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Grade 6 to 8 Science Teachers' Perceptions of Implementing Project-Based Learning

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This is to certify that the doctoral study by

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Walden University
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Abstract

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MEd, Concordia University, 2017

BS, Albany State University, 2014

Dissertation Submitted in Partial Fulfillment

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Abstract

Project-based learning (PjBL) instruction is an inquiry-based method that is beneficial to student achievement and their exploration of 21st-century learning skills, but there is a gap in the literature about how Grades 6 to 8 teachers feel about PjBL and its implementation. The research problem was science teachers in the United States were not consistently implementing project-based learning strategies as an instructional method to support students' learning and academic achievement. The purpose of this study was to explore Grades 6 to 8 science teachers' perceptions about the implementation of project-based learning instruction to support science education. The conceptual framework for this qualitative study was Dewey's constructivist learning theory. The research questions addressed Grades 6 to 8 science teachers' perceptions of their experiences when implementing project-based learning during science instruction. Data were gathered for this basic qualitative study through semistructured interviews from eight participants who taught middle grades science and used project-based learning instruction for 5 years or more. Data were analyzed through coding and thematic analysis. Overall, Grade 6 to 8 science teachers perceived that PjBL had a positive effect on student engagement, participation, and motivation during science instruction. The findings showed that teachers believe they needed more time to plan, collaborate, and practice the PjBL strategy. The results from this study contributed to positive social change by suggesting best practices for the PjBL framework. On the other hand, the data also revealed barriers related to the implementation of project-based learning in science classrooms, which require attention for teachers to consistently engage students in hands-on learning and promote student success in inquiry-based fields.

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Dedication

This dissertation is dedicated to everyone who believed in me along the way and supported me throughout this process: my husband, Henry Smoke Jr., my son, Kodi; my daughter, Zoey; my parents, Christopher and Mischelle; my sister, Christal; and all of my in-laws. A very special thank you to my chair, Dr. Richard Penny, and my committee for your guidance and knowledge.

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Thank you to my Lord and Savior Jesus Christ for giving me the strength, opportunity, and perseverance to complete this milestone in my educational journey. I can do all things through Christ who strengthens me. [Philippians 4:13]

Without education, no other profession is possible. -Unknown

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Chapter 1: Introduction to the Study

In such a globally progressive world, the current educational environment requires teachers who can effectively employ student-centered strategies in the classroom. Several initiatives have been put in place to reform the teaching and learning of science in U.S. schools. One of these reforms includes the implementation of project-based science curricula. Influenced by Piaget's theory of constructivism, project-based learning (PjBL) involves a long-term project where students work on real-world problems to produce a tangible product, which encourages students to design, problem-solve, think critically, and investigate (Savery, 2006).

Furthermore, Boss and Larmer (2018) highlighted that when teachers engage students in PjBL, the strategy encourages students to experience a learning process that stimulates investigation, testing, discovery, and trying again to find a practical solution. Similarly, Talbert et al. (2019) highlighted that student-centered methods foster middle school students' enthusiasm and enjoyment of science while developing their comprehension of science standards and concepts. Therefore, it is vital that educators apply innovative teaching techniques that engage students of all learning types and abilities.

Though research has proven that PjBL is valuable, the majority of science teachers are reluctant to implement PjBL in their classrooms or do not consistently implement the method with fidelity, according to survey data gathered by the Nation's Report Card (2021). Science teachers' lack of implementation of a new pedagogy may be related to their attitudes toward implementing new pedagogies in general and the level of professional development they receive related to the new pedagogy (Baroudi & Rodjan-Helder, 2021; Tschannen-Moran et al., 2017). Teachers do not implement PjBL explicitly because they (a) do not have a complete understanding of what it is (Condliffe et al., 2017), (b) do not understand how to implement it (Herro et al., 2019), or (c) find the process challenging (An & Mindrila, 2020).

The U.S. Department of Education (2021) initiated a federal mandate for educators to incorporate competency-based personalized learning in U.S. classrooms that include online and blended learning, dual enrollment, and early college high schools, project-based, and community-based learning, asserting that transitioning away from seat time, in favor of a structure that creates flexibility, allows students to progress as they demonstrate mastery of academic content, regardless of time, place, or pace of learning. Despite this federal mandate, the majority of Grade 6 to 8 science teachers inconsistently implement the learning strategy during instruction to support science education (National Science Foundation, 2021). Data from science teachers who responded to questions about how often they incorporated scientific inquiry-related activities in their classroom instruction, as well as the level of emphasis they placed on different scientific inquiry-related objectives in the classroom, revealed that over 50% of teachers reported implementing inquiry-related activities in their science instruction only once every few weeks (Nation’s Report Card, 2021).

This study was needed because science teachers’ perceptions of the benefits and challenges related to them inconsistently implementing PjBL were unknown. This research offered helpful insight for educational stakeholders to initiate a group effort amongst teachers and instructional leaders to endorse improved teacher implementation of PjBL, explain critical elements needed to support science teachers’ implementation of PjBL and reflect upon best practices for teachers to use PjBL in their science classrooms to support science education. The consistent implementation of PjBL aids student achievement in science education. In Chapter 1, the background, problem statement, purpose of the study, research questions, conceptual framework, nature of the study, definitions, assumptions, scope and delimitations, limitations, significance, and a summary are presented.

Background

High-quality science education means that students will develop an in-depth understanding of content and develop key skills like communication, collaboration, inquiry, problem-solving, and flexibility, which will serve them throughout their educational and professional lives (Next Generation Science Standards, 2020). PjBL is an inquiry-based strategy that fosters these skills and is advocated as a powerful method for facilitating students’ attainment of high-level competencies and transferable skills that are increasingly being demanded by science, technology, engineering, and mathematics industries. Studies revealed that the consistent implementation of PjBL supports students’ learning in ways that traditional teaching techniques do not. For example, Kizkapan and Bektas (2017) argued that pedagogical models such as PjBL are required to ensure deep learning, so students are prepared to face the challenges of our globally adept and transforming society. Additionally, Dias and Brantley-Dias (2017) asserted that the benefits of PjBL for educational leaders included greater satisfaction for teachers and resulted in new ways that foster communication with parents and other stakeholders in the community. Conversely, few studies have been conducted to understand Grades 6 to 8 science teachers' perceptions of the challenges and benefits of PjBL implementation. Also, many educators agree that PjBL allows students to engage in a new practice of engagement that supports collaborative learning and results in an increase in concentration among middle school students (Reid-Griffin et al., 2020). Yet, the implementation of PjBL can be complex, resulting in teachers struggling with the process (Lee & Galindo, 2021). Challenges to PjBL implementation may be related to a school's allocation of resources, student motivation, or teacher self-efficacy (Warr & West, 2020). Previous research has documented some common reasons that teachers struggle with the implementation of PjBL due to trouble managing groups of diverse students, difficulty setting appropriate and realistic goals for project completion, lack of administrative support, and lack of training (Warr & West, 2020). However, teachers' attitudes toward new pedagogies, their understanding of the PjBL approach, and their implementation process also affect implementation, and the consistency of which teachers implement the practice (Hofer & Lembens, 2019).

Because the implementation of PjBL is complex and complicated, many teachers do not implement the instructional strategy or do not consistently implement the strategy. This gap in practice was the focus of my research. This study contributed to social change by providing information that instructional leaders can implement to support and encourage or equip middle school science teachers with the necessary skills to promote the successful implementation of PjBL instruction. Although the United States

Department of Education does not provide a model or framework for PjBL implementation, it clearly states that PjBL must be "properly implemented and supported" (Office of Educational Technology, 2020). The United States placed a focus on teachers providing high-quality PjBL instruction in science, technology, engineering, arts, and mathematics to prepare students for 21^{st}-century workplace careers (U.S. Department of Education, 2019). Improving teachers' implementation of PjBL and the consistency in which they implement the process in their classrooms will increase student engagement and achievement across the nation.

Problem Statement

The research problem addressed in this study was that Grade 6 to 8 science teachers are inconsistently implementing PjBL instruction to support science education. The first piece of evidence for the gap in practice underlying the research problem was provided by Bielik et al. (2022) in a study to describe and investigate chemistry and physics teachers' perceptions about transitioning their classroom teaching practices towards a Next Generation Science Standards (NGSS)-aligned curriculum using a PjBL approach. The evidence indicated that teachers reported several challenges including access to continuous professional development, lack of engagement in professional learning communities, lack of ongoing teacher collaboration and lack of teacher empowerment during their implementation of PjBL. The second piece of evidence involved data from a qualitative study carried out by DeCoito and Myszkal (2018). In this study, the researchers investigated the influence of inquiry-based science instruction and Grade 6, 7, and 8 teachers' self-efficacy and beliefs. Data collected through surveys and interviews revealed that teachers only implemented hands-on learning half the time in their classrooms because there was a disconnect between beliefs and implementation in practice. This study also highlighted disparities amongst the need for balancing hands-on learning with traditional learning, a lack of resources, lack of preparation and instructional time, and a limited understanding of what real inquiry looks like and the process of implementing this approach in the classroom. The third piece of evidence was based on data reported from Martinez's (2022) case study that investigated secondary school teachers' experiences in learning to teach 21st-century skills through the design and implementation of a PjBL curriculum. Data on teacher perceptions were gathered through pre-post surveys about their knowledge of and confidence in implementing PjBL. The results indicated that teachers believed barriers included too many students per class, poor attendance, and behavior issues, limited classroom space, students' lack of experience with PjBL, lack of funds and resources, lack of time to create and plan PjBL units, and lack of professional development in PjBL.

The importance of the problem was supported by research backing that when implemented consistently, PjBL has many benefits for students, including having a positive effect on student performance and enhancing the ability of students to solve problems and create authentic products that transform the way students think (Almulla, 2020). Being unaware of why teachers are not consistently implementing PjBL was an issue. Without understanding teachers' perceptions, attempts to shift teacher behavior and develop effective learning environments for Grade 6 to 8 science teachers in the United States were unreasonable. Educational leaders must understand teachers' perceptions related to why they are not implementing PjBL consistently to provide teachers with support in essential areas of need, and ultimately, improve student engagement, participation, and academic achievement in science education.

Purpose of the Study

In the educational field, PjBL instruction is a teaching method in which students learn by actively engaging in real-world and personally meaningful projects (Baroudi & Rodjan-Helder, 2021). The implementation of PjBL is widely studied across grade levels in various content areas, but there is not much research about middle school teachers' views of PjBL implementation to increase students' academic achievement. The purpose of this study was to explore Grades 6 to 8 U.S. science teachers' perceptions about the implementation of PjBL instruction to support science education. I also explored teachers' perceptions of the benefits and challenges of implementing PjBL instruction to support science education.

Research Questions

This basic qualitative study addressed science teachers' perspectives on PjBL implementation in the United States. The purpose of this study is to explore Grade 6 to 8 U.S. science teachers' perceptions about the implementation of PjBL instruction, including its benefits and challenges to support science education. The following research questions guided this basic qualitative study to better understand teachers' perceptions:

- RQ 1: How do Grade 6 to 8 science teachers describe their perceptions of implementing PjBL during science instruction?

- RQ 2: What are Grades 6 to 8 science teachers' perceptions of the benefits of implementing PjBL?
- RQ 3: What are Grades 6 to 8 science teachers' perceptions of the challenges of implementing PjBL?

Conceptual Framework

The PjBL approach creates a "constructivist" learning environment in which students build upon their knowledge. The framework for this study was based on the theory of Dewey (1961). Dewey opposed the traditional role of the teacher as the source of a body of facts and the student as merely a recipient of knowledge (Boss & Larmer, 2018). He first described the benefits of experiential learning that helped shape students' understanding and encouraged their natural curiosity, or learning by doing. Dewey and Small (1897) theorized that "education must be conceived as a continuing reconstruction of experience" (p. 5). This experience is created by active learning, thinking, feeling, and perceiving. Dewey argued that active, hands-on experiences scaffold ongoing learning for students to prepare for a dynamic world.

Nature of the Study

The nature of the study was a basic qualitative study. Basic qualitative studies are used to understand how people experience a topic or situation (Aspers & Corte, 2019). A basic qualitative approach was used in this study because this type of research involves investigating an event by describing and interpreting participants' experiences. The purpose of this study was to explore Grade 6 to 8 U.S. science teachers' perceptions about the implementation of PjBL instruction, including its benefits and challenges to support science education. This type of study is well-suited for research in educational settings, so I was able to thoroughly explore teachers' perceptions of PjBL and the challenges and benefits associated with consistent implementation. My choice of eight participants in this study reflected the recommendations of Becker (1998), who found that a pool of eight to 12 was sufficient to achieve saturation of the data. The participants invited were science teachers of Grades 6 to 8 who have implemented or tried to implement PjBL and have taught in middle schools for at least 5 years. To reach the desired sample of eight to 12, educators were recruited through a flyer posted on social media, snowball, and purposive sampling, and the Walden participant pool.

Definitions

Constructivist approach: An approach to learning where students actively construct their own knowledge, use their previous knowledge as a foundation and build on it with new things that they learn, so everyone's individual experiences make their learning unique to them (Elliott et al., 2000, p. 256).

Growth mindset: The belief that one's basic abilities can be cultivated through dedication and hard work, and that brains and talent are just the starting point, also known as incremental theory of intelligence (Dweck, 2016).

Inquiry-based learning: An educational strategy in which students solve problems and construct their own knowledge about a science concept (Correia & Harrison, 2020).

Nation's Report Card: The nation's report card is the largest ongoing assessment of what U.S. students know and can do (Nation's Report Card, 2021).

National Research Council (NRC): A framework for K-12 science education outlines a broad set of expectations for students in science and engineering in grades k-12 (National Research Council, 1996).

National Science Education Standards (NSES): The National Science Education Standards (NSES) are guidelines for K-12 science education in United States schools (National Research Council, 1996).

Next Generation Science Standards (NGSS): The next generation science standards are k–12 science content standards that set the expectations for what students should know and be able to do (NGSS, 2020).

Perceptions: The way people notice things, such as an idea or a belief people have as a result of how to see or understand a situation (Hornby, 2006).

Project-based learning (PjBL): A teaching method in which students gain knowledge by engaging in real-world, authentic, and complex problem-solving projects that promote student voice and require sustained inquiry, reflection, critique, and revision for an extended period of time and teachers serve as facilitators of constructivist learning environments (Lee & Galindo, 2021).

Student-centered learning: An approach in which students' needs and learning goals are the primary focus of the educational process (Green & Harrington, 2020).

Assumptions

I made two assumptions in this study. One assumption was that all the participants would honestly and thoroughly respond to questions during the interviews. Secondly, I assumed that teachers who were strong advocates or opponents of PjBL would be more interested in participating in this study and expressing their perceptions regarding PjBL than teachers who may not be strong advocates of PjBL.

Scope and Delimitations

In the United States, the majority of teachers either are not implementing PjBL in their science classrooms or are not implementing it consistently (NAEP, 2020). Neither quantitative data, nor was the effect of PjBL in the United States, the interest of this study. My interest in this study is not to debate the value of PjBL implementation but to gather data that can be used to better understand why teachers are not consistently implementing PjBL.

I recruited participants for my study online using social media, national websites, and emails. Administrators, instructional coaches, and other instructional personnel were excluded from this study; therefore, this study was limited to teachers. Teachers were the best choice for data because they were first-hand sources of their own perceptions. My study is not limited to teachers in a specific region but is more general to educators in the United States who teach Grades 6 to 8 science. The teachers met the desired criteria of having at least 5 years of science teaching experience.

The examination of Grade 6 to 8 teachers' perceptions of their implementation of PjBL strategies to support students' learning generated critical data signifying PjBL implementation trends. The information gathered from data analysis was central in uncovering patterns and themes prevalent to Grade 6 to 8 teachers' perceptions of their implementation of PjBL strategies to support students' learning and academic achievement that are transferrable to other educational settings.

Limitations

I collected data for my study by only conducting interviews, which limited the triangulation of data. One of the most important limitations was that this study only included Grade 6 to 8 teachers of science. Another limitation was potential bias, as I am a proponent of PjBL. To address that potential bias, I asked my questions in a neutral tone to ensure that the respondent was not led to believe that there was a correct answer. I avoided asking if a respondent agreed or disagreed with a statement. I also used a reflective journal to make notes of my feelings while reading interview transcriptions. So, another way I mitigated my biases was by journaling my feelings about the answers from participants. Another possible limitation of this study was that participants may have believed that they would be judged for negative responses. I did my best to make the participants feel comfortable and I allowed them to tell their personal experiences with PjBL. An additional possible limitation that affected my data collection was the availability of potential interviewees. The response rate for virtual interviews was not high, maybe as opposed to conducting face-to-face interviews.

Significance

This study was significant in that it contributed to social change by providing insight from teachers and information that instructional leaders need to support and encourage or equip middle school science teachers with the resources and skills to promote the successful implementation of PjBL instruction. Teachers' perceptions influenced their instructional decisions, guided what students were taught, and suggested how effectively they produced scientifically literate students who are college and career-ready. The explanations from Grade 6 to 8 science teachers about the challenges and benefits they experienced while implementing PjBL contributed to advancing the knowledge base of pedagogical methods necessary for preparing teachers to consistently implement PjBL and transition away from traditional teaching approaches that do not emphasize active learning. Additionally, this study advanced educational practices and provided a template for structuring PjBL implementation. This study data revealed barriers that demonstrated where attention is needed to aid and encourage teachers' use of PjBL and offered a balance of content knowledge to facilitate the outlooks educators' value in the new generation of teacher practitioners of 21st-century learning skills.

