Morin, 2016; Goldman & Hasselbring, 1997). A concrete representational abstract framework of instruction helps bridge this gap for students, and when embedded within explicit instruction, the gap can decrease. (Agrawal & Morin, 2016; Goldman & Hasselbring, 1997). Priority should be given to math reasoning and making connections, but instruction for at-risk students focuses primarily on computational skills and procedures (Agrawal & Morin, 2016).

High- and low-achieving students react differently to instructional methods. Han et al. (2015) point out that in the classroom, there exist diverse levels of achievement in which teachers change instructional approaches based on needs. Students may exhibit a variance of success within the same learning environment, and instructional needs can differ for different students depending on their specific characteristics. Students must be challenged, which can give

them intrinsic rewards through setting and working on reaching goals (Linnenbrink, 2005; Meyer et al., 1997). Students whose teachers set high expectations, regardless of student ability, attain the highest self-esteem (Davenport & Anderson, 2002). Effective classroom environments must emphasize understanding students' needs and provide varied and meaningful tasks and opportunities for students to make choices to guide their learning (Linnenbrink, 2005).

Teachers can build self-efficacy in students when provided with professional development that prepare them in the use of PBL, growth mindsets, and cooperative learning structures. Teaching students that intelligence is not fixed and can be developed exerts a positive effect on student achievement (Dweck, 2006). Project-based learning addresses this positive effect through engagement in rigorous real world problem-solving (Larmer et al., 2015). Motivational perspectives on cooperative learning show that motivation drives tasks (Slavin, 2015). Students who help their group members to succeed also help themselves if the group is successful (Slavin, 2015).

Efficacy affects students' concepts of their capabilities and can negatively impact student motivation to attempt to complete tasks (Bandura, 2000). Lack of mastery of skills can negatively impact students' belief in themselves to tackle the task at hand. Unless students believe they can do the work, there is little incentive even to try (Bandura, 2000). Ineffective instruction contributes to gaps in low-performing students' knowledge, thereby affecting students' proficiency on assessments (Beers et al., 2010; Fielding et al., 2007). Teacher expertise and knowledge contribute only partly to student success; students must also be motivated to use the skills taught (Mayer, 2011). Project-based learning, with its focus on instruction of the content and application through real-world problems, can improve the academic outcomes of

students (Larmer et al., 2015). When allowed to engage in PBL, students have scored higher on traditional and performance-based tests than similar students learning the same materials without using PBL (Larmer et al., 2015). Using PBL with at-risk students provides a means for the teacher to address students' needs in mathematics with the application of grade-level standards through real-world scenarios (Boss and Larmer, 2018).

Summary

The purpose of this literature review was to explore PBL and its relationship with constructivism, growth mindset, and cooperative learning and the degree to which these teaching methods may affect student learning. The instructional techniques embedded in PBL have been reviewed and demonstrate how they provide students with the opportunity to apply skills and strategies more meaningfully. At-risk students engaged in learning at deeper at levels are more able to use PBL in their learning. Bandura (2000) suggests that building self-efficacy or confidence is one way to help ensure student success in that belief becomes thoughts about one's ability to perform. Trust in one's ability to succeed leads to more proactive approaches in dealing with situations presented without becoming overwhelmed (Bandura, 2000). Fielding et al. (2007) share that "rigor, engagement, lesson purpose, and results are hallmarks of excellent instruction" (p. 231). These characteristics are present in PBL and offer all students the opportunity to practice what they have been taught.

Using PBL with at-risk students provides a means for the teacher to address students' needs in mathematics with the application of grade-level standards through real-world scenarios (Boss and Larmer, 2018). Problem solving, communication, collaboration, and decision-making skills are career-ready 21st-century skills that PBL provides to students (Rollins, 2017). Project-

based learning also introduces the concepts of the constructivist theory of learning, growth mindset, cooperative learning, and self-efficacy to teachers as strategies that improve student performance (Larmer et al., 2015).

CHAPTER 3: METHODOLOGY

Introduction

The purpose of this study was to investigate the lived experiences of fourth, and fifth-grade mathematics teachers that implemented project-based learning (PBL) as a method for teaching mathematics in fourth and fifth grades. When deliberately planned by teachers, PBL can help students retain content taught, improve attitudes about learning, and improve collaboration with others (Hendry, Frommer, & Walker, 1999). Project-based learning provides students not just with exposure to 21st-century skills; it also allows students to engage in practice with content-area knowledge (Larmer, Mergendoller, and Boss, 2015).

This chapter described the research methodology used to investigate the lived experiences of fourth, and fifth-grade math teachers that have implemented project-based learning (PBL) in an urban school district. Outlined are the criteria for how participants were selected. Procedures, data collection, analysis, and limitations reported. Also discussed is the role of the researcher and the bracketing the researcher conducted as a measure of validity.

Research Design

This study explored the lived experiences of fourth and fifth-grade teachers who used project-based learning (PBL) during mathematics lessons in urban schools through a qualitative research design. The phenomenological research approach was used to study the meaning individuals attached to their lived experiences (Ary et al, 2018). "Phenomenology is committed to descriptions of experiences, not explanations or analyses. Descriptions retain, as close as possible, the original texture of things, their phenomenal qualities, and material properties"

(Moustakas, 1994, p. 59). Phenomenology looks to address questions about individual experiences with the same phenomenon (Ary et al., 2018; Moustakas, 1994). The goal of this research design is "To describe experiences from the participants' perspective (Slavin, 2007, p. 143). The phenomenological approach to research interprets the meaning of the experiences of a group of individuals involved in a similar experience. (Ary et al., 2018; Slavin, 2007) This research studied the meaning individuals attached to the experience of using PBL during mathematics instruction in urban schools.

Research Question

The following research question guided this study:

> What are the lived experiences of fourth and fifth-grade teachers in urban schools who use project-based learning during mathematics instruction?

Population/Sample

This study was conducted in a Central Florida urban school district. This urban district has 131 schools in which grades three to five are instructed. Teachers from 16 of these schools received professional development in the use of project-based learning (PBL). Mathematics teachers in grades three, four, and five from these 16 schools were asked to volunteer to participate in this study. The schools invited to participate were schools that had teams of 15 teachers and administrators that attend a Buck Institute for Education PBL Works (BIE PBL, 2020) series of training designed to focus on the implementation of PBL through a multi-tiered development approach. Teams attending the training brought the information learned back to their schools to share with instructional staff.

The training provided by PBL Works included a teacher development series and an administrator development series. The professional development reflected on reinforcing application of PBL implementation standards and generating detailed plans on implementation. The training was in two phases which provided participants the opportunity to engage in practice and come back to training and reflect on the process. This reflection activity was used to help make adjustments to the next round of implementation of PBL.

Teachers invited to participate completed a demographic survey, which included the level of degree held, type of valid professional certificate in elementary education from the Florida Department of Education, and the number of years they have taught. One of the 16 schools was excluded since it is the school in which the researcher serves as principal. In order to gather demographic data, teachers were asked to (1) engage in a demographic survey, and (2) invited to participate in semi-structured interviews. This process promoted a means to research with a sample group that had experience with the phenomenon (Ary et al, 2018; Slavin, 2007).

Procedures

In the initial stages of the research, a proposal was submitted to the dissertation committee for feedback and approval. Once the committee approved the proposal, an application to conduct the study sent to the University of Central Florida (UCF) Institutional Review Board (IRB). Upon receipt of approval from the University IRB (Appendix A), the school district's Research and Evaluation department (RE) contacted, and a request to the school district for permission to conduct the research study in the district made. Upon approval from the school district, the study commenced.

Purposive sampling was used to help identify teachers who would-be participants in the study. Purposive sampling, also called judgment sampling, is described by Ary et al. (2018), as, "A nonprobability sampling technique in which subjects judged to be representative of the population are included in the sample" (p. 564). Ary et al. (2018) summarize that purposive sampling provides sufficient relevant information about the topic when the subjects are sharing information about what they have experienced or have studied. The researcher using this type of sampling must determine what personnel to interview, and settings that will provide an accurate picture of perceptions (Ary et al., 2018).

The school district provided a list of schools where staff participated in project-based learning training provided by PBL Works. Staff members that attended the training shared the information back to their schools. Interested teachers from these schools responded to a demographic survey that described the research. The survey collected information about each teacher, including information about their educational background, years of teaching experience, years instructing mathematics at the fourth, or fifth-grade level, experience using PBL, and the amount of professional development with PBL.

The study explored the lived experiences of urban school teachers who have engaged in the use of PBL as an instructional technique (Plano-Clark & Creswell, 2015; Slavin 2007; Moustakas, 1994). Teachers attending PBL professional development either at the district level or school-level and implemented PBL in mathematics instruction were selected to participate in one-on-one semi-structured interviews (Plano-Clark & Creswell, 2015; Slavin 2007; Moustakas, 1994). Due to the COVID-19 pandemic, in an abundance of caution for the health and safety of those involved, these interviews were changed to one-on-one virtual interviews using an online

platform. Interviewees selected the time and day of the interviews. The interviews consisted of probing questions (Appendix B) that sought to extrapolate the essence of how teachers implemented PBL strategies with students (Ary et al., 2018). While the researcher conducted interviews, potential study participants were recruited. After the sixth one-on-one interview saturation of information was reached and new information was no longer obtained. (Creswell & Poth, 2018).