Moreover, these results produced positive social change by assisting administrators with the knowledge needed to support planning effective PjBL instruction. Positive social change was consistent with and bounded by the scope of this study to include understanding what is necessary to support teachers with consistently implementing PjBL efforts and help students develop skills for living in a knowledge-based, technology-driven society.

Summary

The research problem in this study was that Grade 6 to 8 science teachers are inconsistently implementing PjBL instruction to support science education. The purpose of this study was to explore Grade 6 to 8 U.S. science teachers' perceptions about the implementation of PjBL instruction, including its benefits and challenges to support science education. Implementation of research-based strategies was a vital component of student achievement, although many issues arose that hindered the process of PjBL implementation. The following research questions guided this basic qualitative study to better understand teachers' perceptions:

- RQ 1: How do Grade 6 to 8 science teachers describe their perceptions of implementing PjBL during science instruction?
- RQ 2: What are Grades 6 to 8 science teachers' perceptions of the benefits of implementing PjBL?
- RQ 3: What are Grades 6 to 8 science teachers' perceptions of the challenges of implementing PjBL?

The conceptual framework for this study was based on the beliefs of John Dewey. My study followed a basic qualitative design and the participants invited were teachers of Grades 6 to 8 who have taught for at least 5 years. Implications from this study included educators gaining more awareness and understanding as it related to what teachers need for the successful implementation of PjBL.

Chapter 2 is a wide-ranging review of the literature on PjBL to support student achievement. This literature review outlined the characteristics of PjBL, followed by the influence of constructivist learning theories and the positive impact of the constructivists' perspectives on PjBL strategies to support student learning. Furthermore, I discuss the benefits of PjBL implementation that positively support student learning in different educational settings, along with a growth mindset and the resources required for PjBL. Other topics addressed in Chapter 2 include teacher roles in supporting student-centered strategies, the need for professional development, collaboration, and planning, and the importance of supportive leadership. I conclude the chapter with an examination of the challenges related to PjBL implementation and the perceptions of teachers.

Chapter 2: Literature Review

The research problem that was addressed throughout this study was that Grade 6 to 8 science teachers are inconsistently implementing PjBL instruction to support science education. The purpose of this study was to explore Grades 6 to 8 U.S. science teachers' perceptions about the implementation of PjBL instruction to support science education. Due to the adoption of the NGSS in 2013, teachers have begun to implement inquiry-based methods of learning, such as PjBL, despite their struggles and the various reasons why they struggle (Molebash et al., 2019). The lack of teachers implementing PjBL completely or inconsistently during science instruction is problematic, considering the positive outcomes associated with the instructional method (Morrison et al., 2021). The NGSS was developed by states to improve science education for all students and designed to help students deepen their understanding of domain-specific content through the application of design and engineering processes (NSTA, 2021). As mentioned on its website, these standards set the expectations for what students should know and be able to do and require K-12 science teachers to implement PjBL instruction in their lessons. These inquiry-embedded standards drive students to develop 21st-century learning skills through project-based instruction, but teachers are struggling nationwide with this process (Martinez, 2022). In general, research revealed that teachers encountered several challenges when they shifted their instructional delivery to an inquiry-based curriculum (Gholam, 2019). The NSES is a set of guidelines for K-12 science education in United States schools. Established by the National Research Council in 1996 to provide a set of goals for teachers to set for their students and for administrators to provide professional development, the NSES has significantly influenced various states' science learning standards and state-wide standardized testing (National Science Teaching Association, 2021). Still, the NSES has expressed the following key elements that educational decision-makers should place more emphasis on to promote inquiry:

- Understanding scientific concepts and developing abilities of inquiry vs. knowing scientific facts and opinion
- Implementing inquiry as instructional strategies, abilities, and ideas to be learned
- Investigations over extended periods of time vs. investigations confined to one class period
- Implementing multiple process skills such as manipulation, cognitive, and procedural vs. individual process skills such as observation and inference
- Communicating science exploration and experiment with argument and explanation vs. providing answers to questions about science content.

Although the NSES are guidelines for K-12 science education in United States schools, representatives of the NSES have pointed out that the science education system needs to change on the district, state, and federal levels in order to effectively promote the vision of science education described in the NSES. The major sections of the literature review are Characteristics of Project-Based Learning, Preparing Teachers for PjBL Implementation, Teacher Roles in PjBL Implementation, PjBL Implementation and Benefits, Challenges of PjBL Instruction, and Teacher Perceptions of PjBL Instruction.

Literature Search Strategy

My study is entitled “Grades 6 to 8 Science Teachers’ Perceptions of Implementing Project-Based Learning,” so my search terms were specified as *project-based learning, project-based instruction, PjBL implementation, inquiry-based learning teacher perceptions/beliefs/attitudes, inquiry-based implementation, PjBL science instruction*, and *inquiry-based science instruction*. I generated an extensive pool of relevant, peer-reviewed literature about PjBL through the *Journal of Science Teacher Education, Education Source, Journal of Inquiry and Action in Education, Disciplinary and Interdisciplinary Science Education Research, International Journal of Technology in Education and Science, Research in Science & Technological Education, Interdisciplinary Journal of Problem-Based Learning, Science Direct, Journal of Educational Research and Practice*, and *International Journal of STEM Education.*

Conceptual Framework

My conceptual framework was based on the work of Dewey (1961). John Dewey proposed learning by doing (Williams, 2017). The concept of PjBL is based on Dewey’s constructivist learning theory which defines learning as a hands-on approach instead of a subject-based approach (Matriano, 2020). This theory emphasizes the need for educators to implement instruction that is student-centered. Dewey opposed the traditional view of the teacher as the source of knowledgeable facts while the student memorizes that content. He argued instead for active experiences that prepare students for ongoing learning. Dewey stated that the teacher is not in the school to impose certain ideas or to form certain habits in the child but is there as a member of the community to select the influences that shall affect the child and assist in properly responding to these influences (Dewey & Small, 1897, p. 9). It is through this conceptual lens that this study was conducted.

PjBL focuses on several characteristics, which embody the concept of developing the whole child, instead of rote memorization and recall. Dewey (1961) argued the importance of self-directed learning and that a child's experiences are much more meaningful than the subject matter. Additionally, Dewey emphasized that education happens not by listening to words, but through experiences carried out in the learning environment. Both self-directed learning and learning by experience and through reflection embody constructivism, in which new knowledge is the result of experience. Teachers are the leaders in the classroom who are accountable for preparing students for the future. However, this study focuses on the perceptions of teachers who do not consistently implement the mandated PjBL practice or do not implement the method at all. The results of this study provide teachers, administrators, and instructional leaders with noteworthy acumen to become more prepared to intentionally implement PjBL.

Constructivists assert that learners do not transfer knowledge from outside but instead create their own meaning and interpretation of the world through gained experience (Ertmer & Newby, 1993). In a constructivist learning environment, the student is in control of the knowledge gained and of the interactions with others that happen with developing knowledge (Piaget, 1953). Teachers should be fully equipped for new teaching strategies and have access to the tools necessary to support those strategies. PjBL includes active exploration, where the teacher plays the role of facilitator and students gain knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging, and complex question, problem, or challenge (Almulla, 2020). The teacher does not engage the student in terms of whether the understanding gained is correct or incorrect, but instead allows the student to construct knowledge in addition to constructing understanding. A major element of the framework of PjBL and the constructivist theory is the ability of students to connect what they are learning to their ability to synthesize information into their interpretation (Saad & Zainudin, 2022). PjBL was developed as a response to the idea that traditional, subject-based learning does not offer a global approach to the development of 21^{st}-century skills, although 21^{st}-century skills are necessary for the future of employment, education, digital citizenship, and active citizenship in the world (Baird, 2019). The PjBL learning approach fosters 21^{st}-century skills and allows students the opportunity to create their own path to knowledge. Therefore, it is an important addition to the curriculum.

Traditional classroom instruction and standardized testing generally fail to align with 21^{st}-century requirements and learner needs (Martinez, 2022). Teachers' delivery of classroom instruction should serve individual learner needs. In addition, there are several different types of learners, including low-achieving students and students with special educational needs, whose instruction requires more innovative methods (Culclasure et al., 2019). This idea was emphasized by Leggett and Harrington (2021), who reported on the effectiveness of PjBL in diverse contexts, including racially diverse groups and low-achieving students. A constructivist approach to education not only centers on the student but it includes problem-solving, asks the student to interpret and elaborate, respects the student's prior knowledge, encourages interaction socially and with the environment, and is based on the concept that errors are simply opportunities to learn (Saad & Zainudin, 2022). Therefore, a constructivist approach provides a means for demonstrating and explaining what students have learned.

PjBL is grounded upon central theoretical ideas: (1) active construction, (2) situated learning, (3) cognitive tools, and (4) social interactions (Bransford et al., 2000). There are different styles of PjBL (Barron et al., 2017; Krajcik et al., 1998), but each has the following elements in common: PjBL uses a significant driving question that is meaningful to learners. The phenomena and problems in PjBL that students make sense of are the drivers of an increasingly complex demand for figuring out the driving question that the students investigate throughout the unit (Krajcik & Czerniak, 2018). Each new phenomenon or problem builds off the previous and extends new insight toward the driving question. This intentional and purposeful building of understanding to acquire practical knowledge develops logic and coherence throughout the unit (Miller & Krajcik, 2019). The move toward a student-centered, constructivist approach has emerged as the answer to present-day educational struggles, with some criticism. According to Powell and Kalina (2009), constructivist teaching strategies can have a substantial effect on students' cognitive and social skills, but teachers need to know how to incorporate constructivist teaching methods, strategies, tools, and practices to develop an effective learning environment.

Literature Review Related to Key Concepts and Variable

Characteristics of PjBL

PjBL is an inquiry-based instructional approach in which students gain knowledge and skills by working for an extended period to investigate and respond to an authentic, engaging, and complex question, problem, or challenge (Lee & Galindo, 2021). It involves many characteristics like student voice and choice, reflection, critique and revision, and experimental learning. The goal is to help students learn by actively engaging in real-world and personally meaningful projects, but there is little research to determine teachers' experiences and their adaptability towards the curriculum being student-centered.

Teachers' understanding of inquiry-based learning and science integration is vital for the successful implementation of a PjBL curriculum (Choudhary, 2020). For instance, Markula and Aksela (2022) carried out a multi-case study design where teachers answered questionnaires and were observed during lessons to capture how they actively engaged in PjBL in their science classes. The data analyzed using deductive and inductive content analysis showed that driving questions, learning goals set by students, students' questions, the integrity of the project activities, and using the projects as a means to learn central content were barriers that affected teachers' inquiry-based lesson implementation and instructional delivery. Consequently, these factors also affected teacher behavior. Although previous research has proven that PjBL is an effective teaching tool, there is a disconnect between setting realistic teaching expectations of inquiry-based methods, and teachers' ability to incorporate inquiry-based approaches consistently (Baroudi & Rodjan-Helder, 2021). PjBL is an effective teaching tool that involves several characteristics when put into practice.

PjBL is a multi-faceted learning process that begins with the pursuit of knowledge, thought processes, and problem-solving skills. These characteristics require practice and professional development for teachers to learn the best ways to reach their students and increase student achievement. Brand (2020) sought to examine the learning experiences of middle school teachers involved in an inquiry by engineering design professional development project that was designed to identify strategies for developing student-centered pedagogy for science education. The researchers determined that teachers had fears related to the practical implementation of engineering practices and expressed difficulty with aligning their teaching to this framework and integrating engineering into their instruction. In this basic qualitative study, findings also indicated that teachers also wanted to be more involved in informing the instructional framework through practice, reflection, and revision.

Professional development should address the learners' needs if it is going to help teachers to grow as professionals. Teachers are adult learners, and their professional development is a form of adult education, that shifts the focus of professional development to the needs of teachers and the different contexts in which they learn and teach (King & Lawler, 2003). According to Hofer and Lembens (2019), when incorporating inquiry-based learning through science integration, purposeful discussion of how inquiry-based learning methods can be implemented and facilitated for students of different learning abilities could enhance teacher proficiency during implementation.

Intentional dialogues have shown to be necessary to assist teachers with effectively and consistently integrating new inquiry-based methods (Correia & Harrison, 2020). Intentional dialogue also reduces teachers' urge to fall back on didactic teaching approaches that do not promote inquiry (Baroudi & Rodjan-Helder, 2021). A key characteristic of PjBL is teachers' first understanding the method themselves, and then practicing and incorporating the method within their instructional delivery (Keiler, 2018). Just as it is teachers' responsibility to address student needs, it is the responsibility of administrators to address teachers' needs through professional development.

The next characteristic of PjBL is for students to be able to demonstrate what they have learned by creating a physical end product. The development of inquiry-based science programs, such as STEM and international baccalaureate classes, is a central focus of the NSES according to the National Research Council (1996). These programs challenge students to demonstrate their knowledge and skills by creating a product or presentation for a real audience. As a result, students develop deep content knowledge as well as collaborative, creative, and communicative skills (NSF, 2021). In these programs, lessons are designed to help students become directors and managers of their learning process, guided and mentored by a skilled teacher. Hence, another major characteristic of an inquiry-based format is to provide relevance of PjBL to the real world that learners will soon enter.

PjBL is now used in the curriculum at 80% of universities in the United States (Chen & Yang, 2019). PjBL facilitates learning that is deep and long-lasting through creating personal connections to students' academic experiences. For example, Wu et al.

(2021) reported results from 10 years of undergraduate students' self-assessment of learning which showed that authentic inquiry experiences were consistently associated with significant gains in self-perception of interest and understanding and skills of the scientific process for all types of students. Learners also reported that teachers allowing them to investigate topics in their community or real-world issues made it easier to connect to their learning and stay on task. After learners engage in the implementation of a PjBL course, they are more likely to experience significant changes in their motivation for learning and appreciate the relevance of PjBL to the real world. According to the researchers, after engaging in authentic inquiry projects, both science majors and non-majors perceived PjBL as an effective experience that resulted in substantial gains in their academic performance. This evidence supports that the implementation of PjBL as an instructional method is a fundamental characteristic of an inquiry-based format.

Another characteristic of PjBL is it being student-centered. The elements of PjBL learning activities focus on student learning goals that are aligned with standards-based content to produce skills such as critical thinking, problem-solving, and collaboration (Warr & West, 2020). For instance, Penuel et al. (2022) explored how to support science learning that is coherent from the students' perspective and builds on PjBL using the NGSS framework. The authors summarized their results of students' learning experiences and found a need to support knowledge building as a practice while also ensuring accountability to specific science target learning goals and supporting students' agency in seeing their work as more than simply following directions and doing activities because they are assigned as the task of the day. Although a hands-on PjBL approach improves students' academic performance scores and helps students better understand science concepts, it is equally vital to maintain students' interest across the several weeks it may take to help students develop the target science ideas so that students' science work is more meaningful, and learning is more effective.

The inquiry-based 5e lesson model is widely used during PjBL instruction (NGSS, 2020). This common model influences students to engage, explore, explain, elaborate, and evaluate (Leggett & Harrington, 2021). Similarly, Dias and Brantley-Dias (2017) reported that PjBL instruction is aligned with the NGSS, as well as engineering design tasks that implement projects. Moreover, the findings from Cassata and Allensworth's (2021) mixed methods exploratory study that focused on relationships between NGSS plan participation and student achievement in math and science in grades 6–12 indicated that teachers whose instructional delivery was influenced by the NGSS identified positive shifts in pedagogy and learning during classroom instruction. In this study, students and teachers responded better academically to NGSS-aligned standards than a traditional scripted curriculum. The results from this study lead authors to conclude that the adoption of these science standards lead to better and more equitable student outcomes while teachers expressed positive personal experiences when using standards-aligned instructional practices in their classrooms. A major influence noted by the authors was the lasting effect that positive or negative memorable experiences had on teachers, which resulted in their intentional or non-intentional use of new teaching approaches and practices. Teachers' motives to implement standards-aligned instruction had a direct effect on their engagement when teaching it.

Teachers must be open-minded to integrating the current PjBL models in their science classrooms. Teachers must also believe that they are prepared to apply science and engineering models. Christian et al. (2021) examined the effect that learning experiences had on secondary science teachers' preparedness to implement the NGSS in the U.S. Findings indicated that NGSS-based professional development significantly improved participating teachers' confidence in engineering pedagogy, as well as their knowledge of engineering careers. Additionally, the data from this study revealed that once teachers believed that they were prepared to apply science and engineering practices, they were more willing to make changes to their teaching strategies in response to the NGSS.

Gaining a better understanding of how teachers perceive their use of inquiry-based instruction should be fundamental. Administrators pursuing a better understanding of how they can serve their teacher's needs results in teachers being able to better serve student needs. The results from a mixed-methods study contributed that an inquiry-based science curriculum also promotes problem-solving skills in developing students for the 21st-century (Martinez, 2022). Therefore, it is increasingly important for students to be scientifically literate to adapt to the environmental challenges we currently face (Docherty-Skippen et al., 2020). Teachers can strengthen their scientific literacy, and in turn, their understanding of PjBL through purposeful and intentional professional development.

The next characteristic of PjBL is that the method is very beneficial because it can be used across disciplines. Multiple skills and knowledge can be reinforced in different parts of the same PjBL project (An & Mindrila, 2020). The value and implementation of PjBL are documented to differ substantially about the amount of autonomy given to students. Learning transitions from teacher-directed to guided inquiry and finally student-directed open inquiry (Frey & Shadle, 2019). Zhao et al. (2021) investigated students' perceptions of inquiry-based learning in a set of laboratory activities that were enrolled in an introductory biology course at a large Midwestern university in the United States. The mixed methods data collection prompted participants to complete an online survey, ask open inquiry questions, design experimental procedures, and interpret novel data. The researchers indicated that students believed they were given more autonomy and support during the hands-on lab activities where they designed their own experiments and collected data to test their hypothesis versus in the data-based lab activity where they used an existing dataset and a given research question to test a pre-selected hypothesis. Furthermore, these data findings showed that the need for autonomy dominated student explanations of inquiry, followed by competence and relatedness. The results from student groups supported that having the freedom to choose what question to investigate and what procedures to follow best reflected open inquiry, in which students performed better. Implementation of PjBL where students are given more autonomy has a significant effect on student achievement in science.

The last characteristic of PjBL is the integration of technology use. Technology use itself does not improve student learning outcomes, but when it is combined with intentional and differentiated instructional strategies, it affords time and one-to-one learning opportunities that support the teacher's ability to better meet each student's needs (Vallera & Bodzin, 2020). Technology integration is a dynamic characteristic of PjBL that influences student achievement, although many teachers face challenges while using technology during PjBL implementation. To address this gap in the research, An and Mindrila (2020) conducted a study that explored the barriers that teachers faced when using technology to facilitate learner-centered instruction. Evidence from this study revealed that when using technology to support learner-centered pedagogy, teachers have faced major barriers such as lack of time, lack of technology, and lack of knowledge of learner-centered approaches. With that being said, administrators, instructional leaders, and coaches need to take the time to prepare teachers for technology based PjBL implementation.

Preparing Teachers for PjBL Implementation

During PjBL, instructors guide, model, and facilitate learning in a constructivist fashion (Leggett & Harrington, 2021). However, the instructor should provide demonstrations or prompt the students per their request for answers to their questions. The teacher guides student learning. For example, in a qualitative study to explore school-and teacher-level factors associated with a higher probability of teachers' implementation of student-centered instructional practices, Zhang et al. (2021) found that teachers participating in professional development related to the implementation of adaptive instruction, technology, and small-group learning showed a significant difference in the frequency with which they implemented 21st-century learning approaches. These findings suggested that teachers from schools with adequate instructional resources were more likely to implement student-centered instruction than those from schools with a shortage of instructional resources. Based on this evidence, the role of the instructor is influential in setting the standard for the role of the student.

Using PjBL in science classes offers the chance for teachers to create an environment that invites students to act as a scientist and deepen their thoughts on science concepts. Several districts and schools mandate the use of specific strategies, but ultimately it is up to the teacher to implement what strategies work (Grossman et al., 2019). For instructional coaches and student support staff to design effective learning opportunities for teachers, the professional development offered must demonstrate a deep understanding of student-centered, active learning in the role of a facilitator (Grossman et al., 2019). PjBL depends on good professional development, and the school meets that need by training teachers to develop and deliver high-quality PjBL that drives student engagement and deeper learning.

Teachers must work through future PjBL projects with their colleagues during PD sessions that are dedicated solely to the purpose of fine-tuning their lessons before it is presented to students. Buck Institute's gold standard for PjBL includes eight essential elements: a challenging question, important learning goals, sustained inquiry, authenticity, learner voice and choice, critique, revision, and a public product (Larmer et al., 2015). Using the gold standard as a template, Short and Hirsh (2020) identified the following reasons why teachers should be PjBL-prepared. The first is that students need to be prepared for PjBL, so that means teachers do as well. Next is that new learning models require new roles and skills. Lastly, teaching is a project-based profession, and PjBL is an organizing framework (Short & Hirsh, 2020). Because the PjBL approach has many significant changes from traditional teaching, teachers should fully understand what PjBL requires, and how their knowledge affects their students and their methods of implementation.

Although many teachers across the country are exposing students to PjBL instruction, there remains a deficit in teachers receiving extended PjBL professional development. Students should have experiences that lead them to more authentic learning outcomes and that are more student-centered, but for students to gain these experiences, teachers need to be provided with preparation and development experiences to achieve positive PjBL results. Hamed et al. (2020) conducted a study with a sample of 347 pre-service teachers to describe and analyze the progression of their learning during an initial teacher education course on how to teach science through inquiry. The qualitative analysis identified that most of the teachers progressed in their learning throughout the course. Teachers displayed a statistically significant relationship between inquiry-based teaching compared to a traditional teaching model. The results from this study suggested that identifying progression in learning is complex and nuanced. The researchers believed that having an in-depth understanding of the progression towards teaching science through inquiry is critical for improving teacher education programs and ultimately improving the quality of science teaching and learning in the classroom.

Similarly, Pomerance and Walsh (2020) ranked preparation programs and found that only 11% met the standard in classroom management techniques and only 10% percent of programs offer a strong student-teaching experience. Likewise, authors of a teacher prep review concluded that most teacher preparation programs did not provide candidates with adequate practice before licensure and that there was an absence of effective instructors with strong mentorship skills (National Council on Teacher Quality, 2018). A review was conducted by Pomerance and Walsh (2020) that analyzed the teacher licensure data of 567 traditional graduates, 129 alternative routes, and 18 residency programs across the U.S. When surveyed, teachers said they did not believe they were prepared, with aspiring teachers of color believing that they were unprepared at even higher rates. Although many teachers claim to be implementing PjBL, several of them need to hone their skills. So, administrators need to prepare teachers who are not already structuring their instructional delivery in a project-based way (Correia & Harrison, 2020). Teachers rely on high-quality professional development to support their project management skills.

To improve teachers' project management skills, administrators can help by providing professional development that allows teachers to focus on strategies for improving teamwork, time management, and the integration of tools for inquiry, creativity, and collaboration (Levy et al., 2021). Administrators can also help teachers to improve project management preparation by inviting feedback from colleagues and students. In a research study, Bird and Rice interviewed, observed, and analyzed teacher's lesson plans to identify their use of inquiry-based methods, as well as target areas of improvement. The authors found barriers to inquiry-based implementation that impacted teacher behavior, a disconnect between student capacity and expectations of inquiry-based methods, and that traditionally certified teachers are more likely to fall back on didactic teaching orientations.

The data also revealed that professional development and networking play a vital role in teachers' perceptions of using inquiry-based methods. Until educational leaders and project management practitioners take action to address the growing need for extensive and ongoing inquiry-based professional learning, teachers and students will continue to struggle with the increasing project load in school (Blythe et al., 2015). As a result, students may miss the unlimited potential of being self-directed learners with the confidence to take on more challenging projects. Ultimately, leaving these issues unaddressed may limit the innovative potential of our future generations.

Professional Development

The effectiveness of PjBL largely depends upon the support that is provided (MacMath et al., 2017). Teachers need the highest quality professional development to support the implementation of new learning strategies and curricula (Pringle et al., 2020). For instance, these researchers examined the impact of a professional development program on middle school science teachers' disciplinary content knowledge and instructional practices. In this mixed methods investigation, data was collected from classroom observations, content knowledge assessments, surveys, and interviews. The teachers in the program showed substantial improvements in their disciplinary content knowledge and demonstrated a range of ability levels to translate their knowledge into instructional practices consistent with the principles promoted in the PD. Pringle et al. (2020) concluded that programs that focus on elements identified in the literature can positively impact middle school science teachers' implementation of new learning strategies and science teaching. If instructors do not have enough guidance or support, teachers may gravitate toward implementing those activities that are most familiar, rather than instruction that is most productive for learning.

It is equally vital to observe the practice of teachers during class to examine and understand realistically how they transfer the inclusion of PjBL pedagogy from professional development experiences to the classroom or what impedes them from doing so. According to Almulla (2020), teachers lack the basic skills for PjBL implementation such as creating more opportunities for all students to apply their technical knowledge through practical application and difficulty designing assessments of learning. Without proper observation and professional development, teachers may hinder student growth. Novice teachers, that is teachers who have taught 3 years or less, need even more training in the components and application of project-based instruction (Navy et al., 2021).

In a comparative case study, Wieselmann and Crotty (2022) investigated the experiences of early-career science teachers who were in their first year of teaching when the pandemic struck. After being observed and given feedback from leadership within asynchronous, synchronous, and hybrid settings, the science teachers described growth in their teaching practices in several ways. They described shifting from test-focused instruction to more student-centered instruction. Teachers also reported being able to plan and incorporate a range of innovative activities that shifted to real-world relevance and deviated from their standard in-person practice, which often emphasized lecture, note-taking, and practice test questions. Furthermore, teachers reported recognizing and valuing the experience of trying something new and failing, then using that failure to inform future lesson plans. Accordingly, as teachers experimented with instructional approaches that did not rely on lectures and worksheets, they reported that many students benefited, and engagement rates increased. All these aspects helped teachers build a strong foundation for a collaborative approach to student learning.

Additionally, Jorgenson's (2018) examination of teachers who used PjBL showed that to reassume their role as "transformative curriculum leaders", administrators must provide professional development that is focused on reframing and reimaging PjBL instruction. The author added that this instruction should better serve the needs of low-income and minority students. A transformative curriculum guided by PjBL involves strong leadership that incorporates teachers and administrators working closely together within a supportive environment. Therefore, teachers need to be better supported in the classroom, and during training courses with ongoing professional development opportunities (Almulla, 2020). Support through professional development is an integral part of implementing PjBL. Without proper preparation, teachers are unlikely to use this method.

Educators must also be able to effectively utilize technology when implementing PjBL instruction (An & Mindrila, 2020). According to Davies and West (2018), the integration of technological resources and tools enhances learning for all students. The authors also argued that using technology resources, including computers, mobile devices such as smartphones and tablets, digital cameras, social media platforms and networks, software applications, and the Internet, is needed for effective classroom instruction. However, just because teachers have access to educational technology does not mean that they have integrated these technologies during instruction to increase student achievement (Montrieux et al., 2017). For instance, Kilty and Burrows (2021) sought to examine what and how secondary science teachers integrated technology into their classroom teaching and found conflicting interpretations of integrating technology into science education including teachers' understanding of what technology to use for different science areas and examinations, technology usefulness, collaborating with others, and knowledge using multimedia. Professional development projects should be provided to teachers that incorporate technology tools and training to strengthen and improve their science instruction.

If educational stakeholders want teachers to shift from traditional paradigms of pedagogy and rethink how children are taught and learn science, addressing the absence of proper professional development to align with science reform efforts must happen first (Pringle et al., 2020). Once this happens, it may allow sufficient time for educational leaders to fully explore the problem statement, and possibly help teachers develop the key learning skills required for the steps that frame the PjBL implementation process. Teachers need the highest quality professional learning to understand, practice, and transform project-based instructional skills and practice implementation during student learning.

A recent study investigated middle and high school teachers' use of a PjBL curriculum (Lotter et al., 2020). The PjBL unit centered on the case of Marcus Brown (a pseudonym), a high school football player, who collapsed suddenly while playing football. The results from this study showed that the teachers improved their content knowledge and quality of inquiry-based instruction after participating in a 115-hour professional development program. In another qualitative study, Gray et al. (2020) explored how fourth and fifth-grade science teachers integrate inquiry-based instructional instruction into their classrooms after recently adopting the NGSS. The author used a concern-based adoption model and self-efficacy conceptual framework to capture the experiences and perceptions of the participants. Data were collected in the form of interviews, lesson plans, and classroom observations. Like Lotter et al. (2020), the findings of Gray et al. also supported a need for increased professional development for teachers to implement inquiry-based instruction. Regardless of teaching status, there is a need for continuous professional development that motivates and instills teachers' confidence to take risks in their classrooms.

The planning, implementation, and learner-centered demands that frame PjBL do not necessarily match the pre-service training and professional development that teachers experience (Christian et al., 2021). Although professional development is a key element of preparing teachers for PjBL implementation, teachers are not always confident in their approach to interacting with school administration, which is important to further empower teachers in the pursuit of implementing project-based instruction (Pringle et al., 2017). Collaboration among teachers and administrators is imperative for the successful implementation of PjBL.

Collaboration and Planning

Team-teaching and collaborative practices have proved powerful when outside experts are included in the creation and implementation of the curriculum. Teachers working collaboratively are more likely to implement PjBL and student-centered curricula (Ali, 2019). When team-teaching takes place, problem-based learning may be more feasible and timesaving. As an example, Ronfeldt et al. studied 9000 teachers over 2 years in Miami-Dade public schools to better understand the collaborative relationship between teachers and administration. The author's consensus study showed that collaboration improved teaching and positively affected student achievement in science. But, for many administrators, teacher planning and collaboration came with their own set of challenges.

According to a Global State of Digital Learning Survey, more than 30% of teachers, and nearly 50% of administrators reported that teacher collaboration is a top priority for them, but almost 30% of those administrators believed that getting their teachers to collaborate was one of their biggest challenges. These data may cause educational stakeholders to question where the disconnect is. Challenges to effective teacher collaboration include a lack of a true professional learning community, lack of planning, collaboration, reflection time, personality conflicts, and territoriality (Patrick, 2022). However, within professional communities, teachers can share PjBL ideas, collaborate, and plan projects, which promotes school-wide implementation of PjBL.

Leadership

In the context of PjBL, teachers need different approaches for interacting with leadership to further empower teachers in the pursuit of PjBL implementation (Honig & Rainey, 2019). Administrators are the instructional leaders of their schools, which means that they are also responsible for acquiring the necessary knowledge needed to lead and guide the implementation of best practices (Alvai & Gill, 2017). When instructional leaders increase their knowledge in their content areas, their knowledge of leading teachers in teaching the content does as well (Hildreth et al., 2018). With the many demands and mandates placed on leaders to implement relevant instruction that prepares students for the 21st century, the role of administrators has grown in numerous ways. The foundation for effective leadership includes the professional development of leaders where they can self-reflect and determine ways to positively influence teacher and student learning (Holcombe et al., 2021). So as instructional leaders, administrators must take on an active role in the learning process of teachers and students to promote a shared vision. The expansion of a shared vision creates effective leadership and clear expectations to move a project forward.

Teachers' Roles in PjBL Implementation

PjBL instruction can foster the learning process for students to develop logical reasoning and problem-solving skills when implemented effectively by the facilitator (Almulla, 2020). Teachers must carry out their role as facilitators of PjBL instruction early on. Students should be exposed to project-based practices starting in elementary school and continue the practice throughout middle and high school. Students need time to practice their inquiry-based skills to build their way up to an open inquiry project. Implementing the different levels of inquiry continually from grade to grade can help shift learning from teacher-centered to student-centered.

The development of teachers' roles in PjBL implementation is key for the successful implementation of student-centered pedagogy in the classroom. Correia and Harrison (2020) explored secondary science teachers' viewpoints on inquiry-based learning and its influence on their formative assessment practice in the classroom. The data investigated from interviews, recordings of teacher-student(s) conversations, and field notes of classroom observations revealed that teachers' viewpoints about inquiry are aligned with their teaching practices and assessments of inquiry. Teachers who act as facilitators embrace more open, guided approaches, while teachers who act as *shepherds* adopt more directed approaches to inquiry. The promotion of student autonomy is influenced by teacher beliefs (Correia & Harrison, 2020). Teachers who include PjBL as a regular part of their teaching enjoy their role, although it might take time to adjust from traditional practices.

When transitioning to PjBL, one of the biggest struggles for many teachers is the need to give up some degree of control in their classroom, and trust in their students. It is important for teachers who want to transition to PjBL to understand that although this pedagogy is student-centered, many traditional practices continue, but are reframed in the context of a project. According to Markham (2012), considered one of the founding fathers of PjBL, during implementation, the role of teachers includes: designing and planning, aligning projects to standards, explicitly and implicitly promoting student independence, setting checkpoints and deadlines, scaffolding student learning, and identifying when students need skill-building, redirection, encouragement, and celebration. This assertion is supported by evidence from a qualitative study. Grossman et al. (2019) surveyed almost 50 experts in PjBL and interviewed 15 teachers. The data collected from this study showed that teachers who successfully used PjBL in their classrooms focused on four primary goals: supporting deep content learning, engaging students in work that felt authentic to the real world, supporting student collaboration, and building a culture where students are focused on revision of work, rather than just completion of work.

A teacher's role in PjBL involves knowing where to focus their attention to support student success and incorporating ways to improve their practice to better meet the needs of various types of learners. In the PjBL framework, two teaching practices support this goal: *design and plan*. Both these aspects are related to the decisions that teachers make before students start a project, from choosing an authentic focus for inquiry to anticipating what students might make or do to demonstrate their understanding (Culclasure et al., 2019). Skilled PjBL teachers scaffold student learning and allow for flexibility in their plans to adjust as a project unfolds (Grossman et al., 2019).