Instrument

Demographic survey questions and qualitative interview questions were developed and collected. The panel of experts, using the Delphi method, vetted survey, and interview questions before the survey and interview questions finalized, as suggested by Iqual and Pippon-Young (2009). The panel of experts and the Delphi process strengthened the validity of the study. The Delphi panel, consisting of individuals who were knowledgeable in PBL and elementary education, was convened to develop the qualitative interview questions. The Delphi group engaged in two rounds of question review for the survey and interview questions designed. According to Iqual and Pippon-Youngm (2009), this process helped formulate questions that were both valid and reliable. Probing guiding questions were formed that sought to get a deeper understanding of the ideas, themes, and theories found in the responses subjects provided (Plano Clark & Creswell, 2015; Slavin, 2007; Moustakas, 1994). Teacher interview responses were analyzed for meaning and significance, and themes about the effects of project-based learning developed (Plano Clark & Creswell, 2015; Slavin, 2007; Moustakas, 1994).

Research participants were informed that their identifying information would be kept confidential. All identifying information and data collected throughout the study would be stored

electronically under password-protected files as required by the University IRB protocols. Five years after the conclusion of the study, these documents will be destroyed. An application to conduct the research was sent to the University of Central Florida (UCF) Institutional Review Board (IRB). Upon receipt of approval from the University IRB (Appendix C), the school district's Research and Evaluation department (RE) was contacted, and a request to the school district for permission to conduct the research study in the district was made. Upon approval from the school district (Appendix E), the study commenced. Demographic survey responses were collected using Qualtrics survey system. Interviews were digitally recorded, and verbatim transcription was completed using the transcription service Rev.com. All study contributors who participated in interviews were informed that all identifying data would be kept confidential.

Data Collection

Once the study participants were identified, and surveys and interview questions created, interview locations, and times established. The one-on-one interviews took place via a virtual platform as an abundance of caution to the COVID-19 pandemic and not in person. Interviewees chose the day and time of the interviews. The researcher established the interview protocol, (Appendix B) which included an introduction to enable the interview and interviewee to get to know each other, the nature and purpose of the discussion, and information about the rights of the interviewee in the process (Ary et al., 2018). Information about confidentiality and the intent to use the data from the interviews for publication in a dissertation noted (Ary et al., 2018; Moustakas, 1994). Ground rules and information on the recording and transcription of the interview were shared with interview subjects (Ary et al., 2018). The body of the discussion consisted of the formal questions that have been validated by the panel of experts through the

Delphi method (Iqbal & Pipon-Young, 2009). These semi-structured interviews, using guided prompts based on the formal questions, consisted of open-ended questions (Ary et al., 2018). One-on-one interviews were recorded, transcribed, and coded to help understand the phenomenon under study (Plano Clark & Creswell, 2015). Observation field notes were used to supplement data collected through the interview process (Creswell & Poth, 2018). Interviews continued until a redundancy of information began to surface or to the "point where no new information is emerging, referend to as data saturation" (Ary et al., 2018, p. 382).

Data Analysis

To ensure the design, implementation, and findings of the study were reliable and valid, the researcher selected participants for the study based on their experience with the phenomenon and who were willing to share their lived experiences. (Plano Clark & Creswell, 2015; Slavin, 2007; Moustakas, 1994). Credibility established through the use of structural corroboration that Ary et al, 2018, described as, using several sources of qualitative data and unlike methods to define if there is an agreement in the interpretation. This corroboration was achieved through the use of multiple interviews and subjects with varied teaching backgrounds and from different schools (Ary et al., 2018).

Member checking was used at the end of the data collection by asking participants to review verbatim transcriptions for accuracy (Ary et al., 2018). Researcher bias controlled through the researcher's use of reflexivity by recognition of self-bias within the study. The researcher had a background with project-based learning, and the field of education, so bias on the topic needed to be put aside (Ary et al., 2018). As part of the phenomenological study,

bracketing, which involved the researcher appending their own beliefs to obtain an impartial viewpoint based on data collected from the interviewees that had the phenomenon (Ary et al. 2018), was used. As the primary instrument of the collection of data, the researcher was aware of perceptions and beliefs on PBL and put them aside while collecting and analyzing the data (Chan, Yuen-ling Fung, and Wai-tong, 2013).

Data analysis criteria, as outlined by Plano Clark and Creswell (2015), was followed to synthesize the data collected from interviews. Verbatim transcripts were organized and repeatedly read to determine common threads of the responses: codes were assigned to the data based on meaning to establish categories and summarize the data (Ary et al., 2018, Slavin, 2007; Moustakas, 1994). Meanings from the interviews were clustered into common themes. The content of the study was described in rich detail with factual information, quotes, tables, and figures that support the detail (Plano Clark & Creswell, 2015). The data was analyzed through the three stages of qualitative data analysis, as shared by Creswell and Poth (2017, p. 183). In stage one, the interview transcripts and field notes were prepped and organized (Creswell and Poth, 2017). Next, the data was reduced into themes through coding and condensing the codes (Creswell and Poth, 2017). Finally, the data was interpreted and represented in figures, tables, or discussion (Creswell and Poth, 2017). Triangulation of the data collected was achieved by using a combination of a survey to determine eligibility, multiple interviews, and documents relevant to the phenomenon studied (Ary et al. 2018). Raw data and researcher interpretations of the data were presented to a peer reviewer to help determine if the researcher's findings were reasonable, given the documentation presented (Ary et al., 2018). An audit trail was maintained by the

researcher, which assisted in confirming the data that could help another researcher to arrive at the same conclusion (Ary et al., 2018).

Positionality Statement

My career in education began in Title 1 public elementary school in a suburban district in the northeast where I taught first grade, second grade, third grade, fourth grade and fifth grades overs a 10 year span. During those ten years, I taught heterogeneously groups of students who ranged in ability from one to two years below grade level and one to two years above grade level. Students determined to be learning disabled or gifted were pulled out of my class to receive services. My next teaching position was for two years teaching Kindergarten and third grade in a Title 1 public school in central Florida. That particular school implemented a school reform model in which I was hired on to be a curriculum trainer and school implementation consultant. I remained in that role for seven years. After leaving the school reform model position, I became a school administrator in a central Florida urban school district. I have been in the school leadership role for fourteen serving Title I and non-Title I schools. Throughout my tenure as a teacher, consultant and administrator, I continued to research and experiment with instructional techniques which provided high levels of participation and engagement in my students.

As a teacher, consultant/trainer, and administrator, my goal for students has always been to ensure that they are provided with quality instruction that requires students to be a participant. A student-centered learning environment was a requirement I held myself to as a teacher and one that I require of my teachers as an administrator. The classroom set-up and instructional design must be inclusive of all students learning styles, abilities and interest. The work coming out of

the classroom should be designed to be completed by students with the guidance of the teacher. Students' collaboration should be an essential part of the classroom setting and should a high level of engagement of students in the learning process. Students require practice with the standards instructed and an opportunity to apply what they have learned.

As I began to research learning philosophies and the need to engage students in 21st century learning techniques, project-based learning was often a part of this research. Given that throughout my career I have felt that learning should be student-centered and engaging, project-based learning was an area that I felt needed study. As my research began and I observed teachers in my own school engage in the process with their students I noted the work and that went into the process from the teacher's perspective. I started to question if teachers felt that this process was beneficial to their students, the drawbacks they had with the process and advice they might be able to provide to others teachers who wanted to start engagement in it with their own students.

Limitations

Researcher bias was a potential limitation because the research was conducted in the school district in which the researcher was employed. This study has transferability in that it teachers who have has similar training and exposure to project-based learning could provide similar responses to the questions posed about their experiences with the phenomenon.

CHAPTER 4: DATA ANALYSIS

Introduction

This chapter presents the conclusions of the preliminary questionnaire and phenomenological interviews of the study participants. Breakdown of the information gathered involved a thorough review of interview transcripts to determine the common themes from answers confirming the research question. The chapter is organized by the participants and the common themes discovered.

Purpose of the Study

The purpose of this phenomenological study was to investigate the lived experiences of fourth- and fifth-grade mathematics teachers implementing project-based learning in an urban school setting. This chapter presents the findings of this study as well as identified strategies that are effective as perceived by the teachers who participated. Before discussing the results of the data analysis for this study, researcher bracketing for preconceptions took place, and background information related to the participating teachers was summarized.

Method

A Qualtrics survey was used to collect demographic data and determine the eligibility of the study participants who met the criteria to take part in the study (Appendix A). The goal of the study was to ensure that participants had exposure to the phenomena and could speak to the benefits and drawbacks of PBL through the interview process. The analysis revealed 15 schools eligible to participate in the study, in which six agreed to participate. From that pool, 16 teachers

completed the initial survey. Interviews from six teachers were used in the data analysis process and were included in the study.

Research Question

The following research question guided this study:

> What are the lived experiences of fourth and fifth-grade teachers in urban schools who use project-based learning during mathematics instruction?

This section provides information about the teachers who were included in the study (Table 1). Each of the participants in the study participated in PBL experiences in mathematics with their students. Those participating taught either fourth or fifth grade. All of the teachers taught math and science except for one who taught all subject areas. Collectively the teachers taught an average of eleven years, ranging in experience from four years' experience to twenty-five years'. Teachers interviewed represented three of the 16 schools in the county that had teachers at their school participate in Buck Institute for Education PBL Works (BIE PBL, 2020) training. There were three options for training in the district. The first was for a team of five: one administrator and four teacher leaders from each school attended 40 hours of district training. The second option was to have select teachers from each of the schools participate in 21 hours of training directly from BIE PBL staff. The third option was for those trained at the district level by BIE PBL Works to share the learning and strategies with teachers at their school sites who would implement PBL units with their students.

PBL is not a new instructional technique, and this study's intention was not an evaluation of the training teachers received. The study's intent was on the experiences teachers had with the

phenomenon of PBL and how they perceived their students as interacting with the process. Following are biographical sketches of the participants.

Samantha

Samantha has been a teacher for 25 years. At the time of this study, she was teaching in a school that departmentalized content areas. She has also been a kindergarten through fifth-grade resource teacher, sheltered English teacher, and second-grade gifted teacher. Samantha has done project-based learning in the past and attended 12 hours of in-service training on PBL from the colleagues at this school level that attended the 40-hour district training.

Carol

Carol has been a teacher for 10 years. She was teaching fourth grade and all subject areas at the time of this study. She has also taught second, third, and fifth grades. Carol completed 21 hours of teacher training from PBL Works.

Kiley

Kiley been a fourth-grade teacher for 10 years. She also taught second grade for one year and a primary class at a private school. Kiley completed 40 hours of training at the district level from PBL Works.

Janice

Janice has been a teacher of gifted students for 15 years. She has been instructing a specialized program for gifted students for the last four years. Janice completed 40 hours of training at the district level from PBL Works.

Rebecca

Rebecca was in her fourth year of teaching at the time of this study. She has taught fourth and fifth grade. Before that, she was a substitute teacher for six-years. Rebecca is also a STEAM (Science, Technology, Engineering, Arts and Mathematics) teacher for her school and provides support in that area for students in kindergarten through eighth grade. Rebecca completed 40 hours of training at the district level from PBL Works.

Andrew

Andrew had been teaching for 5 years at the time of this study. He has taught fourth grade for 2 years and fifth grade for three years. Andrew completed 8 hours of in-service training on PBL from the colleagues at this school level who attended the 40-hour district training.

Table 1

Participating Teacher Demographics

Teacher	Years of Experience	Grade level	Highest Degree	Certifications	Number of Hours Spent in PBL training
Samantha	25 years	Fifth	Masters	Elementary Certification (1-6): Specific Learning Disabilities; Emotional Handicaps; ESOL Endorsement; Gifted Endorsement	12
Carol	10 years	Fourth	Bachelors	Elementary Ed (K-6); ESOL Endorsement	21
Kiley	12 years	Fourth	Bachelors	Elementary Ed (K-6); ESOL Endorsement; Gifted Endorsement	40
Janice	15 years	Multiage	Masters	Elementary Ed (K-6); Exceptional Student Education; Gifted Endorsement; ESOL Endorsement; Reading Endorsement	40
Rebecca	4 years	Fifth	Bachelors	Elementary Ed (K-6);Gifted Endorsement	40
Andrew	5 years	Fifth	Bachelors	Elementary Ed (K-6); ESOL Endorsement; Reading Endorsement	8

Research Question Results

The research question in this study was “What are the lived experiences of fourth, and fifth-grade teachers in urban schools who use project-based learning during mathematics instruction?” Analysis of participant responses to interview questions (See Appendix A) demonstrates that all of the teachers interviewed thought that project-based learning (PBL) provided their students with a high level of engagement while providing opportunities to apply the standards taught. During the discussion about how PBL can achieve this, some common themes emerged with the participants. These common themes were (a) challenges with implementation of project-based learning with at-risk students, (b) student ability and participation in project-based learning, (c) teachers’ views on how to implement project-based learning, and (d) lessons learned with implementation of PBL. Descriptions about how participants described these themes follow.

Theme 1: At-risk Students and Project-based Learning Implementation Challenges

The first theme emerged from questions (See Appendix B) related to how teachers defined at-risk students. Definitions vary, but commonalities presented in their perceptions. According to teachers' responses, the at-risk condition was not limited to learning difficulties and school achievement. The characteristics were multi-layered. Overall, teachers shared that the students they worked with whom they deemed at-risk shared some of the following common characteristics: lack of ability to work independently, easily frustrated and overwhelmed, passive about learning, underachieving, have social and emotional issues, have challenges in the home, and lack parental support. These characteristics can make teaching students grade-level

mathematics standards at varying levels and with wide-ranging needs challenging in traditional teaching scenarios. PBL, with its focus on standards application through exposure to real-world problem solving adds further challenges. The following are examples of study participant definitions of at-risk students:

Carol shared that she felt that

> [An at-risk student] is struggling to grasp the concepts. And I guess in that regard it would also be a student that you notice there's some deficiencies from the prior grade. The prior concepts weren't mastered, so that's leading to issues within the next skills.

Janice's definition was multifaceted:

> There's a lot that goes into defining an at-risk student. A student that has come in that might be below level might have different socio-economic circumstances. Students that were maybe coming in as a high student and were doing really well, and then for some reason, the student [achievement], their grades are lacking; their effort's lacking.

Kiley shared that at-risk goes beyond just academics, “They really need a lot of social-emotional support more than I think people realize that they need.” Effective PBL execution of students often requires that they perform independently and show a level of application of standards taught. If they cannot do this, the teacher must intervene with supplemental strategies to help students succeed with PBL implementation.

Theme 1, Subtheme 1: At-Risk Students and Learning Challenges

Study participants were asked to provide their definition of an at-risk student. Three mentioned low socioeconomic status but also stated that status was not the only reason why they felt a student was at risk for failure. Andrew shared that his definition of an at-risk student

included a lack of academic ability and "involved socio-economic factors like poverty and hunger." He also shared, "My definition of an at-risk student is a student who does not have the necessary resources or skills to be able to perform on grade level like their peers." Janice felt that at-risk students might have socioeconomic issues and could also be high achieving that prevent them from fully meeting grade-level standards. Kiley felt that at-risk students had "challenges outside of the classroom. Possibly either parent support at home or financial."

Participant teachers also shared their concerns about at-risk students and their ability to perform at grade level. Kelly added, "I think they are often apprehensive about material because I think they often realize they have some deficiencies or some struggles, and so it just makes them apprehensive about that."

Another concern that teachers attached to at-risk students was their need for social-emotional support. These students may not perform below level, but their potential to reach grade-level expectations can be hindered. Kiley shared,

> [Students] need a lot of social-emotional support more than I think people realize that they need. And I think if those needs are met, then they can really achieve their potential. I think, otherwise, you can see underachievement a lot. They just give up.

Janice added to the social–emotional concerns in this way,

> An at-risk student would be a child that has challenges to stay on grade level, which could be outside factors. So you could think of free and reduced lunch, you could think of social-emotional factors, you can think of language barriers. At risk, a child that is not performing at grade level.

Theme 1, Subtheme 2: Strategies Used with Below-Level At-risk Students

Students who were scoring below level on assessments met the teachers' definitions of at-risk and faced challenges when it came to the implementation of PBL. All teachers in the study shared that they follow the district scope and sequence for math that outlines the standards of instruction at the grade level at which they teach. These standards and trailing standards are often part of the PBL unit. When students are not proficient in a skill or strategy, it can be difficult for them to perform the mathematical computations and problem solving involved in the unit. Samantha shared that to help students who are struggling, it's important to help students maintain a "Yes, I can attitude." She shared that instead of accepting, "No, I can't do it," she helps her students look at how they can approach the work together so the student can be successful.

Kelly recommended that when students are struggling with PBL:

> I still pulled them back, same as I would in the regular class, and work with them a little more one-on-one. So there's still always just a few, two or three that struggle with those standards.

Samantha added that when students are struggling with applying the standards in a PBL unit, she scaffolds the work and "breaks it down into smaller parts," so students can better understand the concept and apply it within the PBL. When asked what she would do for students who may get frustrated with the content and standards in a PBL and want to give up, Janice suggested,

> So I would say with project-based learning, making sure it's interest-based. If the kids aren't interested in it or they don't see themselves invested, then you're going to have pushback, and that's a huge hiccup for a teacher.

Janice shares that “PBL is great for children who must see the standards [from] a different perspective”; she thought it was a time for students to “show of their skill set.”

Theme 1, Subtheme 3: Strategies Used with Students scoring below grade level at risk for failure

Teachers shared that it was not only their students scoring below grade level who needed their attention when implementing PBL, but there they are on, and above level students also demonstrated difficulty and at-risk characteristics. The ideas Janice expressed summarized that she felt sometimes they were misunderstood and did indeed have at-risk tendencies. She stated that “to really make a gifted student reach their full potential, I do feel like they must be treated like a special needs student.” Janice also added,

> They [gifted students] really need a lot of social–emotional support, more than I think people realize that they need. I think if those needs are met, then they can really achieve their potential. I think, otherwise, you can see underachievement a lot. They just give up.

Kristen, who also cited that her gifted students may not have academic deficiencies but that

> “[my students] have their own set of challenges, because of each other's social–emotional needs. They're all very highly energetic or highly sensitive, and that can be a challenge. Also, gifted students deal a lot with fear of failure and perfectionism and things like that.

Julie also shared some of the same sentiments, “[it's] more of a social-emotional time than really trying to pick up the pieces of what foundational aspects they're missing.” She did also share that

> When teachers come across the gifted [students], they always think they're the perfect kids that always get the fives [on Florida Standards Assessment], and they don't struggle, and they don't have challenges, which is quite frankly the complete opposite.

Julie wrapped up at-risk on- and above-level students with this thought: “Do my [above level] kids still miss some foundation parts that we have to go back help and revamp and give extensions? Absolutely!”

Theme 2- Student Participation in Project-based Learning

The second theme that emerged from the data analysis was student participation in project-based learning. Participants shared how the demonstration of a growth mindset was present in students, what levels of engagement that students demonstrated during PBL, and how the role of the teacher interacted with student success during PBL.