Throughout a project, teachers align instruction to standards by connecting activities and assessments to learning targets. Many successful implementers of PjBL also utilize educational technology as a possible solution to the practical applications in the use of PjBL instruction because several researchers have explored that one of technology's major benefits in the context of science education is its ability to support PjBL activities. Furthermore, higher levels of technology integration were associated with creating a better learning experience, and that experience resulted in students' having positive perceptions of their proficiency and competence (Davies & West, 2018). Understanding how administrators go about training and supporting their teachers is vital to the context of my literature review.

PjBL practicing teachers make sure that students understand what the learning goals are and why they matter. PjBL is multidisciplinary and product-oriented, so, to implement the practice effectively, teachers must receive sufficient, ongoing professional training. Even more, it is equally important that instructional coaches and administrators acquire, record, and understand teacher feedback from their professional learning experiences to make changes that improve teachers' understanding of PjBL and the implementation process (Aguirre-Muñoz et al., 2020). Herro and Quigley (2017) also examined the perspectives and classroom practices of teachers who participated in science, technology, engineering, art, and mathematics (STEAM) professional development. This intervention revolved around using digital media as a means of communicating and collaborating with peers and mentors, collecting, and analyzing data, and creating and sharing projects. The results from this study suggested that after STEAM PD, teachers' understanding of STEAM literacy increased to teach content and that they felt more prepared. As an effective initial step to change teaching practice, educational stakeholders should start by recognizing the importance of collaboration and technology integration as a fundamental part of the learning process.

Although foundational researchers like Schraw et al. (2006) suggested that inquiry-based teaching such as PjBL promotes metacognition by actively engaging students and causing them to self-reflect, the author also wrote that adequate teacher training and adequate resources are central to incorporating inquiry with rigor. According to the author, teachers not being sufficiently trained to implement PjBL is directly correlated to teachers' self-efficacy. Effective professional development maximizes teachers' content knowledge and support in classroom management. For instance, in a mixed methods study, Kaya et al. (2021) explored secondary science teachers' self-efficacy attitudes and their implementation of inquiry to offer knowledge for the improvement of science education in a Midwestern state.

The data collected through questionnaires, surveys, and interviews revealed connections between teachers' self-efficacy beliefs and their implementation of all five essential features of inquiry. Teachers' background in terms of content knowledge, pedagogical knowledge, and experience affects teachers' self-efficacy and implementation of teaching science as inquiry. The outcomes from this study revealed that teachers are timid when using student-centered practices as opposed to having more confidence when using teacher-centered practices. This research pointed to the need for science teachers to identify how their level of self-efficacy with inquiry-based learning influenced their implementation of PjBL. The self-efficacy level of science teachers matters regarding the practices used in classrooms set out to meet state academic standards and close achievement gaps. Teachers' perceptions of their self-efficacy with inquiry influenced how they implement instruction.

A systematic approach to training and having supportive school personnel also positively influences teacher self-efficacy. Teachers' self-efficacy correlated to their confidence in supporting student learning. Additionally, the PjBL approach directly influences student achievement, as established through the results of Acuña and Blacklock's (2022) study. Self-efficacy is a concept that builds upon Bandura's (1977) social cognitive learning theory and is related to a teacher's perception of their teaching ability and impact on student learning. A teacher's sense of efficacy influences several attributes of classroom instruction (DeCoito & Myszkal, 2018). In particular, Novak and Wisdom (2018) engaged 42 preservice elementary teachers in a three-dimensional (3D) printing science project that modeled a science experiment in the elementary classroom.

The purpose of this study was to explore how collaborative 3D printing inquiry-based learning experiences affected preservice teachers' science teaching self-efficacy beliefs, anxiety toward teaching science, interest in science, perceived competence in kindergarten through third-grade technology and engineering science standards, and science content knowledge. The authors adapted the Intrinsic Motivation Inventory, which included five five-point Likert-type items. The results demonstrated that this intervention significantly decreased participants' science teaching anxiety and improved their science teaching efficacy, science interest, and perceived competence in K-3 technological and engineering design science standards.

PjBL Implementation and Benefits

The implementation of PjBL instruction in science classrooms offers several long-term benefits for future leaders who will be entering the workforce. Our world is transforming into a globally competitive society and there is a shortage of students choosing fields in STEM due to the lack of exposure and the absence of project-based instruction (DeCoito & Myszkal, 2018). Also, due to a lack of knowledge, many teachers are unable to effectively carry out fundamental project concepts and strategies that students may need for the project and technology-based workforce they will soon enter (Margot & Kettler, 2019). Many teachers lack the knowledge to implement PjBL due to not having enough experience with the instructional practice, and therefore, not realizing its usefulness.

Revelle (2019) investigated this problem in a qualitative study that focused on the student and teacher experiences of the usefulness of PjBL and the acquisition of the skill set. After teachers who serve in a high-poverty school implemented a project-based curriculum, analysis of teacher interviews revealed more successes than challenges in their enactment. Not only was there a strong correlation between the achievement of generic and research skills but also between the perception of PjBL usefulness and overall satisfaction with the experience. Revelle also pointed out that creative skills were developed during the different PjBL phases. Once exposed to the opportunity to enact PjBL, many teachers agreed that it made them a more effective teacher and that student achievement, participation, and application of information was better when using PjBL than other instructional methods they have tried (Culclasure et al., 2019). Furthermore, teachers reported that participating in PjBL helped their students improve collaboration, problem-solving, creativity, self-direction, and interpersonal skills (Culclasure et al., 2019). PjBL offers positive results for students when implemented correctly.

PjBL motivates students to experiment and may play a vital role in preparing them for college, careers, and citizenship (Min et al., 2019). The PjBL instructional approach helps learners meet standards and succeed on tests that require critical thinking and deep knowledge (Deaton & Daugherty, 2020). The implementation of PjBL is one of the dynamic influences that improve literacy across disciplines, build theories about natural phenomena through investigations, generate explanations, and actively participate in a democracy (Schneider et al., 2022). An inquiry-based pedagogical approach to science teaching remains an effective means to influence agility, adaptability, initiative, entrepreneurism, effective oral and written communication, accessing and analyzing information, and curiosity and imagination (Martinez, 2022). PjBL instruction simultaneously encourages students to work together, think critically, be creative, and communicate in a variety of ways.

Challenges of PjBL Implementation

PjBL has become progressively useful as a 21st-century instructional approach. Teaching strategies that actively involve students in this learning strategy are more likely to increase conceptual understanding than strategies that rely on more hands-off or traditional techniques (Lee & Galindo, 2021). Although PjBL provides boundless opportunities for students to explore, explain, construct, and utilize science knowledge, implementing this instructional practice is not an easy task and teachers often face several challenges (Eckardt et al., 2020). In fact, the National Council on Teacher Quality (2021) pointed out that scarcity of qualified teachers, inadequate quality pre-service training, unfavorable teachers’ attitudes, and school and classroom cultures as a few of those challenges.

In a study conducted by Yang et al. (2021), the purpose was to examine in-service teachers’ learning experiences of planning and implementing PjBL and gain insight into the challenges and ways to overcome implementing PjBL in practice. Results indicated that teachers cited obstacles, such as lack of mentoring, planning time, and implementation experience that prevented them from completing the implementation of

PjBL in teaching. Kreifels et al. (2021) developed a case study to document agricultural teachers' perceptions and attitudes of science integration using inquiry-based learning as an instructional method. The data were accumulated through online video conferencing and focus groups. The teacher participants in this study recognized that PjBL is beneficial for better knowledge construction, but they believed teacher engagement and getting students to formulate explanations after summarizing evidence that was collected were challenges. Furthermore, teachers stated that improvements should be made to help them facilitate and critique student connections to scientific knowledge.

In a similar study carried out by Swift et al. (2020), the authors examined elements that prevented teachers from enacting project-based learning. Preservice teachers were required to develop an authentic, real-world, project-based inquiry task that incorporated a standard from three different content areas. Data analysis revealed themes regarding time management and classroom discipline challenges. In much of the literature cited in my review, teachers expressed experiencing collaboration challenges, mindset challenges, and change challenges. Exposure to methods and strategies that build teachers' confidence in their ability to effectively enact PjBL will result in better preparation. Moreover, teachers must stay connected to an educational support group and external professional development organizations to develop best practices and to stay committed to implementing those practices.

Growth Mindset

The mindset of teachers is extremely important as it relates to the successful implementation of PjBL in schools today. Accordingly, the data from Savić et al. (2021)

study suggested that teachers promote instruction where learners experience productive failure while exploring inquiry-driven conceptual change. PjBL instruction requires facilitators to trust their students to come up with answers on their own (Leggett & Harrington, 2021). Therefore, teachers should foster a learning environment where students feel safe risking failure, especially in front of their peers. When teachers promote this growth mindset, a positive learning environment is established. Feedback from learners has also been proven to encourage teachers to maintain a growth mindset. The frequency of implementing PjBL in classrooms was 32% greater for teachers who received feedback from student surveys about their teaching compared to those who did not receive such feedback (Zhang et al., 2021). Many common struggles for teachers when implementing PjBL are related to a growth mindset.

A growth mindset is a behavioral belief. Ajzen (1985) believed that behavioral beliefs linked the behavior of interest to expected outcomes. An individual must be interested in the behavior and believe it is going to have a positive outcome. If an individual believes there is going to be some impeding factor to carrying out the behavior successfully, then they are less likely to pursue the intention of changing the behavior (Ajzen, 1985). This belief aligns with the behavior of teachers who do not implement PjBL consistently or avoid implementation completely.

It is equally imperative for teachers to understand how their mindset can impact student behavior and motivation toward learning (Tan & Maeda, 2021). In a mixed methods study, Meierdirk and Fleischer (2022) investigated whether mindset matters in teacher education. The data collected indicated that a growth mindset is associated with goal achievement and that good teachers are more likely to have a growth mindset. These findings also showed that teachers who model and promote a growth mindset by acting as resilient and optimistic facilitators, create a more positive classroom culture. A growth mindset begins with the mindset of the teacher and is crucial for teachers staying in the profession.

Resources

In general, a lack of resources makes the creation and implementation of a PjBL framework challenging. Resources may include elements such as space, storage, technology, professional development, leadership, and collaborative time. When these resources are lacking, teachers and students are impacted (Yang et al., 2021). Although inquiry-based learning and instruction are promoted for K-12 education by both the administration and educators, the educational industry lacks reliable instructional technology and assessment tools to measure the quality and quantity of the effective and efficient blending of PjBL (An & Mindrila, 2020). Many teachers in the U.S. set forth to promote and implement PjBL as a student-centered learning strategy during their science instruction to support students' learning. Yet, teachers are facing difficulties associated with a lack of resources to implement PjBL strategies consistently.

The recurring theme of the lack of technological resources has raised critical issues related to the challenges of access to such resources for the effective and consistent implementation of PjBL strategies. To examine this issue, Herro et al. (2019) conducted a qualitative study to understand the challenges that teachers face in STEAM instruction. Teachers discussed technology impeding the flow of the unit, citing unreliable Internet access, blocked websites, inability to schedule time in the computer lab, and accessibility to secure enough devices as challenges. Likewise, the data from a case study revealed that a lack of a wide variety of resources hindered teachers' experience as they experimented with PjBL methodologies.

In this study, Martell (2020) collected interviews and observations and found that teachers were hindered by a lack of practical tools and support during teacher preparation. Teachers need more resources and time to plan, discuss, and reflect. There is a high need for professional development that is related to collaborative practices for teachers and students who lack skills because PjBL depends heavily upon authentic collaboration (Miller et al., 2021). Teacher training that involves how to use the resources necessary for PjBL is crucial in increasing teachers' confidence and competency to put PjBL into practice.

Teachers' Perceptions of PjBL

Current educational expectations require teachers to meet federal and state standards as well as develop 21st-century skills like collaboration, critical thinking, and problem solving (Correia & Harrison, 2020). Preparing students for state testing while also preparing them to be successful in a global society can present an instructional dilemma (Grossman et al., 2019). Many researchers have identified the implementation of PjBL as a possible solution to this problem. Although researchers agree that integrating 21st-century skills into daily instruction is necessary, many teachers and administrators have shied away from implementing a project-based curriculum (Almulla, 2020). Research about teachers' perceptions of PjBL has revealed challenges in implementation.

Teachers' voices should have a significant effect in shaping curriculum and frameworks, school climates and cultures, grading, and school policies (Whitney et al., 2012). The concerns that teachers have, such as a lack of professional development and lack of resources, need to be presented and addressed. The current literature places a substantial amount of focus on the "outside" support and role of professional development (Connors, 2019). As previously noted, professional development instills and strengthens characteristics such as teacher confidence, and personal and pedagogical knowledge, and ultimately impacts student learning (Kaya et al., 2021). These components, plus several others, shape the teacher's voice and it should be considered at each level of curriculum and program development. Moreover, teachers' voice being considered at every level of curriculum and program development increases teachers' engagement, motivation, satisfaction, attitude, and general buy-in to the mission of the school (Peck & Reitzug, 2021). When teachers are included in school decisions, school climate improves.

Stakeholders have voiced their concerns about the U.S. public school system (Anderson et al., 2019). Gaining insight from an educator's viewpoint of PjBL implementation will likely increase administrators' awareness of teachers' struggles during facilitation. To gain a knowledgeable insight from a teacher's perspective on the implementation of authentic project-based learning (APBL), Lewis et al. (2019) carried out a qualitative study and collected data using interviews from 47 APBL teachers. APBL instructors reported consistent challenges of: (a) scoping, sourcing challenges, and balancing the needs of the program, students, and clients; (b) curriculum preparation, making the curriculum flexible enough for shifting project problems and codify standards to help students understand how to do quality work; (c) providing assistance to teams, including monitoring, and delivering assistance; and (d) coordinating a range of stakeholders involved in assisting teams, including co-instructors, clients, and students.

Similarly, Culclasure et al. (2019) conducted a study to investigate how PjBL was implemented in schools and to discover the influence of PjBL in schools, on teachers, and students. The data were collected by observations and surveys in three southeastern U.S. public schools. After data analysis, the findings showed that several stumbling blocks resulted in two schools ceasing implementation by the end of the school year. Implementation was hindered by factors including the pressure associated with testing, the minimal amount of district support provided for PjBL implementation, and the complexities of implementation. Overall, in multiple studies that explored PjBL implementation, teachers have suggested that changes need to be made to planning time, assessment expectations, and ongoing professional development (Yang et al., 2021). The design and planning of PjBL lessons are among the biggest challenges for classroom implementation, so teachers must be prepared and confident in their understanding of what implementation looks like.

Teachers' reluctance to pursue PjBL instruction within their classrooms is due large in part to a lack of confidence in effectively doing so (Martinez, 2022). When teachers are given more time to gain knowledge and experience with new instructional approaches, they are more likely to accept change because they feel more comfortable (DeCoito & Myszkal, 2018). Consequently, if teachers do not feel confident to apply new learning strategies during classroom instruction and do not practice new strategies, it may hinder their ability to grasp new instructional models. All of these factors influence the ability or inability to successfully and consistently implement project-based learning to promote student success.

Summary and Conclusions

PjBL is an underused resource for implementation in science instruction, although it is included in the mandated science curriculum. PjBL is not emphasized and, therefore, is underutilized and may not be a priority for teachers (Baroudi & Rodjan-Helder, 2021). The lack of PjBL instruction has denied students access to powerful STEM knowledge that will be necessary to strive in such a competitive economy (Jorgenson, 2018). The differences between inclusive STEM high schools are due primarily to contextual factors during the implementation process (Christian et al., 2021). For inquiry-based instruction to be truly effective, support for effective implementation needs to be in place. Therefore, the perceptions of grade 6 to 8 science teachers need to be investigated. In Chapter 3, I explained my research method, design, and rationale.

Chapter 3: Research Method

The purpose of this study was to explore Grade 6 to 8 U.S. science teachers' perceptions about the implementation of PjBL instruction, including its benefits and challenges to support science education. In this section, I discuss nine aspects of the research method for his study: the research design and rationale, the role of the researcher, the methodology, the participant selection, the procedures for recruitment, participation, and data collection, the instrumentation, the data analysis plan, the trustworthiness, the ethical procedures. A summary of key points is included at the end of the chapter.

Research Design and Rationale

Creswell and Poth (2017) described that qualitative research is suitable when a problem needs investigation and thorough understanding. This type of study is most effective when the researcher seeks to cultivate an understanding of how participants perceive instructional methods (Merriam & Grenier, 2019). Qualitative research grants the researcher the opportunity to question participants' daily activities and bring relevance to understanding their experiences (Ravitch & Carl, 2020).

Applying qualitative research to examine a problem also permits the researcher to engage with participants using dialogue. This allows the researcher to be open and receptive to what is taking place during the study (Ravitch & Carl, 2020). Gordon (2018) suggested that education research is best characterized as basic qualitative research because a targeted group of participants share their first-hand experiences. Basic qualitative studies are interpretive, descriptive, and useful when a researcher wants to promote a general understanding of a topic and situation (Merriam & Grenier, 2019). Basic qualitative research is also useful when a researcher wants to better understand real-world issues from the viewpoint (e.g., beliefs, attitudes, opinions, perceptions) of the study participants. A basic qualitative design was chosen for this study because the purpose is to explore Grade 6 to 8 U.S. science teachers' perceptions about the implementation of PjBL instruction, including its benefits and challenges in supporting science education.