Theme 2, Subtheme 1- Demonstration of a Growth Mindset in Students and PBL

According to the research, to set the stage for successful PBL implementation, a culture of a growth mindset is necessary (Larmer et al., 2015). Students must understand cycling through revision and critique as opportunities to improve their work, which requires a growth mindset (Larmer et al., 2015). Students’ demonstration of a growth mindset is not reserved only for work during a PBL unit; it is an attitude that can permeate all aspects of the school day. Carol tried to help establish a growth mindset in her students by helping them with “being okay with mistakes, being okay with failures, I think, also, not ignoring that that's [mistakes and failures are] going to bother you.” Janice felt that a growth mindset was

> Always having that perseverance and thinking you can do it because I would say that is huge in PBL. If children don't have that understanding of, “Hey, I can do this, it's going to get hard.” And always looking at the positives and not the negatives of the project.

Andrew adopted the attitude with his students of “I can do this.” He shared that as a school, teachers shared growth mindset slogans each week that helped teach students how they should think about attacking a problem and having the confidence to work through it. He reported that this school-level approach created positive results in his classroom. He often asked his students, “So what's another way we can say that? let's try this a different way.” He shared that this was how he helped his students use the language of a growth mindset, and it became the “norm” when addressing difficult content or synthesizing difficult information. Andrew also shared that he did a study of growth mindset using online videos, literature, and a school-wide PowerPoint presentation with his students to help them establish a growth mindset. He shared,

> For example, if a student said, “I can't do this.” I would ask them for another way we can say that, let's try this a different way, or how can we bring others in to help us feel like we can do this and can accomplish this? That became a language and our norm to really adopt that mindset.

Rebecca shared that she noticed a growth mindset in her students when she saw an “openness and willingness [in her students] to try something new, even if there is a struggle, and to persevere past that.”

Theme 2, Subtheme 2- Student Engagement and PBL

Participants reported experiences about how their students demonstrated higher levels of engagement with the math standards during PBL units than with traditional mathematics teaching methods. Student engagement includes the work students do with PBL and work they do with their peers collaboratively.

Janice noticed that when her students worked through the process of project-based learning,

> when [students] they come to a classroom, and they feel challenged with PBLs, or they feel challenged with work where they have to have that growth mindset, then that's when they feel excited because now this is their time to shine.

Rebecca elaborated that she could tell when her students were invested in the PBL work:

> Oh well, I mean, they don't want to stop talking about it. They get so excited. They have to show me, and they have to talk about the details, make sure I noticed every little, you know, maybe hidden jokes that they put in their projects. Or things that are meaningful to them or, you know, because it's really all in the details.

Andrew added that the cooperative learning aspects of PBL helped motivate his students to tackle challenging math standards in their projects and continue working:

> Cooperative learning has really been helpful because even if they're not able to receive some type of learning from me, they can learn from their peers and be able to share. They can hear others on their level. I think that peer-to-peer interaction has really been a big help, especially if the student that they're sitting with understands. It gives that student an opportunity to show what they know even if I'm not the main one giving the information.

Janice elaborated that the topic and interest level helped to motivate students to complete PBL and work with the standards: “So I would say with project-based learning, making sure it's interest-based because that can be a hiccup. If the kids aren't interested in it or they don't see themselves invested, then you're going to have pushback.” Janice shared an instance of PBL in which she wanted her students to study the effects the Great Dust Bowl had on the environment.

They lacked interest in the topic, and she found it challenging to keep them interested and engaged in the activities the PBL required. She related that she heard “crickets” in her classroom, referring to her students’ lack of excitement about the topic. She did continue with the PBL but wrapped things up quickly and moved on to something else that they did find interesting. In contrast, Kiley shared, “My favorite way to use math in projects is with money, because money is so ‘real world.’” She continued, “We did a food truck project where the kids had a budget, and so we did a lot.”

Study participants also noted student enthusiasm when completing PBL units. Samantha said that when students completed a project, “You can just see the enthusiasm when they're sharing it. And the fact that because some of the projects can be difficult for some, it's just the fact that they finished it and they're like, ‘Wow!’” Susan described a project that her students completed on the base ten domain:

> Project-based learning is a project that's generic enough that allows the students to be creative and enjoy putting what they want into the project. Instead of saying this is what to do next and this is what to do next and this is what you do next. For example, we did for the Christmas holidays a math project where they had some parameters, they had to buy gifts for 10 family members. And it had to be $99.99 and you couldn't go over.

Susan continued,

> And then you had to present it creatively. And the presentations were just amazing. It had a holiday theme to it, so they got to do some decoration. They got to be creative, with what they were going to get. They got the research on the computer, but they had to find magazine pictures. They had to calculate [the gifts] them, including the costs of taxes and

> if they had shipping or whatever. So a lot of different ways. So all different levels [of students] were able to attain to that project.

Theme 2, Subtheme 3- The Role of the Teacher in PBL

A subtheme emerged when teachers were asked to describe where they fit into the implementation of PBL in their classrooms. Four of the six teachers in the study mentioned that they become "facilitators" when students are engaged in PBL. Samantha described feeling that as the facilitator, her role was, "Just getting them going, encouraging them, checking in, being a sounding board." Kiley felt that she was

> more of that facilitator and that guide on the side, there to help them check-in, how are we doing, and then constantly do that. But really it is a lot of hands-off, because the students are really guiding the questioning and guiding the inquiry. And you're just there to ask questions about what they know, more of a coaching kind of job.

Janice observed that she functioned more as the "guide on the side",

> You know, you set up the project, you give the guidelines or the rubric for the project, and then you're there to answer any questions. Or if they get stuck, like maybe they're using a program they haven't used before, and they get stuck on it. I just am normally there to kind of guide them.

Teachers also shared they were involved in more behind the scenes work when their students were engaged in PBL. Kiley felt that her knowledge of what the final outcome should be was the most important part of her role

> I guess just having a good understanding of where you're trying to take the kids because I think understanding what the final project is going to look like, you must know that as you're working through the different steps and stages to help them get there.

Kelly described how she interacted with students:

> I was able to go around and gauge their understanding of it and everything. And what we were doing with the different activities and make sure that they understood what the activity was, what we were planning to do, where we were going.

Janice added that the teacher role included "Being organized. Oh, my goodness. If you are not organized, and you do not have your resources available, and you are uncertain of what avenue your kids can take it, you might come up with some hiccups."

Theme 3- How to Implement PBL in a Classroom

The teachers who participated in interviews all had some level of project-based learning training. Kiley, Rebecca and Janice had attended 40 hours of sustained formal training provided by Buck Institute for Education PBL Works (BIE PBL, 2020), along with a team of 14 others from their school. Carol had attended a 21-hour Buck Institute for Education PBL Works (2020) training for teachers along with nine other teachers from her school. This training, a systemic partnership between BIE PBL Works and the school district, began during the summer break and progressed throughout the school year with other school teams in the district. It used a multi-tiered development approach to expose participants to Gold Standard PBL design elements (Larmer et al., 2015). Teachers and administrators in this training were presented research-informed workshops and frameworks designed to develop teaching practices. Support was provided to the schools and administrators between sessions through on-site visits and virtual

meetings. Participating schools then brought what they learned about PBL back to their school sites and shared the information through school-based professional BIE PBL Works formal training through school-based professional development.

All of the teachers interviewed implemented one or more PBL math units. Five of the eight used the project templates provided by PBL Works exclusively, while the others have used PBL Works templates and templates they have found in other places or created themselves. No one used PBL Works sample PBL units exclusively or used the units provided on the PBL Works site exclusively. All six teachers used units for which they had searched on the internet and adjusted them to meet their needs.

Theme 3- Subtheme 1- Integration of Content Areas in PBL

The experiences participants described when sharing information about how they integrate mathematics and other content areas or real-world scenarios pointed toward how this makes a strong instructional connection for students as they work through PBL units. Rebecca shared some examples of real world scenarios. While students participated in a PBL involving fractions, she referenced fractions by sharing how one might cut apart a cake so often that she shared this example, "As hilarious as it sounds, fractions were referenced to cake so much that, at one point, a parent brought in like a sheet cake. And we did an entire lesson with the actual sheet cake." Rebecca continued with another real-world example PBL that she felt provided connection and motivation to complete: "Thanksgiving's coming up. You're going to be in charge of figuring out what you want to make, who's invited, how much you want to make . . . If you have to change any of those recipes, how are you adjusting them?"

Janice described how she tries to incorporate all content areas in her PBL units. The units usually have a main focus, but she always looks for a way to incorporate mathematics into the units. Janice shared the following about a recent PBL:

> I did the reducing carbon footprint [PBL], and we've integrated math within that because we pulled power bills and our electricity bills, water bills, and we kind of were looking at numbers and who used the most. And anyway, so we did math there so we were comparing and contrasting. We were looking at bar graphs and pie charts and incorporating math in that component. It was mostly science and reading language arts, writing.

Kiley described how she tries to weave students' other subject areas and creative interests into the PBL content:

> [Math] can really be put into most projects, because in the real world, you're going to need [math], like designing a dream house, for instance. There's a lot of geometry and measuring. And I do think that they're [PBL] better when you put more than one together, more than one subject area. I feel like it's more real world. We don't usually do things in isolation.

Theme 3, Subtheme 2- Mathematics Standards Mastery and PBL

Study participants were all asked to share how they determine which mathematics standards they would teach during the school year. All teachers responded that they use the district scope and sequence as a guide, which was build based on the Florida State Mathematical Standards. When asked how they monitor student progress toward mastery of the standards, all teachers mentioned using a digital web-based instructional and diagnostic platform provided by

the school district and a variety of other techniques. However, study participants did not use the work done by students during a PBL to help determine if they have mastered mathematic standards.

Samantha shared that her school used the diagnostic platform as a tool to help monitor where students are with specific standards. She then uses the diagnostics to determine “areas in math, numbers, and operation, algebraic thinking... and there's different areas, to let you know what they're really struggling on at grade level. And then you can adjust to help them with those skills.” Kiley also “incorporates exit slips daily, or we might see how they're doing on some of the problems that they're working through in small group.” Kiley also added that she

> looks at the [diagnostic platform] to see which standards they struggled with. We usually assign the standards we're working on too in [diagnostic platform] after we've taught it to see how they did on it, to see did they understand that or do they need additional help.

Kristen stated that at her school they “pretest to find out what skills they [students] need and which ones they do not.” Carol described using

> a little mix of new and old [assessment methods] ways, I feel. We obviously have exit slips. We do that for progress monitoring assessments clearly as a way to progress monitor. But I also feel that just meeting with the kids, talking with the kids, pulling the kids back one-on-one, small, group things like that, is a great way to monitor and really kind of get an idea for what they're understanding and what they're not.

Andrew uses diagnostic platform data and FSA data at the start of the school year, but throughout the year, he relies more on formative assessments to track student mastery.

Theme 4- Lessons Learned with Implementation of PBL

The fourth theme that emerged from the data analysis was recommendations from teachers about the use of PBL in their classrooms. Teachers participating in the study all had some level of PBL training. Each of the participants in the study conducted one or more PBL experiences in mathematics with their students.

Theme 4, Subtheme 1- How to Get Started Using PBL

None of the participating teachers mentioned that training was necessary before embarking on a PBL unit with students. Kiley suggested that, at minimum, reading a book on the topic would provide a process to follow so that training did not overwhelm teachers. Rebecca compared her use of PBL before and after attending the district training:

> Now, after the training, I can see how they want you to write out the lesson plan. And it's extremely detailed and every little piece, of [the] component... You know, they just want you to, I guess, be more thoughtful in the process of project-based learning.

Participants were asked to share what advice they would give to a teacher who wanted to get started with PBL with their students. Andrew recommended that the teacher should "make sure it's something that you're excited about." He also suggested "having real people come in and talk to the students." Andrew prepared his students for visitors by having them write questions in advance. He felt it was important to "hear from real people doing real things that related to the project. So that inquiry piece and research where the interviews could happen with the kids really made them appreciate the opportunity to do the project."

Julie's advice to teachers getting started with PBL was:

> I would just say the biggest thing on the teacher's side is really the organization and having everything ready and knowing your kids. Because if you don't know your kids and you're just kind of pulling something to see if it's going to work, it may or may not, but then that's a lot of work that you just devoted that may not be fully executed with your class, and you may not enjoy it.

Theme 4, Subtheme 2- Drawbacks of PBL Implementation

A subtheme emerged from the Use of PBL theme. When asked, teachers shared some lessons learned for colleagues who might venture into the process in the future. Carol felt that she had struggled at first because she had not been able to attend the district training:

> I think it was a struggle for me in the beginning because I was just trying to understand where we were going since I hadn't really done the training, and my team members were trying to explain it to me.

Carol further explained that part of the problem was that she and her team were working on different topics of PBL, which made their subject-based explanations challenging to her

Rebecca suggests ensuring that the school day is conducive to PBL: “So the biggest drawback I think we've seen this year is when the school day isn't planned well for project-based learning.” She added, “Something that came up in the session training was you don't want it to become like a dessert where you get to it at the end, and it's just something free or fun at the end of the day.”

Andrew shared his point of view as a teacher implementing PBL and the drawbacks associated:

> I think that one of the biggest drawbacks is trying to learn your place as a teacher to be a facilitator, rather than direct teaching. Especially with the time constraints, it's really hard to get that discovery learning gear turned on in students' minds, where they're problem-solving for themselves. It was hard to get them set up on the right path because they were very quick to ask questions, to get frustrated because they're so used to me just giving them the information.

According to Kiley PBL is not as effective with students who have trouble working independently:

> I have found that it works really well for students who can work pretty well independently. I struggled last year with the students who just don't really care about school, just getting them to get the work done and getting them to focus. So I've had to revamp it this year to make sure there's motivation built in to get them to do the work because it is a little more independent work.

Kiley then shared her thoughts about how PBL would benefit at-risk students and how to ensure a successful implementation:

> Project-based learning would be difficult [to implement] if you were at a more at-risk school. I started my career at a Title I school, and I tried to think of doing project-based learning there. It would be such a benefit for those students because it's real-world based and interest-based, and it would get them excited. But to really make sure your project had the basics really built in there, before you go too far, really making sure that the actual work was really impacting them, too.

Validity and Reliability Outcomes

As part of this study's validity and reliability component, the researcher used member checking, peer debriefing, and bracketing. Member checking, used at the end of data collection involved asking participants to review transcriptions for accuracy. One study participant was concerned about inaudible sections from the recording and transcription. The researcher and participant determined that these inaudible sections did not detract from the overall meaning. Data analysis criteria were followed to synthesize the data collected from interviews. Verbatim transcripts were organized and repeatedly read to determine common threads of the responses: codes were assigned to the data based on meaning to establish categories and summarize the data.

Meanings from the interviews were clustered into common themes. Triangulation of the data collected was achieved through combined member checking, multiple interviews, and use of a peer debriefer for the phenomenon studied. Raw data and researcher interpretations of the data were presented to a peer reviewer to help determine if the researcher's findings were reasonable, given the documentation presented. The peer debriefer asked questions about some statements made, and an agreement was reached through a review of the transcriptions. Review of quotes within the context of the interview rather than in the isolation of the raw data collection spreadsheet helped with this process. As part of the phenomenological study, bracketing was used, which involved the researcher appending their own beliefs to obtain an impartial viewpoint based on data collected from the interviewees that demonstrated the phenomenon.

As the primary data collection instrument, the researcher was aware of perceptions and beliefs regarding PBL and put them aside while collecting and analyzing the data. The researcher

conducted a bracketing exercise to lay aside bias. The experience that could cause bias is also the same experience that permits the researcher to ask probing questions, speak intelligently on the topic, and process the data collected.

Summary

This phenomenological study explored a research question about the lived experiences of teachers using project-based learning (PBL) in urban schools. Biographical sketches of the eight participants were provided on each study participant, which included their levels of teaching experience and training levels with PBL. The researcher analyzed the raw data from these interviews. Four main themes and ten subthemes evolved from the analysis.

The first theme to emerge dealt with teacher perceptions of at-risk students and their work with PBL. Overall, teachers shared that the students they worked with whom they deemed at-risk shared the following common characteristics: they lacked ability to work independently, were easily frustrated and overwhelmed, were passive about learning, were underachieving, had social and emotional issues, experienced challenges in the home, and lacked parental support. This led to three subthemes: socioeconomic status and at-risk students, strategies used to help below-level students with PBL, and on- and above-level at-risk students and PBL.

The second theme was student participation in PBL. The three subthemes resulting from this theme were PBL and demonstration of a growth mindset in students, student engagement and PBL, and the role of the teacher in PBL. This theme focused on active rather than passive learning that occurs as students build an understanding of the world. If student participation is passive or marginal, their level of standard and skill acquisition is nominal.

The third theme that developed was how to implement PBL in a classroom. Two subthemes evolved from this theme: integration of content areas in PBL and mathematics standards mastery and PBL. All of the teachers interviewed implemented at least PBL math units.

The final theme that emerged was that of lessons learned through PBL implementation. The two subthemes that developed were how to get started using PBL and drawbacks of PBL implementation. The study participants had a great deal of knowledge to share with those wanting to start using PBL in their classrooms. They learned some lessons from reading text and some from training, but most of their learning came from actual implementation and trial and error. The tips teachers shared could be invaluable to someone just starting or having questions about where next to go with PBL.

CHAPTER 5: CONCLUSION

Introduction

This chapter reviews this study's methodology and summarizes its findings. The review presents research connections and implications of the findings, discusses the study's limitations, and provides recommendations for future research in this and similar areas. This study was intended to identify effective instructional strategies embedded in project-based learning pedagogy and provide valuable, practical information for educators who strive to incorporate project-based learning into their classrooms and schools.

Review of the Methodology

This study explored the lived experiences of fourth and fifth-grade teachers who used project-based learning (PBL) during mathematics lessons in urban schools through a qualitative research design. The phenomenological research approach was used to study the meaning individuals attached to their lived experiences (Ary et al., 2019). This research examined the meaning individuals attached to the experience of using PBL during mathematics instruction in urban schools using one-on-one interviews of teachers who had experienced the use of project-based learning units in mathematics with their students. The following research question guided this study: What are the lived experiences of fourth- and fifth-grade teachers in urban schools who use project-based learning during mathematics instruction?

Study participants recruited for the study were from the 16 schools in the district who had participated in a Buck Institute for Education PBL Works (BIE PBL, 2020) series of trainings focusing on implementing PBL through a multi-tiered development approach. Teams attending

the training brought what they learned back to their schools to share with instructional staff. Teachers invited to participate completed a demographic survey and one-on-one interviews. The teachers who participated in the study, based their responses on work they had done with their students prior to March 23, 2020 when schools were closed due to the COVID-19 pandemic. At the time that interviews were conducted, schools had just begun a process of digital learning with their students and were using a digital platform to provide instruction. Teachers who participated in the interviews had not implemented PBL with their students through digital learning platforms.

Discussion of Findings

Four common themes developed through the analysis of the demographic and interview data: (a) challenges with implementation of project-based learning with at-risk students, (b) student ability and participation in project-based learning, (c) teachers' views on how they implement project-based learning, and (d) lessons learned through implementation of PBL.