The other types of qualitative study designs would be less effective because I wanted to understand how teachers perceived PjBL. In ethnographic research, the researcher usually lives with the participants and becomes a part of their culture (Fetterman, 2010). An ethnographic study would not be appropriate because it involves the collection and analysis of cultural groups (Eriksson & Kovalainen, 2011). The grounded theory method uses an inductive and deductive approach to theory development (Charmaz, 2006). A grounded theory study was not appropriate because data are collected, analyzed, and then a theory is developed that is grounded in the data (Creswell et al., 2007). The intent of historical studies is to uncover events of the past and relate these past events to the present and future (Buckley, 2016), so it would not be appropriate for my study. In case studies, the researcher must be interested in the meaning of experiences to the subjects themselves, rather than generalizing results to other groups of people (Creswell et al., 2007). In action research, the implementation of solutions occurs as an actual part of the research process, therefore, a case study would not be appropriate for my research. Lastly, action research would not be appropriate for my study because it seeks action to improve practice and study the effects of the action that was taken (Streubert & Carpenter, 2002).

This study focused on addressing the following research questions:

- How do Grade 6 to 8 science teachers describe their perceptions of implementing PjBL during science instruction?
- What are Grades 6 to 8 science teachers' perceptions of the benefits of implementing PjBL?
- What are Grades 6 to 8 science teachers' perceptions of the challenges of implementing PjBL?

Qualitative research was appropriate for this research because it is nonexperimental and is often implemented to examine human behaviors and investigate a study problem (Edmonds & Kennedy, 2017). Based on that, this study was best described as a basic qualitative study.

To collect data for my study, I interviewed eight participants. I used patterns observed from participants' responses to explore Grades 6 to 8 U.S. science teachers' perceptions about the implementation of PjBL instruction, including its benefits and challenges to supporting science education. I recruited participants who had at least 5 years of experience using snowball sampling, purposive sampling, and public websites.

Role of the Researcher

My role as a researcher was to interview my participants. Interviewing allowed me to relate with my participants on a personal level. My professional role was as a middle school science teacher. Because I used public websites to recruit participants and my study was not conducted at a focus school, I have no personal or professional relationships with future participants involving power over participants. There were no ethical conflicts that may have existed. My study was not conducted within my work environment, had no conflict of interest or power differentials, and had no justification for the use of incentives.

Methodology

Keeping the focus on exploring Grades 6 to 8 U.S. science teachers' perceptions about the implementation of PjBL instruction, including its benefits and challenges to support science education, is consistent with Creswell and Poth (2017), who emphasized that qualitative research gives details to complex issues by talking directly to participants. In my study, I used interviews to provide an opportunity to gain insight into teachers' experiences, which allowed me to gather extensive data about my research topic, hence addressing my study's problem. The method of interviewing lead to meaningful interactions with study participants to obtain information about their perceptions of the challenges and benefits of consistent PjBL implementation to improve students' learning.

Participant Selection

Identifying appropriate participants is one of the most important tasks I, as a qualitative researcher, can undertake. The participants I selected were those who could best inform the research questions and enhance their understanding of the phenomenon under study (Creswell & Creswell, 2018). In this study, my interest was to explore Grades 6 to 8 U.S. science teachers' perceptions about the implementation of PjBL instruction, including its benefits and challenges to support science education.

I used purposeful sampling because it is widely used in qualitative research for the identification and selection of information-rich cases related to the phenomenon of interest (Patton, 1990). Although there are several different purposeful sampling strategies, criterion sampling appears to be used most in implementation research. Using criterion purposive sampling, I selected participants defined as Grade 6 to 8, U.S. science teachers with 5 or more years of experience who have implemented or attempted to implement PjBL to provide quality assurance.

Instrumentation

The data for my study were collected using semistructured interviews. The purpose of the interviews was to have teachers express their perceptions of facilitating PjBL, along with its benefits and challenges. Before the start of the interview protocol, I asked simple demographic questions to offer a warm-up period and to ensure that teachers met the criteria to participate in my study. The interview protocol for Grades 6 to 8 science teachers is presented in Appendix A. I developed the interview questions considering the study problem, conceptual framework, and related literature. The members of my committee served as an expert panel to review my interview questions. During the development of the instrument, I sought feedback by asking some of my peers to review the protocol and make recommendations for improvement. To address content validity, I used an expert panel consisting of committee members. Additionally, I aligned my research questions with my interview questions to investigate Grades 6 to 8 science teacher participants' perceptions of PjBL implementation. Below in Table 1 are my interview questions mapped to my research questions.

Table 1

Interview Questions Mapped to Research Questions

How do Grade 6 to 8 science teachers describe their perceptions of implementing PjBL during science instruction?	1. How do you define project-based learning? 2. In terms of ease of use, how would you describe the implementation of project-based learning? 3. In terms of time required to prepare lessons, how would you describe the implementation of project-based learning?
What are Grades 6 to 8 science teachers' perceptions of the benefits of implementing PjBL?	4. How does project-based learning affect active participation and student engagement? 5. Have you noticed a change in student motivation when using a project-based approach over traditional coursework? 6. What are the benefits of project-based learning as it relates to students' academic achievement?
What are Grades 6 to 8 science teachers' perceptions of the challenges of implementing PjBL?	7. What challenges within your professional learning communities have you encountered during professional development sessions on project-based learning instruction? 8. What are your perceptions of the barriers to implementing project-based learning instruction? 9. Do you have any additional thoughts regarding your perceptions of project-based learning?

Procedures for Recruitment, Participation, and Data Collection

Procedures for Recruitment

Responses from teachers was the best source to gain information about teachers' perceptions regarding the implementation of PjBL in the United States. To recruit teachers, I posted a flyer on social media and used the Walden participant pool, professional communities on social media, snowball sampling, and purposive sampling. The flyer stated the required background experience, and it was posted on social media. It can be found in Appendix B. The flyer, or invitation to participate, included criteria for inclusion that prompted responders to reflect on their eligibility to participate. Individuals who responded to the flyer then received a recruitment and informed consent email that they responded with "I consent." Additionally, I provided $10 Amazon gift cards as an incentive to each study participant.

Procedures for Participation

After participants responded to the invitation to participate with "I consent," followed up to schedule interviews. The informed consent form includes details to explain the purpose of the study, the procedures for participating, the voluntary nature of the study, the risks, and benefits of participating in the study, and privacy information. I offered participants my point of contact for if they had any questions or concerns about the study.

Procedures for Data Collection

Qualitative data were collected for this study through semistructured interviews with questions that I developed. The procedures for data collection consisted of collecting participant responses using a semistructured interview to gather participants' perceptions and give insight about the research questions that guided my study. Furthermore, I followed the interview protocol designed in a way that gathers information about the education, background, instructional pedagogy, and practices of the participant as it related to their implementation of PjBL instruction. The semistructured, in-depth interviews were developed to understand the participants' points of view and to unfold the meaning of participants' experiences to determine their understanding. This method of instrumentation typically consists of a dialogue between researcher and participant, guided by an interview protocol and supplemented by follow-up questions, probes, and comments (DeJonckheere & Vaughn, 2019).

To exercise the practice of social distancing, I conducted and recorded 30-to-45-minute remote interviews using Zoom (see Archibald et al., 2019; Gray et al., 2020; Mirick & Wladkowski, 2019). Further, I used open-ended questions to help eliminate or minimize researcher bias. Afterward, I sent a summary of my findings by email. Then, I asked volunteers to review my overall findings. Each interview was conducted in a quiet, virtual setting that was convenient for the participant. I was in a private home office, so the participant knew that their identity was not exposed.

Data Analysis Plan

First, I transcribed interview data using the Rev transcription tool. Next, I became familiar with the data from my interview by reading, reviewing, and reflecting on the transcripts of my participants' responses. Later, I reviewed the analysis of each transcript for accuracy. I printed a hard copy of each transcript with notes in the margins of ideas and concepts thought of during my reading. I then coded the interview transcripts according to topics, concepts, and events. Additionally, I manually coded, categorized, and gathered themes and patterns based on participants' statements during the interviews. Moreover, I followed the steps that Creswell and Creswell (2018) set forth about qualitative research, which are: organize and prepare all the data for analysis, read, or look at all the data, code the data, generate a description and themes, and represent the description and themes.

I combined the coded text into categories that expressed the underlying characteristics of the data. Likewise, a code may be based on specific characteristics of the data, a topic explicitly contained in the data, or may be applied to individual words, phrases, or paragraphs. Furthermore, I used axial coding because it was especially useful for categorizing the individually coded data according to shared characteristics (Creswell, 2014). I then conceptualized the categorized data thematically for presentation (Creswell, 2014). So, I used thematic analysis to describe the emerging ideas using categories and interpret the categories using themes. I also use rigorous thematic analysis that can bring objectivity to the data analysis in my qualitative research (see Nowell et al., 2017). When sorting and summarizing the data collected during the interviews, I systematically examined concepts, themes, and topical markers (see Rubin and Rubin, 2005, p. 224). I categorized thematically in a way that demonstrated a pattern and helped explain the conditions of the perceptions and behavior under study. Lastly, I translated the raw data into conceptually relevant data that was used in my discussion to address the study's research questions.

Trustworthiness

According to Frey (2018), four criteria in qualitative research show a trustworthy study: credibility and validity, transferability, dependability and reliability, and confirmability. Researchers must assure the readers that the research findings reflect the participants' experiences to provide credibility and validity. I used member checking to establish internal validity. During member checking, my data record, interpretations, and reports were reviewed by the participants who provided the data for my study (see Creswell & Creswell, 2018). Therefore, I emailed summaries of my findings to all participants, and then followed up to ensure my information was interpreted accurately (see Creswell & Poth, 2017).

Member checking is a qualitative technique used to establish credibility in trustworthiness (Birt et al., 2016). I conducted member checking by email and through interviews. I sent a summary of my findings by email to all participants to review, ask questions, and clarify anything that was said during the interview. I received email responses from six participants and one participant volunteered for a second member-checking interview. The participants confirmed that my understanding of their perceptions was accurate and a great depiction of their perception of what PjBL is, the challenges related to PjBL, and the benefits associated with PjBL during their implementation in science class. The responses from participants about the summary of my study confirmed that my themes were accurate and that my interpretations were fair and representative. Member checking provided a way for me to ensure the accurate portrayal of participant voices by allowing participants the opportunity to confirm or deny the accuracy and interpretations of data, thus adding credibility to the qualitative study.

Transferability refers to the degree to which the results of qualitative research can be generalized or transferred to other contexts or settings (Creswell & Poth, 2017). I established transferability by providing readers with evidence that my research study's findings could apply to other contexts, situations, times, and populations. To enhance transferability, I have thoroughly described the research context and the assumptions that are central to my research.

To maintain and establish dependability and reliability in my qualitative research, I was consistent and incorporated techniques like the use of comprehensive data, constant testing, and comparison of data, and the use of tables to record data. Additionally, I improved stability over time using repetitive observation and re-questioning participants about key issues in my research (see Creswell & Poth, 2017). Lastly, I used an outside researcher to examine the processes of my data collection, data analysis, and the results of my research study.

Confirmability refers to the degree to which the results can be confirmed or corroborated by others (Creswell & Poth, 2017). To address conformability, I kept a detailed record of how the data were collected and included the details in my research so that readers can check for confirmability. I documented the procedures for checking and rechecking the data throughout my study. I also followed the procedures given by Walden’s IRB to attain trustworthiness in my research.

Ethical Procedures

Throughout my study, I followed all necessary ethical guidelines to ensure that all participants’ rights were protected. During my study, I held the ethical responsibility to ensure all participants felt safe, were kept fully informed throughout the study, and were not subjected to any harm. Before data collection, I gained Walden’s IRB approval, # 10-25-22-0743475. Moreover, I followed Walden’s IRB guidelines for participants to receive information about their rights and my study's procedures. As I stated in my procedures for recruitment, I provided $10 Amazon gift cards as nominal incentives to each study participant. To ensure I followed Walden's ethical procedures, participants agreed to an informed consent document before I conducted any research. The consent form was written in simple language, explaining the extent, risks, and intention of the study, and any additional information relevant to the study. Still, I reminded participants of their withdrawal rights at any time from my study. I made sure that they did not feel pressured to participate. Moreover, the identities of participants were always kept confidential. To follow Walden's requirements for the treatment of data, I stored all study data on a USB drive in a locked cabinet. After 5 years, I will shred all hard-copy files and digital study data will be deleted from my computer.

Summary

The purpose of this study was to explore Grades 6 to 8 U.S. science teachers' perceptions about the implementation of PjBL instruction, including its benefits and challenges to support science education. The major sections of this chapter are the introduction, research design, and rationale, role of the researcher, methodology, trustworthiness, and ethical procedures. I used a basic qualitative study approach including eight to 12 Grade 6 to 8 science teachers. Teachers received online invitations via social media to participate in this study. The teachers invited to participate then answered open-ended questions during a Zoom interview. I used the information from the interviews to collect data about teachers' perceptions of the consistent implementation of PjBL, including its challenges and benefits. The interview transcripts were coded using axial coding and I used thematic analysis to organize, describe, and interpret data. To ensure the trustworthiness of my study's findings, I demonstrated that the findings were credible, confirmable, dependable, and transferable through member checking, repetitive observation, and re-questioning participants. During this study, I used proper ethical procedures to ensure that all participants' rights were protected. Results of the data analysis for this study are presented in Chapter 4.

Chapter 4: Results

The purpose of this qualitative study was to explore Grades 6 to 8 U.S. science teachers' perceptions about the implementation of PjBL instruction to support science education. Furthermore, I also explored teachers' perceptions of the benefits and challenges of implementing PjBL during science instruction. I interviewed eight teachers who taught Grade 6 to 8 science for 5 years or more in the United States. By exploring Grade 6 to 8 science teachers' perceptions of their implementation of PjBL, educational stakeholders, leaders, and administration can better support teachers with this task and teachers can improve their instructional strategies to consistently implement the mandated curriculum.

Chapter 4 includes the following sections: setting, demographics, data collection, data analysis, the results of the study, and evidence of trustworthiness. I include information about the study participants, my research design, and the findings of Grade 6 to 8 science teachers' perceptions of their implementation of PjBL instruction. I then close with a summary.

Setting

The participants were Grade 6 to 8 science teachers who have or have tried to implement PjBL during science instruction. All participants taught science for 5 years or more in the United States. All participants were interviewed using a semistructured protocol using Zoom video conferencing due to the global COVID-19 pandemic.

Data Collection

Qualitative data were gathered from eight Grade 6 to 8 science teachers using a semistructured interview protocol. After I received IRB approval, I posted a recruitment flyer on social media platforms with the eligibility criteria for participation. I also used the Walden participant pool to recruit study participants. I sent an informed consent form via email to those who responded to the post, then scheduled Zoom interviews with those who replied, "I consent." Upon confirming an interview time, I sent a calendar invite with individual Zoom links. Data were collected over 12 weeks from 10-25-22 until 1-25-23. The semistructured interviews that I conducted via Zoom lasted about 30 minutes. The interview protocol that I used can be found in Appendix A. I recorded all interviews during our Zoom and saved them as an audio file. All recordings and files are password-protected to maintain confidentiality.

Data Analysis

I read my transcribed data many times. I transcribed the data using codes and themes. I analyzed the transcript data for each participant after every interview. During the coding process, I summarized my raw data in a journal to organize my thoughts and patterns (Creswell and Creswell, 2018). Then, I identified emerging themes per participant. During the first cycle of coding, I analyzed the open codes from participants' words (Creswell, 2014). During the second cycle of coding, I combined and organized codes to develop categories. I developed 15 a priori codes and 36 open codes. Table 2 reflects the a priori codes and open codes.

Table 2

A Priori and Open Codes

A Priori Codes	Open Codes
Collaborative learning	A lot of materials
Cross-curriculum	Active question and analysis session
End-product	Administrative support
Funding	Buy-in
Guided learning	Chaotic
Implementation	Challenges your thinking
Lack of resources	Comfort zone
Planning	Critical thinking
Professional development	Driving questions
Student-centered	Essential questions
Student engagement	Excitement to learn
Take ownership of learning	Exploratory
Teacher preparation	Hands-on projects
Technology	Improved academic performance
Time	Increased motivation
	Increased skillset
	Inquiry
	Limited resources
	Money
	More time
	Overwhelming
	Problem-solving
	Project manager
	Proper planning
	Realistic expectations
	Required training
	Space
	Standards
	Storage
	Student autonomy
	Student-led approach
	Time consuming
	Time management
	Valuable

		Visual presentation Workforce training

Coding data provides transparency. I looked for relationships and links between what I found in earlier rounds of coding. I also kept a journal to organize my findings during the coding process. I searched for patterns in my coded data and found relationships to categorize them (see Nowell et al., 2017). Patterns included similarity and frequency. Table 3 presents the a priori codes and open codes organized into six categories.