Summary of Themes

Theme 1: At-risk Students and Project-based Learning Implementation Challenges

The first finding of this study emerged from questions asked of teachers on how they defined at-risk students. Definitions varied, but commonalities presented in their perceptions. According to study participants, being at risk was not limited to learning difficulties and school achievement. Overall, teachers identified the following common characteristics of the students with whom they worked and whom they deemed at-risk: lacking ability to work independently, being easily frustrated and overwhelmed and passive about learning, underachieving,

experiencing social and emotional issues, experiencing challenges at home, and lacking parental support. Teachers noted that students rarely demonstrated only one of the noted characteristics. It was a combination of these that presented in students who have difficulty and find themselves in a situation in which they fall behind academically and become at-risk for failure in school. Linnenbrick (2005) argued that productive classroom environments must emphasize understanding student needs.

Mayer (2011) concluded that teacher expertise and knowledge only partly contribute to student success; students must also be motivated to use the skills they are taught. Participants shared specific strategies they used to assist students with academic difficulties in the classroom and while engaged in project-based learning (PBL). Some students are two to three grade levels below and lack the necessary skills to successfully navigate a PBL unit, which requires them to apply grade-level standards in their work. Participants reported that these students needed small group instruction and one-on-one guidance. Agrawal and Morin (2016) argued that priority should be given to math reasoning and making connections but that instruction for at-risk students currently focuses primarily on computational skills and procedures. Project-based learning emphasizes engagement in rigorous real-world problem-solving (Larmer et al., 2015). This real-world aspect can make success in the process difficult for students who are performing below grade level or who lack the basic skills necessary to complete the tasks assigned.

Participants also mentioned that at-risk students can become passive learners and that the work required can easily overwhelm them. Han et al. (2015) point out that in the classroom, there exist diverse levels of achievement for which teachers change instructional approaches based on needs. Individual students may exhibit a variance of success within the same learning

environment, and instructional needs can differ for each student based on their specific characteristics. Bandura (2000) noted that students who do not feel successful with their work can negatively affect their belief in themselves and can affect their desire even to attempt the work. Teachers who are not able to pivot and adjust to the needs of students at the moment find meeting students' needs a challenge task. Boss and Larmer (2018) recommend using PBL with at-risk students to provide a means for the teacher to address students' needs in mathematics with the application of grade-level standards using real-world scenarios that provide purpose and meaning for students. Linnenbrink (2005) noted that effective classroom environments emphasize varied and meaningful tasks and opportunities for students to make choices to guide their learning, which PBL helps to provide.

Not all students whom participants defined as at-risk were below level. Some shared that students who were on or above grade level could often be just as fragile as their below-level classmates and that they also demonstrated at-risk characteristics. Some of these students needed social–emotional rather than academic support. The same strategies of small group or one-on-one assistance were provided. Bandura (2000) pointed out that efficacy affects students' concept of their capabilities and can negatively affect student motivation to complete tasks. Linnenbrink (2005) reinforced the idea that students must be challenged, which can give them intrinsic rewards through setting a goal and working on reaching it.

Theme 2: Student Participation in Project-based Learning

The second finding of this study stemmed from how study participants explained the levels of engagement in students, demonstration of a growth mindset, and the role of teacher interaction during project-based learning. Study participants focused on ensuring that students

maintained high levels of perseverance, belief in themselves, and never giving up. This is the attitude that students needed to stay engaged in the content and in the learning experience.

The triangulation of the data was used to synthesize this theme. The researcher has had a career in education as both an instructor of students and an observer and supervisor of teachers. The study participants all shared how they were able to help ensure students were engaged in the work of PBL and the characteristics students demonstrated that supported their claims.

Larmer et al. (2015) highlights that to set the stage for successful PBL implementation, a culture of a growth mindset is necessary and students need to understand how they cycle through revision and critique and use these as opportunities to improve their work. Study participants shared how students have to be able to handle making mistakes and not worrying about how it may bother them to the extent of giving up. Teachers shared how they helped motivate students to work through challenging content. Teachers also shared how they helped their students reach this level of perseverance and recognize that sometimes the work is challenging. In agreement with Dweck (2006), study participants also described students with a growth mindset who could stretch themselves and believed that they had become smarter for the effort. Bandura (2000) argued that when students believe in their ability to be successful, their self-efficacy increases, and so does their level of achievement.

Study participants observed that for their students to be successful in the work of PBL, they had to adopt a classroom atmosphere where students felt supported while being challenged. Boss and Larmer's (2018) definition of PBL includes student-centered learning, small group interaction, the teacher as a facilitator or guide, an authentic, real-world problem under investigation, and previously taught information practiced while new information is learned.

Cooper and Murphy (2016) reinforce this: to sustain that thriving atmosphere, teachers must encourage their students to explore their curiosity and take risks, which enhances their cognitive abilities. Participants shared that they felt their role in PBL shifted from instructor to facilitator, frequently commenting that they needed to be close by and guide the work but that the decision-making was ultimately left up to the students.

Teachers shared examples of student engagement, excitement, and collaboration during project work, as well as how students supported their peers' efforts. Slavin (2015) suggests that students who participate in groups with a common goal are more motivated to learn and better equipped to elaborate on content and experience. Larmer et al. (2015) suggested that teachers need preparation in providing a classroom that promotes student participation in engagement strategies such as working in teams, collaborative discussions, active listening, sharing, building on ideas, respecting other viewpoints, and creating a plan that provides for sharing the workload. Teacher comments on these topics were shared throughout the interview process, as were procedures in which their students engaged during PBL. Slavin (2014a) suggests that cooperative learning results in students' ability to provide clarification to other students in a way that they can understand. This was also was a theme amplified by study participants.

The opportunities for cooperative learning provide a springboard to success with PBL. While engaged in PBL, students work in groups to share personal knowledge, research their topic, and solve the problem presented (Bell, 2010). Students who have the chance to ask questions exhibit learning at higher levels (Ostroff, 2016). Project-based Learning encourages social interaction as students rehearse and become skilled in 21st-century forms of communication, negotiation, and relationships (Bell, 2010).

Theme 3- How to Implement PBL in a Classroom

The third theme to emerge from the analysis of the data comprised information on how teachers engaged in implementing project-based learning (PBL). The two areas that emerged from this theme were integration of content areas into PBL units and mathematics standards mastered in PBL units.

All participating teachers in the study received some level of training on the PBL process. All participants were chosen from one of the 16 schools in this urban district that had a team of teachers and administrators attend a 40-hour Buck Institute for Education PBL Works (BIE PBL, 2020) training. If teachers did not attend the 40-hour training, they received a 21-hour training or received turnkey training at the school level from team members who did attend one of the other trainings. All teachers interviewed implemented one or more PBL units that included mathematic standards at the fourth- or fifth-grade level.

The participating teachers shared the mathematics standards they had used in a PBL unit. Teachers had done a mix of mathematics-only-focused PBL units and units comprising mathematics integrated with other content areas. Warner and Kaur (2017) elaborated that modern mathematical instruction requires student engagement in ways that help them solve problems without fixed responses and thinking that contributes to resolving present-day dilemmas. Larmer et al. (2015) supported that PBL provides an opportunity for students to learn more deeply than through traditional teaching methods in preparation for building competency for 21st-century skills. Study participants shared examples about how real-world scenarios and integration of content areas provide students with motivation to engage in the work and apply what they had learned in the PBL work about the mathematical standards. The integration of mathematics and

other content areas in PBL helps to stimulate this process. Boaler (2016) suggested that ingenuity and flexibility are all part of the PBL process and can help instill ingenuity, flexibility, and the desire to explore a variety of ideas, in students. Participants shared that including real-world problem solving that integrated mathematics led to students naturally making connections with the standards.

Study participants shared that they all used the district scope and sequence as their guide to determine the standards they needed to include in their instruction. To monitor the progress of student mastery of grade-level standards, teachers used a web-based diagnostic platform to track student performance and determine intervention needs. On a less formal basis, teachers used formative assessments and exit slips to monitor student mastery. Agrawal and Morin (2016) and Goldman and Hasselbring (1997) offered that students with mathematical deficiencies have problems with both conceptual and procedural knowledge of math concepts. Teachers shared that when students demonstrated deficiencies, they engaged in one-on-one instruction or small group instruction on those standards and skills to help fill in missing mathematical concepts. Some teachers also assigned the corresponding lesson on the digital diagnostic platform that provided extra instruction and practice. These strategies were implemented outside of PBL units as needed. One-on-one and small-group instruction also took place during PBL units when students needed extra assistance. Han et al. (2015) expressed that in the classroom, there exist diverse levels of achievement in which teachers change instructional approaches based on needs. This is also what teachers in the study described as their process as needed.

Theme 4- Lessons Learned with Implementation of PBL

The fourth and final theme that emerged from the data analysis included information from study participants about how they implemented project-based learning. Teachers participating in the study used varying levels of PBL training and implementation. They all used the process with their fourth- or fifth-grade students and included grade-level mathematics standards in their units.

Study participants shared that the work they did with students during PBL implementation helped to engage students in inquiry-based active learning, which Holm (2011) identified as the goal of PBL. Teachers also shared that through PBL implementation, they are engaging students in what Marzano (2009) defined as 21st-century instructional methods. Warner and Kaur (2017) attest that modern mathematical instruction requires students to engage in problems that do not have a fixed or correct response. Specifics that teachers shared about the PBL units they in which their students were engaged included those characteristics. Villa and Baptiste (2014) explain that each time a student engages in activities, new connections are made that help build on prior knowledge and cognitive adjustments are made to accommodate new information and its application.

Teachers shared that their role in PBL was less that of instructor and more that of guide and facilitator in the process. Hallerman et al. (2011) and Larmer et.al. (2015) concur that instruction based on PBL requires the teacher to have the confidence to allow student engagement in independent learning and to be a facilitator in the process. Participants shared experiences about how, as students engaged more in PBL activities, not only did their enthusiasm and engagement improve, but so did their ability to become more self-sufficient.

When students are demonstrating self-sufficiency and independent problem-solving, the teacher becomes more of a guide on the side. Strobel and van Barneveld (2009) highlight that if teachers see PBL as a meaningful instructional tactic and a way to help students retain information, it could be a way to expose students to 21st-century skills.

Teachers' experiences with PBL also included how their students were motivated to participate in the activities and how they engaged in hands-on learning. Piaget (1964) theorized that when students demonstrate assimilation and accommodation, they build schema about the information that enable them to solve problems through discovery. The work that participants described their students engaged in during PBL demonstrated this phenomenon. Wiggins and McTighe (2005) illustrated that when students show varied levels of knowledge, they synthesize and evaluate, solve problems, and evaluate outcomes. Study participants provided examples about how their students, engaged in PBL activities, were making clear connections with the content and also were able to synthesize the standards embedded in PBL units.

Study participants also shared drawbacks they experienced in implementing PBL. Some shared that they sometimes struggled in leading implementation with students because of their own discomfort with the process. Those who had more experience with PBL described having less struggle with implementation. Participants also stated that they needed to remember to let students do the work and remember their place as facilitator and guide. Larmer et al. (2015) reiterate that do this effectively with PBL, the teacher must balance inclusion of the concepts of the constructivist theory of learning, growth mindset, cooperative learning, and self-efficacy, all of which are strategies that improve student performance. These are also strategies that help teachers provide appropriate instruction to all students in the classroom.

Study participants expressed the concern that not all students in the class have the same learning needs. Some are above level, and some are below, making instruction difficult in any setting. This was a particular concern of participating teachers regarding PBL, which Pepper (2017) noted requires that students participate in problem solving, collaboration, and decision-making skills. If students lack skill mastery, these requirements can be a struggle for them. Bandura (2000) concludes that to operate at this level, students must have the self-efficacy or confidence to perform effectively and not become overwhelmed. According to Agrawal and Morin (2016), engaging students in an instructional environment that provides these types of opportunities is what helps improve student achievement. Study participants shared their concerns about how students lacking basic grade level ability can achieve this goal and participate fully in PBL. Davenport and Anderson (2002) state that students whose teachers set a high level of expectation, regardless of student ability, attain the highest self-esteem. Linnenbrink (2005) suggested that effective classroom environments must emphasize understanding student needs and provide varied and meaningful tasks and opportunities for students to make choices to guide their learning. Following these directions will help teachers address their own concerns about varied levels of ability and meet their students' needs.

Implications of the Findings

The findings from this study indicated that teachers in urban schools who have experienced PBL with their students had positive experiences and challenges with the phenomenon. Study participants used a variety of definitions to describe at-risk students. One common characteristic they identified, whether the students were below level, on level, or above level, was that they all need for teachers to implement specific strategies to best meet their needs.

There was not a “one size fits all” definition or strategy to meet these needs. Participants shared that socioeconomic status was only one component of what can contribute to at-risk status for students. However, what all students had in common, according to the teachers interviewed, was that they had one or more special circumstances that affected their learning capacities and contributed to their being considered at risk of failure.

Overall, one finding of this study was an indication that students of all ability levels experienced success with PBL. A review of teacher comments about student interaction and engagement demonstrated how students reacted positively and were willing to demonstrate application of the standards, even if the work was challenging. Study participants indicated that students were stretching themselves and engaging in an inquiry process, leading to learning beyond the typical lecture and workbook-style lesson. The key to this style of teaching and student learning was that teachers had to build a sense of community in their classroom and a culture where students felt safe to take risks and ask questions. Teachers also had to step away from leading the learning and facilitate by walking alongside students, assisting and guiding only when needed.

Another implication of this finding is that teachers implementing PBL with their students still had to engage in some common classroom procedures to ensure mastery of the standards integrated into the unit. Teachers still engaged students in progress monitoring activities and used the data to work with students in small groups or one on one as needed. This practice was needed to help fill in the skills students were missing to proceed with the skills required for the PBL unit. Students who did not show a need for this type of support continued with their work. Proficient students were also often poised to provide intervention, helping peers with the skills or

strategies. Teachers noted that these students who were able to help or explain concepts to others demonstrated mastery of the skill that went beyond typical progress monitoring strategies.

This study also found that participants who did not attend formal PBL training were still able to engage their students in activities that focused on providing 21st-century skills and strategies. These skills in mathematics are critical in preparing students for success beyond school and for successfully moving into a modern workforce. Participants without formal training engaged in turnkey training, conduct self-study, and rely on peer guidance to make the experience successful. Participants also shared that they depended on sample PBL units and some trial and error to help ensure that all components of PBL were covered.

Participants shared drawbacks with the implementation of PBL. Remembering to let students be the guide and act as a facilitator to students was also a struggle for participants. Another concern shared by participants was that students had a variety of learning needs that made PBL implementation difficult at times. Students who lacked the necessary skills found participating in problem solving and decision-making a challenge. For teachers, providing students with the level of self-efficacy and confidence to perform at a level that helps improve achievement is a challenge when students are missing skills or are well below level.

Study Limitations

There are limitations associated with qualitative research. One limitation of this study stems from researcher subjection to bias. The study was conducted in the school district in which the researcher is employed. The second limitation is the generalization of the study. The third limitation was that this study's transferability might be unclear.

Recommendations for Future Research

Student preparation for the rigors of 21st-century skills in a growing complex economy and society is a constant concern at the school and district level. The need for further research to determine if project-based learning (PBL) is the strategy that will help propel students to success is necessary. Some suggestions to guide this future research include:

(a) A similar study of PBL that looks at students with learning disabilities and how they react to the strategy. Many students with learning disabilities may be below level or at- risk, but how their specific challenges, and this study did not explore how they interact with the phenomenon. Future study could focus on how students with disabilities react to the process.

(b) Further exploration of the impact that school leadership has on PBL implementation from the viewpoint of stakeholders such as teachers, students, parents, and the community is needed to help determine PBL effectiveness at the school level. This study's findings focused on PBL from the perspective of the teacher only and did not address that experience from different viewpoints. Further research could address this shortcoming.

(c) The onset of the COVID-19 pandemic required that students engage is distance learning for the last marking period of the school year to help mitigate spread of the disease. Project-based learning requires that students collaborate and work together which may prove difficult if social distancing and digital learning continues. Further exploration of how this may impact students' ability to work together and work in partnership on project work is needed to address this practice and how it impacts PBL.

Conclusion

In this study, the researcher utilized a phenomenological approach to understand the lived experiences of fourth- and fifth-grade teachers who used project-based learning (PBL) during mathematics lessons in urban schools through a qualitative research design. The following research question guided this study: What are the lived experiences of fourth- and fifth-grade teachers in urban schools who use project-based learning during mathematics instruction? One finding of this study was an indication that students of all ability levels experienced success with PBL. A review of the teacher comments about student interaction and engagement demonstrated how students reacted positively and showed a willingness to demonstrate the application of the standards, even if the work was challenging. Another finding of this study stemmed from how study participants explained the levels of engagement in students, demonstration of a growth mindset, and the role of teacher interaction during project-based learning. The third finding that emerged from the analysis of the data was information on how teachers engaged in the implementation of PBL. The two areas that developed from this finding included information on integration of content areas in PBL and mathematics standards mastery. The fourth and final finding that arose from the data analysis includes information from study participants about their implementation of project-based learning.

APPENDIX A
SURVEY QUESTIONS

Survey Questions – to determine eligibility in the interview portion and establish demographics

These questions were put into a Qualtircs survey and used to help determine which teachers would be part of the interview process and the study.

1. Teacher Name

2. School

3. Number of years teaching

- 0-5
- 5-10
- 10 or more

4. What is your highest level of education?

- Bachelor's Degree
- Master's Degree
- Doctorate

5. List your major for each degree

- Bachelor's Degree
- Master's Degree
- Doctorate

4. List the area(s) in which you hold a professional certification

5. What is your current grade level of instruction?

6. Please list all the grade levels in which you have teaching experience?

7. Have you attended training on project-based learning?

8. Please state the number of hours/professional development opportunities you have had to learn about PBL.

9. Have you implemented project-based learning during mathematics instruction?

10. Contact information

APPENDIX B
SEMI-STRUCTURED INTERVIEW QUESTIONS

Semi-structured interview guide		
Data/Purpose	Question	Prompts & elicitations
To break the ice and provide some background.	1. Please tell me about how long you have been teaching in your current grade level. 2. What is your definition of an at-risk student? Have you had experience with students who are at risk for failure? 3. Have you had experiences with teaching special needs students? Have the students with special needs been included in grade level standards based instruction?	What other grade levels have you taught? What is your favorite subject area to teach and why? What are some of the difficulties you have experienced with ensuring that the needs of all you your students are met? What are some of the strategies you have used to meet the needs of at-risk students during instruction?
To get background on the experience the teacher has had with the math standards instruction.	1. How do you determine which math standards you should address with your students and why? 2. Do you use a particular progress monitoring tool to determine if your students have mastered the skills you have taught?	Do you follow a specific scope and sequence? If so, who provides it? How do you address reteaching these skills?
To get a background of the teacher's Project –based Learning (PBL) implementation	1. Have you had experience using PBL as an instructional technique? How do you define Project –based Learning (PBL) implementation? 2. Please tell me about your experiences in using PBL with your students in Math?	Is there a particular model of PBL that you follow? Have you implemented that particular model in your classes? When did this take place?
To get a background of the teacher's PBL implementation and Math standards instruction	1. What math standards have you addressed using Project –based Learning (PBL)? 2. How do you determine which standards to address when using Project –based Learning (PBL)?	Were multiple standards addressed or just one? Are there mathematic standards for Grade XXX that you believe align better to the use of PBL?"?