Table 3

A Priori Codes and Open Codes in Categories

A Priori codes	Open Codes	Categories
End-product Funding Technology	A lot of materials Hands-on projects Money Space Storage	Instructional resources
Collaborative learning Cross-curriculum Student-centered	Active question and analysis session Critical thinking Exploratory Inquiry Problem-solving Student-led approach Workforce training	Learning skills
Student engagement Take ownership of learning	Excitement to learn Improved academic performance Increased motivation Increased skillset Student autonomy Valuable	Beneficial learning and student performance
Implementation Lack of resources Planning Time	Challenges your thinking Chaotic Comfort zone Limited resources	Implementation issues

A Priori codes	Open Codes	Categories
	More time Overwhelming Proper planning Project manager Required training Time-consuming Time management	
Professional development Teacher preparation	Buy-in Realistic expectations	Admin support
Guided learning	Driving questions Essential questions Standards Visual presentation	Instructional objectives

Description of Codes, Categories, and Themes

I identified six themes during data analysis. Table 4 reflects how codes were aligned to my research questions, which addresses the perceptions science teachers shared about PjBL implementation, and how the codes were mapped to six categories that led to six themes. Theme 1 indicated that Grade 6 to 8 science teachers use similar PjBL frameworks and models to guide their implementation and instructional delivery. Theme 2 indicated that Grade 6 to 8 science teachers use technology and a lot of materials to create hands-on projects, which require space and storage. Theme 3 indicated that Grade 6 to 8 science teachers perceive PjBL to be an effective student-centered approach that encourages critical thinking and learning skills that are related to workforce training. Theme 4 indicated that Grade 6 to 8 science teachers perceive PjBL as beneficial for increasing student engagement, motivation, and academic performance. Theme 5 indicated that most Grade 6 to 8 science teachers perceive a lack of resources, control, training, and time as challenges in implementing PjBL. Theme 6 indicated that Grade 6 to

8 science teachers feel they are unprepared and unsupported by the administration when implementing PjBL. Table 4 provides an overview of my research questions aligned with a priori codes, open codes, categories, and themes.

Table 4

Overview of Research Question Alignment, A Priori Codes, and Open Codes Organized in Categories and Themes

Research Question	A Priori codes	Open codes	Categories	Themes
RQ 1: How do Grade 6 to 8 science teachers describe their perceptions of implementing PjBL during science instruction?	Guided learning	Driving questions Essential questions Standards Visual presentation	Instructional objectives	Theme 1: Grade 6 to 8 science teachers use similar PjBL frameworks and models to guide their implementation and instructional delivery.
RQ 1: How do Grade 6 to 8 science teachers describe their perceptions of implementing PjBL during science instruction?	End-product Funding Technology	A lot of materials Hands-on projects Money Space Storage	Instructional resources	Theme 2: Grade 6 to 8 science teachers use technology and a lot of materials for students to create hands-on projects, which require space and storage.
RQ 2: What are Grades 6 to 8 science teachers' perceptions of the benefits of implementing PjBL?	Collaborative learning Cross-curriculum Student-centered	Active question and analysis session Critical thinking Exploratory Inquiry Problem-solving Student-led approach Workforce training	Learning skills	Theme 3: Grade 6 to 8 science teachers perceive PjBL to be an effective student-led approach that encourages critical thinking and learning skills that are related to

Research Question	A Priori codes	Open codes	Categories	Themes
				workforce training.
RQ 2: What are Grades 6 to 8 science teachers' perceptions of the benefits of implementing PjBL?	Student engagement Take ownership of learning	Improved academic performance Increased motivation Increased skillset	Beneficial learning and student performance	Theme 4: Grade 6 to 8 science teachers perceive PjBL as beneficial for increasing student engagement, motivation, and academic performance.
RQ 3: What are Grades 6 to 8 science teachers' perceptions of the challenges of implementing PjBL?	Lack of resources Implementation Planning Time	Challenges your thinking Chaotic Comfort zone Limited resources Project manager Proper planning More time Overwhelming Required training Time-consuming Time management	Implementation issues	Theme 5: Most Grade 6 to 8 science teachers perceive lack of resources, control, training, and time as challenges of implementing PjBL.
RQ 3: What are Grades 6 to 8 science teachers' perceptions of the challenges of implementing PjBL?	Professional development Teacher preparation	Buy-in Realistic expectations	Admin support	Theme 6: Grade 6 to 8 science teachers feel unprepared and unsupported by the administration when

Research Question	A Priori codes	Open codes	Categories	Themes
				implementing PjBL.

Results

I examined three research questions in this basic qualitative study. In this section, I report the findings of my study. The semistructured interview protocol that I used allowed participants to give open-ended responses regarding their perceptions of the use, challenges, and benefits associated with implementing PjBL during science instruction. Six themes emerged from my study.

Research Question 1

My first research question was: How do Grade 6 to 8 science teachers describe their perceptions of implementing PjBL during science instruction? I found two themes related to my first research question. The first theme was Grade 6 to 8 science teachers use similar PjBL frameworks and models to guide their implementation and instructional delivery. The second theme was Grade 6 to 8 science teachers use technology and a lot of materials for students to create hands-on projects, which require space and storage.

Theme 1

Theme 1 was Grade 6 to 8 science teachers used similar PjBL frameworks and models to guide their implementation and instructional delivery. This theme emerged from most participants describing the same process and concepts for students to follow during their instructional delivery of PjBL. The majority of Grade 6 to 8 science teachers referred to the same gold standard PjBL guidelines when implementing PjBL during science instruction. The teachers in this study stated that their students begin a lesson with a driving question that is related to the standard, collaborate to determine the inquiry project that will be completed, integrate essential questions that lead to student reflection, use a rubric with feedback and revision, and design an end product.

Theme 1 created an understanding of what Grade 6 to 8 science teachers perceived PjBL to be and their perceptions of the steps for implementing this instructional method. When asked to define PjBL, there was a similarity in all responses. For instance, Participant 3 described PjBL with:

> It's a lot of authentic instruction that goes with it, so it takes a lot of organization. We have a really intensive planning system. It's completely student-centered in so many ways, and I have standards and I make sure our questions address that, but the exact "how" is done with a lot of student input, so I end up with less behavior issues, I have less missing work. On the front end it's hard because I have a curriculum to follow, but I've got to piece a lot of things together, and that's hard. It's much easier to just follow a curriculum, but you don't have as much buy-in from the kids.

Many participants also talked about how students made the decisions about their projects. A pattern emerged regarding teachers having open and whole-group discussion with their students about project ideas. Participant 4 expressed PjBL as a technique that forced students to use creativity. Participant 4 defined PjBL by stating their perception as:

> Basically, PjBL is giving students a problem and making them figure it out. And my favorite way is to basically research the internet and spend like 20, 30 minutes

> researching various dynamics and watching videos and stuff and just putting in the rules and guidelines. It really forces them to create. It’s awesome.

Participant 6 described a similar perspective, saying, “Project-based learning is where I use a project to supplement what I'm teaching in the classroom. Through doing projects, students are able to grasp concepts a little better. I love that project-based learning carries on for weeks, so that my students can focus on one end goal, but I can hit different teaching standards along the way that access different learning skills and concepts.” Along the same lines when defining project-based learning, Participant 7 said:

> Project-based learning is where students are learning their standards through the creation of a project. So, they have to go through the different processes to research and plan, to create, to test, to fix up, and then to share out about their project.

A pattern emerged in the perceptions of Grade 6 to 8 science teachers’ definition of PjBL. The majority of participants said that PjBL included using a project to teach a standard. Participant 7 further voiced their framework and process for project-based learning implementation by saying,

> Project-based learning is where students are learning their standards through the creation of a project. So, they have to go through the different processes to research and plan, to create, to test, to fix up, and then to share out about their project.

Participant 8 stated a comparable perception about the framework and process:

> I define project-based learning as an activity that is not just built on a lesson. It's activities over a period of time that has an end product that students produce. All of the activities or steps that lead up to the end allow the kids to actually produce something at the end. After I've hooked my students with the driving question, they use it to create other little need-to-know questions which become our essential questions. Usually, these smaller questions trigger students to ponder and inquire about even more questions, so then they go do research. I want them to discover more and more info because research is a life skill. And they typically use some sort of technology to do their research, which they enjoy.

More importantly, a pattern in my data amongst all of my participants was that they began their implementation with a driving question. Interestingly, the study participants who perceived success with project-based learning understood the benefit of sparking students' interest early with a hook that led to the creation of a driving question. For instance, Participant 1 said "Project-based learning triggers a more active question and analysis session so the class is not so boring as it would be without that." Likewise, Participant 3 stated:

> Student buy-in is important. I create buy-in by finding a local or national issue. The purpose is to find something irresistible that will keep my students focused and interested. Students see purpose in trying to solve community issues that affect their neighborhood. Using relatable, real-life issues as a hook catches my students' attention and it makes them eager to discuss, debate, and learn about the topic. I'd say discussion and debate is the best way for my students to brainstorm

> driving questions for their projects. If I'm doing these integrated projects, I've gotta sit down with my colleagues, we have to figure out where the overlap is; and that takes *hours*. We don't integrate for the seventh graders. I just do projects with them. I go, "Here's what we're learning, what do you guys wanna do?" We create a driving question board, and they tell me what they wanna do, and then I go digging through the curriculum to basically find it – and then I reorder the curriculum. I co-plan with the kids, but then again you have to have that climate where the kids want to co-plan with you. The students definitely feel like they have a lot of agency in that. It's part of our class routine. It doesn't take a lot of time outside of class. It's just gathering materials and looking through the curriculum. Mostly I already have these materials, and sometimes I send an email to parents, like 'I need this,' or I'll just buy it. I turn in receipts. We have some funding for this.

Participant 4 showed mutual understanding for the importance of student buy-in and how it can make project-based learning implementation easier or more difficult. Participant 4's perception of the biggest barrier to implement PjBL instruction was explained with "Student buy-in is the number one thing. You've got to figure out what works for your students and have fun with it. It's harder to keep their attention if you can't figure that out." The problem in my research is that teachers are inconsistently implementing PjBL. Although teachers who had success with PjBL implementation agreed that student buy-in is a challenge, they also agreed that there are methods and strategies, such as using issues to create a driving question and spark student interest to create discussion that teachers incorporated to relieve this barrier.

Several participants described the need for buy-in during PjBL and their methods for earning it. Participant 5 explained their perspective on the importance of a driving question during the implementation of project-based learning in science. When I asked about their definition of PjBL, Participant 5 explained that:

> Project-based learning is not lecture and worksheets. To me, it is an approach where all the subjects are used, and it's hands-on learning where you incorporate the standards as well. It influences student-centered and guided learning. I always use a driving question for projects. The project centers around the driving question so it has to be good. By the end of the project, each student should be able to answer the question based on their research.

Like Participant 5, Participant 7 agreed that the students appreciated having choice and voice when they brainstormed project ideas. Participant 7 communicated that "Allowing students voice and choice when coming up with their projects is an important component because it inspires them to take charge of their own learning." In sharing their perceptions, Participants 3, 4, and 5, all commented positive perceptions on how guided PjBL is an awesome instructional tool that gives students autonomy in the project design and execution process, and as a result, increases academic performance.

Participant 1 expressed that their implementation of PjBL science instruction included the integration of essential questions that lead to student reflection and the use of a rubric with feedback and revision. Participant 1 pointed out, "Students come to me when they need assistance or when they want to reflect. I either redirect them to make improvements or coach them to keep the project moving along." Teachers agreed that with PjBL, they acted as guides in which they facilitated instruction and kept track of time versus telling students what to do and how to do it.

In an excerpt from their definition of PjBL, Participant 8 stated:

> After I've hooked my students with the driving question, they use it to create other little need-to-know questions which become our essential questions. Usually these smaller questions trigger students to ponder and inquire about even more questions, so then they go do research.

Many participants agreed that a vital component during PjBL implementation is feedback, reflection, and revisions. Many participants characterized like concepts. In general, evidence from the participants showed they executed comparable instructional objectives, frameworks and models to guide their implementation and instructional delivery. This theme emerged from most participants describing the same process and concepts for students to follow during their instructional delivery of PjBL.

Theme 2

Theme 2 was Grade 6 to 8 science teachers used technology and a lot of materials for students to create hands-on projects, which required space and storage. I surveyed perceptions about how Grade 6 to 8 science teachers described their implementation of PjBL. This theme emerged because many participants stated that they routinely collected and recycled materials and found it significant to display student end-products, but their classrooms were not sufficient in size to store these items. Many patterns developed from participants who discussed how project-based learning is centered around projects that require space and how classroom design makes a difference.

Besides space, several participants brought up the issue of not having the proper materials to facilitate PjBL. Even more, a few other participants spoke about PjBL as it related to student motivation. Evidence showed that other factors like using computers and different technologies also took up a great deal of space. Furthermore, some participants cited having issues getting instructional resources. Participant 2 discussed that organizational tools increased productivity and are necessary in order for students to create an end-product:

> There were often limitations in the amount of time, the amount of space, and resources, and certainly, a huge variability in the motivation of the children as well. I have issues getting enough materials. Plus, the physical design of my classroom is not conducive for project-based learning. I don't have the space or storage… I think that one of those things that is really a challenge is when you have multiple periods trying to do multiple things – just having enough space to store things. It's hard to have several weeks' worth of stuff halfway made all over the place.

The qualitative data showed that there were many repetitive similarities in the responses from Grade 6 to 8 science teachers about merely having enough space. Participant 3 went on to state the importance for the need to store superb student projects that have been accumulated over the years. Teachers found purpose in displaying past projects as example models. Teachers relied on exemplar end-product examples to speak to different learning styles, to spark student interest, and to showcase the creativity of end-products completed by former students. Participant 3 said, “More storage would be great for all of these wonderful resources that are needed, especially storage for example.”

Following the pattern of expressing concerns, Participants 3, 4, 5, and 6 identified other instructional resources such as funding as a pressing issue. Several teachers expressed their concerns about the amount of their own money they have spent to gather materials promptly so that students can have what they need to execute their hands-on projects. Take Participant 3 for example, whose response, when asked what support would improve their implementation, was “a Visa card that I can use, an Amazon account.” Several teachers criticized the absence altogether or the scarcity of money that they provide and prioritize to support the implementation of PjBL.

Also, Participant 4 said, “Monetarily I'm not really supported that much. I don't get the money I need working in an urban school district. But other than that, I try to get almost anything that I need with donations.” A common point in my data was that a lot of teachers mentioned how they gather instructional resources by any means, including by way of parental support and by salvaging supplies.

Funding was a problem that most Grade 6 to 8 teachers agreed needed to be brought to the attention of the school district. A common problem that stood out in my data was how often teachers brought up how not having certain materials affected the engagement of their students. Participant 5 expressed their perspective in the following way, “Funding is just always an issue. We're always looking for grants.”

There were variations in participants' thoughts about having to make PjBL work with the limited supplies that they had. Similar to Participant 5, Participant 6 had a parallel response when asked what support would improve their project-based instructional delivery:

> Funds. Projects take money and materials. And we're blessed to be at an academy where the students have parents that support and will chip in and bring extra supplies for those who don't have. But when I was teaching in a public school, none of the kids brought anything. So, you have to bring everything in for these kids or start collecting materials early. Funding is a big thing. I use my money sometimes.

Both Theme 1 and 2 expressed participants' responses to Research Question 1: How do Grade 6 to 8 science teachers describe their perceptions of implementing PjBL during science instruction? The pattern that emerged for theme 1 is the similarities in practice to carry out PjBL during science instruction. In addition, participants believed they do not have adequate space and storage for PjBL. The next research question revealed data about what Grade 6 to 8 teachers perceived the benefits of PjBL to be.

Research Question 2

My second research question was: What are Grades 6 to 8 science teachers' perceptions of the benefits of implementing PjBL? I found two themes related to my second research question. Theme 3 was Grade 6 to 8 science teachers perceived PjBL to be an effective student-led approach that encourages critical thinking and learning skills that are related to workforce training. Theme 4 was Grade 6 to 8 science teachers perceived PjBL as beneficial for increasing student engagement, motivation, and academic performance.

Theme 3

Theme 3 was Grade 6 to 8 science teachers perceived PjBL to be an effective student-led approach that encourages critical thinking and learning skills that are related to workforce training. The responses of the teachers connected to the conceptual framework of this study. The PjBL approach creates a constructivist learning environment in which students build upon their own knowledge. The framework for this study is based on the theory of Dewey (1961), who encouraged the student-led approach and opposed the traditional role of the teacher as the source of a body of facts and the student as merely a recipient of knowledge.

In sharing their perceptions of PjBL being a method that increased learning skills, teachers characterized their students' classroom experiences during project-based science instruction as exploratory, inquiry-driven, collaborative, student-led, and an environment of investigation and real-world logic. In sharing the benefits of PjBL, Participant 1 described their perception with:

> It has triggered a lot of student achievement in terms of their performance and in terms of their goals, and how they want to enter their future. I think students have become more focused. Project-based learning challenges students to design and engage in more authentic, complex learning over an extended period of time.

Participant 2 stated the following about the value of project-based learning and learning skills:

> I think that there's real value in the aspect of trying to collaborate and compromise and come up with different plans and solutions during project-based learning. I think that's a really important skill set for students to have. I also think that designing it so that there is accountability for each individual has some benefits and also looking at things in different ways so that they may look at options of what is already done and then look for ways to modify along the way. Hearing kids discuss and debate is probably one of the biggest areas of growth that I saw in the students; tackling challenging questions and that idea of there's not an easy solution for everything. I like when the kids are unsettled and that there isn't one perfect bow on the top. I think that's when they really learn the most – when they leave with more questions and recognize that there aren't always easy answers for things.

Several of the study participants alike noted their positive perceptions about how PjBL triggered students to think more than one way. A pattern emerged as it related to increased learning skills. Participant 3 expressed a positive response with:

> When students are completing their projects, I see them really honing their organizational and research skills. Many of them have developed better communication, outgoingness, and participation with their peers. I also think it's pretty cool that with completing these projects, students get to collaborate with our community, and they are seeing the positive effects of their work.

Participant 4 confirmed that learning skills are increased by saying:

> I learned a lot through project-based learning. It's amazing to me. If I give my students a project to solve a problem, you have 20 kids working on the same problem and if you just let 20 minds go wild and they're actually interested in solving it, you're going to come up with different results. You will be amazed at the skills they use and how they solve things through project-based learning.

Many participants talked about their fascination with how the implementation of PjBL encouraged students to use deep critical thinking skills. Besides that, participants pointed out how students got to explore investigative theory during PjBL instruction. Participant 7 voiced their opinion about how well PjBL instruction works for the development of workforce training skills:

> I think PBL is the future of education because when we're teaching kids at school, they're like, "I'm going to my math hour, I'm going to my ELA hour, I'm going to my science hour, I'm going to my social studies hour." But if we're trying to prepare them for work, I wouldn't go to my job at a nonprofit and be like, I'm going to my math hour for today. Everything that you're working on has all of those things put together in a project, like you're working on projects. And so, this teaching method is training kids for the workplace of the future, which is project-based. And then even taking a step further to make it problem-based, the projects that I've been able to connect to problems in our community, kids get more excited about because they are even more connected because they're like, oh, that's something that's happening here.

Theme 3 addressed RQ 2, and students' learning skills as it relates to PjBL being a student-led approach. Participants also guided students in using PjBL to encourage critical learning skills and workforce training. In sum, I concluded from the data that collaborative learning, student-centered learning, and cross-curricular learning were valuable practices that were integrated during the implementation of project-based learning instruction.

Theme 4

Theme 4 was related to beneficial learning and student performance. Theme 4 was Grade 6 to 8 science teachers perceive PjBL as beneficial for increasing student engagement, motivation, and academic performance. There was not much variation in the responses from participants about the benefits of implementing PjBL. In some way, every participant mentioned that their students' academic progress, motivation, and engagement had increased. Many teachers also described how much of a positive effect their implementation of PjBL had on classroom culture since the return of face-to-face instruction after several months of closures and virtual learning because of COVID-19.

These teachers were aware that by using PjBL as a student-led approach, they were to act as facilitators and allow students to direct their own learning, which in turn, resulted in students taking ownership of their learning. For instance, when considering concepts that benefit learning and student performance, Participant 1 stated "I feel like PjBL has made my students more inquisitive, they now want to know more, and they definitely have more passion." Participant 3 had a similar perception about how beneficial PjBL is for science instruction:

> With PBL, these products are so cool and I don’t have to fight that hard for student engagement. It’s a lot of work figuring out what works and following the curriculum. Alter that, change this. But they are so proud of their products. We have lot of cool projects! It’s hard because it’s messy and it’s a lot of trying to take what you have and use it. I have been doing this a long time. This school opened as a PBL school in 2014, but even in all of my previous jobs, I’ve done PBL – but not as structured. We used PBL works for guidance and I’ve gone to a ba-jillion trainings.

Participant 4 stated that:

> I don’t have a problem with participation. My students have developed a lot more confidence and self-direction when engaging in team-based and independent project-based instruction. Students’ take ownership of their work. I love when they have aha moments. That's really more valuable I think than giving them everything to do. Project-based learning gives students’ core value, and it really teaches them how to learn on their own.”

Participant 5 had like perceptions about active participation and student engagement, and stated, “Students love project-based learning because it is hands-on. It has a positive effect on participation and engagement. Lessons that are hands-on engage their minds while they’re learning. It’s simple as that – when we changed to this approach, students began really learning. I absolutely see the difference with everything being hands-on.” Participant 5 also believed collaboration allowed students to be more engaged in the lesson:

> I like that we collaborate with people from our community. We have alumni week which entails former students who are out of college that are now in STEM careers who have come back to talk about their journey from when they left this school up until now. So, for students, they get to see how STEM and PBL effected these alumni students' lives and careers. Talking to alumni helps students see how important a school like this is and how it relates to people's real lives.

The majority of the participants described extremely positive perceptions about how beneficial PjBL instruction was for getting students involved with scientific phenomena. Similarities developed in my data that made it apparent that PjBL as an instructional method alleviated keeping student attention while learning standards and concepts. Participant 6 also confirmed that high engagement keeps students active. Participant 6 stated:

> A really good project heightens participation. I think a lot of the science-based projects are very engaging and exciting and they like it. It also depends on how the student likes to learn. But overall, I think it heightens their engagement… Projects give an experience and a visual and a hands-on experience for them to see what you're actually wanting them to learn. They're not even focused on It being work because they're so engaged. At the same time, they're picking up a lot of different skills and a lot of different vocabulary."

Participant 7 agreed that PjBL had a positive effect on active student participation and student engagement by saying:

> I would say that it is incredible for student engagement. Students love to be working on projects. They love to be in charge of what is happening, they love to be creating. So, I think engagement goes through the roof. I think that it's the best way to teach, basically… Student motivation has increased.

Teachers described the positive effect that PjBL had on student engagement. This was another pattern in my data that emerged. Qualitative data illustrated that Grade 6 to 8 science teachers used project-based instruction to encourage engagement and participation. Participant 7 summarized their interaction with students:

> If a project is planned well enough, it works. So, take a project I did last year with my eighth graders where we were learning force and motion, and we did a project where they had to build a ramp. And so, they were also learning about friction. When they have something tangible that they can touch and feel, they better remembered the standards. So, when we did the math part of trying to do the distance, time, and speed, they were like, oh yeah, I actually touched that car and I had to physically measure how long that car went. And so, they were more excited. They were excited to do the math because they wanted to see who had the fastest car. Whereas if I had just said, "Do this problem on the board," I'd get zero engagement. That engagement would only be motivated by grades. Whereas this engagement is motivated by the project that they're working on.

Participant 8 expressed a similar pattern regarding active participation and student engagement by saying, “Based on my experience, projects increase the participation from the students, especially when they are assigned roles. I've done projects where it's cross curriculum, so it's every other class. Even the classroom discussions improve.” Participant 8 also described a change in student motivation when using a project-based approach over traditional coursework with,

> Kids are more motivated. They have a way of seeing exactly why they’re doing what. I think based on my experience, I would say it improves their academic performance because it’s not just for the student who always excels, but it’s also for those reluctant students who you have a difficult time pulling into the lesson, participating, turning in all the assignments, adding to the discussion - it really helps to bring them in to the fold so they can accomplish something. So, based on my experience, it's definitely improved student success.

Although the majority of participants agreed that PjBL is beneficial for improving student participation, the response from another participant pointed out challenges that other students faced during implementation. Participant 2 stated:

> I think that there are some students who really struggle with the idea of having to create and formulate their own ideas and they are far more comfortable with searching for an answer. While we are always trying to help them to grow, the kids that have the most success are those who don’t get overwhelmed when there aren’t very narrow guidelines which creates a larger discrepancy in what the kids are able to produce and what they feel comfortable with.

Teachers engaged students with real-world issues and societal problems during PjBL. Theme 4 highlighted differences in student learning and performance. Overall, participants believed that project-based learning instruction was beneficial for increasing student engagement, motivation, and academic performance.

Research Question 3

My third research question was: What are Grades 6 to 8 science teachers' perceptions of the challenges of implementing PjBL? I found two themes related to my third research question. Theme 5 was most Grade 6 to 8 science teachers perceived lack of resources, control, training, and time as challenges of implementing PjBL. Theme 6 was Grade 6 to 8 science teachers feel unprepared and unsupported by the administration when implementing PjBL.

Theme 5

Theme 5 was most Grade 6 to 8 science teachers perceived lack of resources, control, training, and time as challenges of implementing PjBL. This theme emerged because lack of resources and planning time were the two most quoted barriers during my coding. Many participants discussed that during planning time, teachers often need help and communicate with one another to assess each other's understanding of implementing science learning standards, exchange project ideas, and discuss common assessments to carry out. A review of the data showed that grade 6 to 8 science teachers perceive lack of time as their greatest challenge when implementing project-based learning during science instruction. For example, Participant 1 stated:

> A project-based learning lesson requires a lot of critical thinking and a lot of analysis, so it takes much more time to plan. It varies depending on whatever you're going to teach, but it definitely takes more time, and this could be a

> hinderance to you achieving all the goals that you have set. It usually takes me more than 20 hours or about three days to prepare a project-based learning lesson. Once we begin the lesson, a lot of students need intervention. Students always have a lot of questions, and as a teacher, it is challenging to answer everything in the allotted time. A lot of students need intervention, they have a lot of questions, and as a teacher, it is challenging to answer everything because even teachers have their flaws.

Unplanned student intervention during lessons was an issue that the majority of the participants recognized. Similarly, many teachers mentioned either students needing additional help or not getting back lost instructional time as challenges for PjBL implementation. Participant 2 had a related perspective about time and how project-based instruction required collaboration with other teachers, and that collaboration was time-consuming:

> Project-based learning was sort of a district initiative and so we had several work days where we were able to meet together, and plan and create what we wanted our rubrics and guidelines to look like and then over the years, we would make some adjustments to that, so it probably took, I would say, if it were staff development days, probably at least two solid days of a team of teachers who were trained, and then also had a similar collaborative philosophy. But during the school year, I feel like we always have things coming up so it takes more time to plan.

It was interesting that several teachers talked about unplanned events occurring throughout the school year. A pattern most definitely stood out regarding how the participants described their perceptions of never being able to finish lessons. Participant 5 criticized the time it took to implement the number of projects having to be carried out:

> Time is probably the biggest complaint. We do four projects in a year, and they're considered nine-week PBLs. However, they can build on them. Even though it's going to be a different driving question, they build on it. We have themes for the whole school that has to do something with agriculture, animals, and plants. Our second theme is water and aquaponics. Our third one is natural disasters, global warming, and climate change. Our fourth one is energy and power. Teachers often complain about running out of time so we use a pacing chart. During your grade level meeting, chairs see if you're on track, and suggest what you have to change.

Similarly, Participant 6 said, “Project-based learning can be very time-consuming. It often takes me two planning periods for a lesson, and you try to map everything out, but it extends longer sometimes because you have to explain or overexplain or repeat. It's time-consuming.” Too, when I asked Participant 8 to describe their implementation of project-based learning in terms of the time it takes, and the response was:

> It takes a lot of time and planning, especially if it’s your first time doing the project. Years later, or the second year, you'll use less time, but that first time it takes a lot of time because you’re not just thinking of one activity, you have to think of the entire project to make sure you are hitting the points where the kids

> are having those experiences that they need to be able to do the demonstration. So, it takes a lot.

Participant 8 responded similarly when asked what support would improve project-based instruction and stated, “More time. Just having more time, especially with project-based lessons when you plan across curriculum.” Many participants said collaboration amongst teachers is crucial because there are so many definitions of PjBL. Teachers expressed that collaboration encourages lesson alignment and delivery but having time to collaborate presents an issue.

In addition to lack of time, participant teachers complained about the inconsistency in project-based learning grading policies and would appreciate pacing guides that take into account unplanned school activities with make-up dates, benchmark assessments that help measure student understanding and academic progress, supplementary resources that provide inquiry-based activities that are aligned to academic standards and tools that support promoting guidance and direction for teachers that may be novice or unfamiliar with the implementation of PjBL instruction.

Furthermore, there was a discrepancy in the data that brought attention to the need for extensive teacher professional development, such as ongoing workshops provided by PjBL experts, follow-up coaching, and support staff who can answer specific questions related to lessons. Participants did not like the idea of professional development being led by individuals who are not teachers. For example, Participant 2 said:

> The thing that was often most frustrating for me, having gone through several different versions of professional development for project-based learning, was the

> number of times the presenter had actually never been in the classroom themselves and I find that appalling. There's a lot of things that look great on paper but if you haven't actually pulled this off with children, it's very hard to really buy in to what you're presenting. I teach in a very affluent community, but I also have students that are homeless, so there's a disparity, so it's disingenuous to believe that one model will somehow solve everybody's' test scores.

Participants spoke about the need for more instructional guidance with PjBL for autistic students. One issue with PjBL is the independence and take on ownership it requires from students. With that being said, a pattern developed related to teachers' ability, or inability, to differentiate project-based learning instruction based on student needs. Alluding to the complexity of differentiation, Participant 7 said, "There are a lot of moving pieces with PjBL. Students will be engaging in several interest-driven projects with various student needs, all moving at different rates. Using technology helps to manage it all." Participant 2 stated that she has varying degrees of students in her classes, which made it difficult to accommodate all student needs:

> I think that PjBL is wonderful for some of the students and really overwhelming for other students. So, there is a huge range in that skill set and then also because our school is mainstreamed for all of our students. So, if you are an ELD 1 with no language capabilities whatsoever, you're in my science class. If you are severely emotionally disturbed and have a one-on-one aid, you're in my science class. And then also if you just don't care because you're a middle schooler, then also if you are the state finalist in the super smart whatever, you're still in my

> class. So, then it's how do you make them all work together and come up with a plan. We have a huge range of students, and that makes project-based learning a bit of a challenge. So, we've come up with a variety of different ways to do group work. One of the strategies we use is Google classroom and so each of the different students will have different sections that they're in charge of and they each have their own font, which helps a lot with accountability.

Yet, an additional concern for some teachers related to student motivation and implementation issues of PjBL was the inconsistency of practice over time. A lot of teachers discussed that the practice of PjBL was varying. For instance, Participant 2 expressed:

> What I've found is that over the years we've jumped into it more, and then backed off from it – back and forth – especially post-pandemic. We haven't done a true project-based learning project since we've been back after the pandemic, and part of that is just the mental capacity of the kids and the weight they feel prepared to carry is sometimes a struggle. When we were doing the project-based learning, there were certainly those students that very much loved it and were all in and then there were the kids who just did not care at all. Trying to find a balance and making sure I'm checking all of the boxes of what looks good on paper and then the textbook version of it and what works in my actual classroom with all of the different personalities. What looks great is one thing, but what works in practice is often a modification.

Amongst the participants, a few teachers felt like PjBL was not the best strategy for students because of the hands-on work it requires. On the other hand, other teachers perceived that PjBL was fundamental for their engaging classroom environment. Unlike, Participant 2, Participants 3, 6, and 8 spoke on their backing for PjBL as a way for struggling teachers to increase student motivation. Participant 3 said:

> I haven't taught in a non-PBL school. Years ago, I was in a traditional school, and not everything was PBL. But it's been like 10 years. But according to my colleagues that aren't required to do pbl – they're frustrated with finding ways to keeping students engaged. My colleagues at the school express a lot of frustration and I think they would be happier if they had the support and the freedom to do PBL. I think it's a good thing for teachers and our voices matter.

Participant 6 said:

> Where everything is just instant and digital, a lot of students don't pick up and retain information that well. I think project-based learning is something that all teachers should start to do in their classroom because "sit still and be quiet" will get you more discipline problems because they're agitated and they're not focused and they're bored.

Participant 8 said, "I really think it's a great way to teach, and it shouldn't just be done in science." Although several participants discussed how they believe more teachers would appreciate PjBL implementation, an issue that stood out in my data analysis was teachers not being comfortable enough to relinquish control and allow students to explore learning in their own way. Participant 2 stated that:

> It’s very important to me that projects be done in the classroom because if not you lose all control of what’s actually happening and who’s doing it, but then the chaos of what I thought would take a week or a week and a half is now taking three and a half weeks because of class time constraints.

A pattern that came up in my data was how participants termed their troubles dealing with students doing work outside of their classroom. Several responses made it very clear that teachers prefer being in control of instruction and present when students are completing assignments. Participant 7 said:

> It is a shift in thinking about the educational model, and it is really hard to make that shift. I think for a lot of teachers, I don't know how to explain it. I think that the traditional education is like, I have the knowledge. I will tell you the things, you do the problems on the board, and you learn them, and then you know the things. Whereas project-based learning is a lot more exploratory, and you let go of control of their learning, so that students are exploring those things and learning them on their own, and then you are just reinforcing the fact that they did learn it. I think that the issue is that it's a difficult shift to make, you become more of a project manager than a teacher, which I love it, like I'm totally sold but it's difficult. But when kids are engaged, they're a lot more excited. So, there's more noise in the classroom.

Shifting from telling students what to do and how to do it was brought up often in the responses. Dealing with a disordered environment was another concern for teachers.