	3. Have you experienced any drawbacks or difficulties in using PBL? 4. Have there been content standards you addressed while using PBL? How did you reteach the content because your students' needs have not been adequately met?	Can you describe those experiences? How did you know their needs were not met and reteach these skills?
To get a background of the teacher's PBL implementation	1. What do you feel is the role of the teacher in Project –based Learning (PBL)?	Do you provide instruction differently when implementing PBL? What do you do that is the same as other instructional techniques you use?
Experiences with aspects of a Growth Mindset	1. Having a Growth Mindset plays a part in a student's success with Project-based Learning (PBL). Are you familiar with the concept of growth mindset? 2. How do you define a Growth Mindset? 3. Tell me about how you know when you students are demonstrating a Growth Mindset in your classroom.	Is there a particular article or text that has helped you determine your definition of a Growth Mindset? Can you share a typical example of when you have seen your students demonstrate a growth mindset?
Experiences with aspects of student ownership in Project-based Learning	1. Have you observed your students taking pride/ownership in their projects? How would you describe what you see as "pride or ownership"?	Can you share a typical example?
Analysis of student achievement	1. Have you noticed if all your students meet the standards being measured in a lesson by using PBL?	How are you measuring success? Have you observed students not meeting the standards? Can you describe the next steps you took?
Lessons Learned about PBL	1. What advice would you give a teacher that wanted to start using PBL with their students?	Positive Experiences Negative experiences A typical example

Member-checking.	Paraphrase main data: PBL Implementation, Growth Mindset, Cooperative Learning, Metacognition and Motivation	

APPENDIX C
EXEMPTION DETERMINATION

UNIVERSITY OF CENTRAL FLORIDA

Institutional Review Board
FWA00000351
IRB00001138
Office of Research
12201 Research Parkway
Orlando, FL 32826-3246

EXEMPTION DETERMINATION

January 17, 2020

Dear Bernadette Jaster:

On 1/17/2020, the IRB determined the following submission to be human subjects research that is exempt from regulation:

Type of Review:	Initial Study, Category 2
Title:	Phenomenological Study of Project-based Learning Implementation in Mathematics in Urban Schools
Investigator:	Bernadette Jaster
IRB ID:	STUDY00001333
Funding:	None
Grant ID:	None

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made, and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request so that IRB records will be accurate.

If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

Sincerely,

Racine Jacques, Ph.D.
Designated Reviewer

APPENDIX D
EXPLANATION OF RESEARCH

UNIVERSITY OF CENTRAL FLORIDA

EXPLANATION OF RESEARCH

Title of Project: Phenomenological Study of Project-based Learning Implementation in Mathematics in Urban Schools

Principal Investigator: Bernadette Jaster

Other Investigators: NA

Faculty Supervisor: Dr. Suzanne Martin

You are being invited to take part in a research study. Whether you take part is up to you.

- The purpose of this study is to investigate how the lived experiences and views of third, fourth, and fifth-grade math teachers that are implementing project-based learning (PBL) addresses the needs of their at-risk students in urban schools. Among factors that affect student learning are race, socioeconomic status, and disability.
- The study will seek to ascertain if teachers believe that exposure to project-based learning experiences positively influence if their students benefit from this system of instruction.
- You are being invited to participate because you are a teacher that has used project-based learning as an instructional tool with at-risk students in an urban school.
- Participation in the demographic survey should take no more than 5 minutes to determine appropriate study qualifications are met.
- Participation in a one-on-one interview should not take more that 60-70 minutes.
- You will be audio recorded during this study. If you do not want to be recorded, you will not able to be part of the study. Discuss this with the researcher. If you are recorded, the recording will be kept in a locked, safe place. The recording will be erased or destroyed three years after the study has been completed.
- Names, work location and information about education and work experience will be collected. Only the researcher will have access to the information. This information will be retained for five years after the study has been completed and then destroyed. Identifiable information will not be disclosed in the study.
- You must be 18 years of age or older to take part in this research study.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints contact Bernadette Jaster, Graduate Student, Curriculum and Instruction Program, College of Community Innovation and Education, (407)758-5356, or by email at bernadette.jaster@Knights.ucf.edu. Faculty Supervisor, Dr. Suzanne Martin, College of Community Innovation and Education at (407) 823-4260 or by email at suzanne.martin@ucf.edu.

IRB contact about your rights in this study or to report a complaint: If you have questions about your rights as a research participant, or have concerns about the conduct of this study, please contact Institutional Review Board (IRB), University of Central Florida, Office of Research, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901, or email irb@ucf.edu.

APPENDIX E
SCHOOL DISTRICT RESEARCH NOTICE OF APPROVAL

[redacted] Research and Evaluation [redacted]

[redacted] Application to Conduct Research
Research Notice of Approval

Approval Date: 2/21/2020 **Approval Number:** [redacted]
Expiration Date: 2/20/2021
Project Title: ***Phenomenological Study of Project-based Learning Implementation in Mathematics in Urban Schools***

Requester: Principal Bernadette Jaster
Sponsoring Agency/Organization/Institutional Affiliation: Orange County Public Schools

Thank you for your request to conduct research in [redacted]. We have reviewed and approved your application. This *Research Notice of Approval (R-NOA)* expires one year after issue date, 2/20/2021.

Additionally, we have received principal approvals from the following schools to participate in your study:

- [redacted]

If you are interacting with [redacted] staff or students, you may email the school-based or district-based administrators who have indicated interest in participating, including this notice as an attachment. After initial contact with applicable administrators, you may email any necessary staff included in your application. This approval notice does not obligate administrators, teachers, students, or families of students to participate in your research study/project; participation is entirely voluntary. [redacted] badges are required to enter any [redacted] campus or building. Additionally, you are required to bring a copy of the R-NOA with you during research activities.

You are responsible for submitting a Change/Renewal Request Form to this department prior to implementing any changes to the currently approved protocol. If any problems or unexpected adverse reactions occur as a result of this study, you must notify this department immediately. Allow 45 days prior to the expiration date, if you intend to submit a Change/Renewal Request Form to extend your R-NOA date. Otherwise, submit the Executive Summary (along with the provided Cover Page) to conclude your research with [redacted] and within 45 calendar days of the R-NOA expiration. Email the form/summary to [redacted]. All forms may be found at this link.

Should you have questions, need assistance or wish to report an adverse event, please contact us at [redacted] or by phone at [redacted]

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APPENDIX F
RECRUITMENT EMAIL MESSAGE

Recruitment Email Message

Dear <Teacher Name>
You are being invited to take part in a research study. Whether you take part is up to you.

- The purpose of this study is to investigate how the lived experiences and views of third, fourth, and fifth-grade math teachers that are implementing project-based learning (PBL) addresses the needs of their at-risk students in urban schools. Among factors that affect student learning are race, socioeconomic status, and disability.
- The study will seek to ascertain if teachers believe that exposure to project-based learning experiences positively influence if their students benefit from this system of instruction.
- The study will include teachers who teach grades three, four or five in the 16 schools who received training on project-based learning and will be offered the opportunity to participate in the demographic survey. Based on responses of the survey up to 10 teachers or until data collection saturation is met will be invited to participate in one-on-one interviews.
- You are being invited to participate because you are a teacher that has used project-based learning as an instructional tool with at-risk students in an urban school.
- Participation in the demographic survey should take no more than 5 minutes to determine appropriate study qualifications are met.
- Participation in a one-on-one interview should not take more that 60-70 minutes.
- You will be audio recorded during this study. If you do not want to be recorded, you will not able to be part of the study. Discuss this with the researcher. If you are recorded, the recording will be kept in a locked, safe place. The recording will be erased or destroyed five years after the study has been completed.
- Names, work location and information about education and work experience will be collected. Only the researcher will have access to the information. This information will be retained once the study has been completed and then destroyed. Identifiable information will not be disclosed in the study.
- You must be 18 years of age or older to take part in this research study.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints contact Bernadette Jaster, Graduate Student, Curriculum and Instruction Program, College of Community Innovation and Education, (407)758-5356, or by email at bernadette.jaster@Knights.ucf.edu. Faculty Supervisor, Dr. Suzanne Martin, College of Community Innovation and Education at (407) 823-4260 or by email at suzanne.martin@ucf.edu.

IRB contact about your rights in this study or to report a complaint: If you have questions about your rights as a research participant, or have concerns about the conduct of this study, please contact Institutional Review Board (IRB), University of Central Florida, Office of Research, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901, or email irb@ucf.edu.

APPENDIX G
PEER DEBRIEFER INSTRUCTIONS

Deer Peer-Debriefer,

Thanks for your assistance with my data review for my dissertation.

To ensure the validity and reliability of the data, I am using the peer-debrief method. I interviewed a total of 8 participants. Please review my coding, categorizes, and development of themes.

1. I have included one original transcript from one of my interviews.
2. I have included an Excel document with my coding analysis.
    a. The first column has the significant statements extracted from each interview transcript, the second column is the coded meaning I assigned, and the third column the category I placed it into.
3. Also included in this email is the data analysis process I used from my dissertation.
4. I have also included my interview questions for the individual face-to-face interviews.

Please follow these steps when reviewing the coding I completed:

1. Read the significant statement (first column) and the code I assigned (second column). In column three, indicate your agreement or provide feedback in the column that says, "Your agreement or feedback." If you decide to write feedback, please include what you do not agree with and why. Also, include an option for a different coded meaning.
2. Read the coded data (second column) and the category I assigned (fourth column). In the fifth column, indicate your agreement or provide feedback in the column that says, "Your agreement or feedback." If you decide to write feedback, please include what you do not agree with and why. Also, include an option for a different category.

Thank you so much for your assistance. If you have any questions, please let me know.

REFERENCES

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