A few participants used words such as chaos, disorder, etc. when conversing about the classroom environment during PjBL implementation. Participant 4 said:

> PjBL is easy on paper. It is really, really hard to learn how to let your students struggle. That's the biggest thing. Some of them go home crying and everything. But they just need to go through that one or two days of struggling and then they finally learn how to struggle. Another challenge is when they have to take their project home to finish because we don't have enough class time and allowing them to have parental support. I let them know they can come in during lunch and finish together but the main concerns is student buy-in. But that usually solves itself when they see other children having fun. If they don't have parental support to get the stuff they need, then it's a wash."

Furthermore, a few of the participants mentioned how their traditional or authoritative teaching style made them feel uneasy when trying to implement lessons with the students in control. Repetition regarding teachers being able to allow for more student autonomy and tolerating a chaotic classroom environment stood out in many responses. Participant 5 stated:

> For us, because we have to stick to our themes, and the ecosystems have to be included, it challenges us in our thinking. Also, our teachers actually have to take the students outside when we do aquaponics, so stepping out of your comfort zone as a teacher if that's something you're not used to is different. It's challenging for us to go outside our comfort zone.

Being challenged in their thinking seemed to be difficult for a few teachers. Some teachers are not comfortable with PjBL because it is *different*. When I asked how they'd describe their implementation of PjBL in terms of ease of use, Participant 6 told me:

> I think it's very easy to use. It depends if you love hands-on learning. I'm not a textbook or notes-taking teacher. I think it's extremely easy if that's what you like. You have to think outside of the box so it may be more difficult to come up with ideas or projects.

Participant 6 pointed out that they perceived PjBL implementation as simpler for teachers that are okay with non-traditional learning. Teachers being comfortable with classroom practices that are not the norm stood out in my data. Participant 7 discussed their perception about being able to shift their thinking during PjBL:

> I would say that project-based learning is more difficult on the upfront planning side and more difficult in terms of allowing for chaos, allowing kids to be moving around, to be using materials, to be making messes. But then once you allow students to engage in that project-based learning, they are more engaged, they do learn more, they're excited to do the work, and then they retain more information. It's just a shift in thinking, I think.

Participant 8 expressed "I think project-based learning is pretty easy to use as long as you have the resources, or you are the type of teacher like I am. I think outside the box." Several participants had varying opinions related to ease of use or about their difficulties with PjBL implementation. Overall, Theme 5 was related to implementation issues. Grade 6 to 8 science teachers feel overwhelmed with the implementation of PjBL regarding time management and having enough resources. Most grade 6 to 8 science teachers perceive a lack of resources, control, training and time as challenges of implementing PjBL.

Theme 6

Theme 6 was Grade 6 to 8 science teachers feel unprepared and unsupported by the administration when implementing PjBL. This theme came from teachers reporting their interactions with leadership regarding PjBL implementation as unsupportive. Participants complained about realistic expectations, lack of teaching time, receiving training from non-teachers, and school business and events interfering with instructional class time. Participant 1 stated:

> I would appreciate more support from the school, more platforms where students can share their concerns, challenges, and expectation so that I can reflect on feedback and adjust my instruction. I want to know that I am fulfilling the requirements. I need more planning time, more realistic goals for teachers, and keeping a good performance report of teachers and what is expected. Better measurements of student performance.

Having a similar response, Participant 2 said:

> One challenge is realistic expectations from admin of what really goes into PBL. When they first rolled it out, they were like every teacher in every class will do at least one project-based learning thing a quarter. And it was like, that’s absolutely unrealistic. And if I’m doing this in science, and then there’s some classes that don’t lend themselves as well to it, and you want test scores, and you want us to

> cover all of this other content. There are no miracle projects that can meet all of those requirements every single quarter for every single class. The biggest thing is having admin expectations be realistic and be willing to give the time and the space because it also takes a whole lot of planning and collaboration. Admin will say they want to adopt some initiative, but they often have very little actual idea of what that's going to look like or that willingness to give the time for it. If anyone is going to truly invest in project-based learning, it has to be realistic and then there has to be money to supply resources.

Like Participant 2, Participant 3 would appreciate the administration being more understanding. Participant 3 stated:

> Our voices matter. We have a say in how we teach because we know what's best for kids. How often are we hearing people say we're the experts, but our voices are being stifled by someone sitting in an office all day? Many teachers don't have the freedom to do PBL. They don't have the planning time. Many teachers don't have the supportive community to get them resources that make it more fun. I really think more teachers should be allowed to dive in project-based learning. It's what kids want. It's very often what teachers want. It can be a simple model with the right support. It doesn't have to be expensive if you recycle.

A pattern that emerged was how teacher participants felt about the lack of accountability placed on administration. Many teachers would appreciate the consideration of teacher voice because they are the facilitators of instruction. Many teachers felt that the administration placed project-based learning on them without proper training and the proper resources in place to aid instructional delivery during science instruction. Participant 4 said, “Although I enjoy PBL as a strategy for increasing student engagement and motivation, it’s not easy to orchestrate.” Many teachers felt like planning units together would be extremely helpful as it related to being adequately prepared and “working smarter, not harder”. Many teachers would like to see continuous and collaborative PjBL models for teachers to imitate.

Like Participant 2, Participant 5 perceived that their implementation of project-based learning might be better if other subject teachers helped by integrating cross-curricular content. A common pattern in my data was that many participants brought up wanting help from the team that they already plan and work with daily. Participant 5 stated:

> I think we're getting better. This is the first time we're having our PBL walks. We were doing academic walks, but now the teachers are seeing that it has to be integrated. When we first started this journey, it seemed like the science teacher would carry all the weight. This year the ELA and social studies teachers help but the science teacher is leading. I think this way they're finding it easier to integrate when they collaborate. It’s better than a few years ago.

Both Participants 2 and 5 believe that if project-based learning was all-inclusive throughout all content areas its implementation may be easier and become more familiar in practice. Participant 5 referenced how adding a couple of other content teachers to take on PjBL relieved science teachers. Another participant described their thoughts about compiling everything necessary for PjBL. Participant 6 expressed their perception in the following way:

> It [PjBL] got easier as I became a better teacher. In the beginning, anything that's new is going to take some time. It takes a lot of time to figure out what you need. Actually, you start from the end and then you work towards the beginning. What's the outcome you're looking for? And then you say what do you need? What's the best way to implement this? If it's a brand-new project, it may take me my whole hour and a half planning. It may take me two days. I usually don't do last minute projects. Because it takes a while to gather material, it takes a while to figure out how to differentiate because not all students are on the same level. Taking into consideration all of those different aspects, it does take maybe two planning periods. And sometimes it takes tweaking and re-teaching too. Sometimes what you've planned it's not quite what you expected.

Grade 6 to 8 participants all talked about their process to begin PjBL and the average time it took to plan a lesson was two days. A lot of teachers shared their differences in experiences from school-to-school. Participant 7 shared noteworthy dialogue about the differences in PjBL implementation from school to school by stating:

> When I worked at a different school, a middle school, I was totally sold on project-based learning, but there was no educational support, no model, no technical support, no resources, no funding. We used literal trash as materials for the projects. But teaching PBL was mandatory. Then I came to this school, that is very technology-driven, they have funding that they use for STEM resources. And

> this has been over the course of ten years that they've been focused on science and technology. These schools are in the same district. If the district wants to see all their schools succeed, there has to be an equal focus throughout all schools. Also, I went through my STEM endorsement last year where you learn about PBL and writing curriculum. But a lot of teachers are expected to teach PBL before going through the endorsement and it's very difficult to just pull stuff out of thin air. It has to be a school wide focus. If your principal is not invested and excited about it and you do not have support from the all the subject teachers, it's going to be very difficult. Luckily, at this school, everybody is on board.

Unlike Participant 7, who transitioned to a school where PjBL is supported, Participant 8 fell into the pattern of feeling unprepared and unsupported during PjBL implementation, they described her barriers as, "It would be the planning time. The other barrier would be, I would say resources, materials." Participant 8 also expressed their additional thoughts regarding perceptions of PjBL with:

> School leaders really need to plan for professional development to help teachers understand how to implement project-based learning and give us enough planning time to work together, because it really changes learning. When I implement PjBL, I basically facilitate my student's experience by offering structure and the tools for them to successfully take ownership of their own learning experiences. I've seen these projects change students' mindsets from doing an activity. It's not just students doing it to prepare for a quiz or test. They're actually doing it to do

> something. Kids get excited about the project and in this world, we always need something to get kids excited about.

Participant 2 also described their experience with inconsistency: “What I’ve found is that over the years we’ve jumped into it more, and then backed off from it – back and forth – especially post-pandemic.” A pattern that emerged was that many participants experienced inconsistency with PjBL throughout their teaching career, although it is mandated throughout the U.S. Data from both Themes 5 and 6 connected the issue of inconsistency of PjBL implementation, hence the problem statement in my research.

Summary

Overall, the data analysis from my themes illustrated the implementation of PjBL and what Grade 6 to 8 science teachers’ perceptions are regarding the benefits and challenges during science instruction. The data from my study indicated that Grade 6 to 8 science teachers in the United States had positive perceptions regarding the benefits of the hands-on instructional method and its effect on student achievement, although its implementation posed several challenges, such as strict time constraints, proper support, and consistent training, and realistic expectations from the administration. Grade 6 to 8 science teachers explained that they used similar PjBL frameworks and processes to guide their implementation during science class. The next section addresses credibility, transferability, dependability, and conformability.

Evidence of Trustworthiness

Qualitative researchers must convey evidence of credibility, transferability, dependability, and confirmability to ensure the trustworthiness of the study’s findings.

The evidence of trustworthiness can be determined by ensuring that study participants clearly understood the phenomenon to provide accurate information that aligned with the literature. I paid close attention to the responses of the participants and took into consideration their perspectives without interposing my views.

Credibility

To ensure credibility, I used the Zoom video conferencing platform to conduct semistructured interviews, the Word transcribe tool for transcription, and used a reflective journal to review my notes and the transcriptions several times. Further, I established credibility using criterion purposive sampling. I selected participants defined as Grade 6 to 8, U.S. science teachers with 5 or more years of experience who have implemented or attempted to implement PjBL to provide quality assurance.

Transferability

To ensure transferability, I thoroughly described the research context and the assumptions that were central to my research. I established transferability by providing readers with evidence that my research study's findings applied to other contexts, situations, times, and populations. I used the words of the study participants and significant emerging themes to present my findings. I presented my findings from first-hand interview data and secondary sources.

Dependability

I established dependability and reliability in my qualitative research by consistently incorporating the use of comprehensive data, comparison of data, and the use of tables to record data. Additionally, I implemented repetitive observation and requestioned participants about key findings in my research. Lastly, outside researchers examined the processes of my data collection, data analysis, and the results of my research study.

Conformability

I addressed conformability by probing participants with open-ended questions about their perspectives of PjBL implementation during science instruction. I kept a detailed record of how the data were collected and included the details in my research so that readers could check for confirmability. I documented the procedures for member checking and rechecking the data throughout my study. I also followed the procedures given by Walden's IRB to attain trustworthiness in my research.

Summary

In Chapter 4, I presented my findings based on the data analysis that was guided by my three research questions. The first research question was how do Grade 6 to 8 science teachers describe their perceptions of implementing PjBL during science instruction, the second research question was what are Grades 6 to 8 science teachers' perceptions of the benefits of implementing PjBL, and the third research question was what are Grades 6 to 8 science teachers' perceptions of the challenges of implementing PjBL? Participants provided insight into the definition and process of PjBL and explained their perceptions of its benefits and barriers.

Study participants shared their perspectives in a private virtual Zoom setting during 30-to-45-minute semistructured interviews by answering open-ended questions. I conducted member checking by emailing summaries to each participant to ensure that my findings were as accurate as possible. My interpretation of the data led to the discussion of my results which are presented in Chapter 5. There, I presented my interpretation of the findings, the limitations of the study, the recommendations, and social change plans.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this study was to explore Grades 6 to 8 U.S. science teachers' perceptions about the implementation of PjBL instruction to support science education. I also explored teachers' perceptions of the benefits and challenges of implementing PjBL instruction during science instruction. In this basic qualitative study, data were collected from eight Grade 6 to 8 U.S. science teachers with 5 or more years of teaching experience using 30-to-45-minute semistructured interviews in a private, virtual Zoom setting. The findings showed that science teachers shared mutual perceptions that PjBL is a beneficial inquiry-based hands-on instructional method that increased student engagement, achievement, and motivation during science class. On the other hand, the data revealed that teachers struggled to consistently implement PjBL because of limited resources and space, storage, lack of instructional and planning time, and unsupportive administration.

The study revealed six themes: Grade 6 to 8 science teachers use similar PjBL frameworks and models to guide their implementation and instructional delivery, teachers use technology and student materials to create hands-on projects, which require space and storage, teachers perceive PjBL to be an effective student-led approach that encourages critical learning skills and workforce training, teachers perceived PjBL as beneficial for increasing student engagement, motivation, and academic performance, most Grade to 6 to 8 teachers perceived lack of resources, control, training, and time as challenges of implementing PjBL, and Grade 6 to 8 science teachers feel they are unprepared and not supported by administration when implementing PjBL. The findings illustrated that PjBL instructional is a beneficial teaching tool that promotes student participation and achievement at high levels. Conversely, the responses from some participants revealed issues related to consistent professional development and realistic administration expectations. In this chapter, I discuss my interpretation of the study's findings, the limitations, recommendations, implications of the study, and plans for social change. Exploring teachers' perceptions of the challenges and benefits associated with consistently implementing PjBL to support science instruction in the United States will afford instructional leaders the knowledge to make significant changes and benefit teachers so they can consistently implement PjBL instruction to support science education.

Interpretation of the Findings

The findings in this basic qualitative study confirmed that Grade 6 to 8 science teachers perceived PjBL as having a positive effect on students during science instruction, although many teachers felt they needed more time to plan, collaborate, and practice the strategy. Besides challenges with storing projects and having enough space for materials during their implementation, I found that the participants expressed student-led project-based instruction to be the most effective way to engage Grade 6 to 8 science students. The literature review and conceptual framework guided my interpretations. The constructivist learning theory, pioneered by Dewey in the 20th century, pointed to students learning through action and experience. Furthermore, studies support that the perceptions of middle school science teachers affect their implementation of instructional strategies during class time (Peck & Reitzug, 2021). Former studies also found that students benefit most academically from inquiry-based activities when they are interested and engaged (Culclasure et al., 2019). I found from my study that the teacher participants followed this notion by involving their students in authentic activities where they learn by doing project-based tasks.

Findings Related to Research Question 1

Research Question 1 addressed how Grade 6 to 8 science teachers described their perceptions of implementing PjBL during science instruction. Two themes emerged from Research Question 1. The first theme was Grade 6 to 8 science teachers used similar PjBL frameworks and models to guide their implementation and instructional delivery. The second theme was Grade 6 to 8 science teachers used technology and a lot of materials for students to create hands-on projects, which required space and storage.

Finding 1: Grade 6 to 8 Science Teachers use Similar PjBL Frameworks and Models to Guide Their Implementation and Instructional Delivery

The first finding was that Grade 6 to 8 science teachers use similar PjBL frameworks and models to guide their implementation and instructional delivery. My findings corroborated previous research which pointed out that Grade 6 to 8 science teachers carried out PjBL instruction using real-world issues to spark discussion while integrating essential questions that prompt students to further explore science standards and concepts (Krajcik & Czerniak, 2018). Likewise, the teachers in this study used driving questions that the students investigated throughout the unit to help generate their PjBL projects. I found that the participant teachers followed a PjBL framework of constructivism that suggested relevant multimedia applications, web-based software, or interactive content through design and delivery, which allowed students to collaboratively design, complete, and evaluate the learning task given. The study participants explained how they allowed students the autonomy to create the foundation of their inquiry projects, while teachers acted as facilitators and re-directed students when necessary. Constructivists deem that learning is allowing students to discover meaningful information on their own. The data from my study supported preceding research that showed PjBL as a great teaching tool where students appreciated autonomy (Zhao et al., 2021).

Teachers reported that the implementation of PjBL included using a driving question, essential questions that addressed the mandated standards and concepts, and a visual presentation end-product. Every teacher spoke the same about the aforementioned being the instructional objectives that guided their instructional delivery. The findings confirmed prior research of teachers' definition of PjBL as using an extended period to investigate and respond to authentic, engaging, and complex questions, problems, or challenges (Lee & Galindo, 2021). Grade 6 to 8 science teachers in my study found that integrating profound questions helped students foster deeper learning skills, which strengthened their understanding of science concepts.

Finding 2: Grade 6 to 8 Science Teachers Used Technology and a lot of Materials for Students to Create Hands-On Projects, Which Required Space and Storage

The second finding was that Grade 6 to 8 science teachers used technology and a lot of materials for students to create hands-on projects, which required space and storage. Previous research also found that the lack of resources, such as space and storage, affected teacher's ability to consistently implement PjBL (Yang et al., 2021).

Many schools in the United States mandated PjBL during science instruction, and teachers began shifting to this pedagogy, despite instructional leaders not providing the proper classroom accommodations to support PjBL. The teachers in my study expressed their concerns about not having enough space to consistently implement PjBL.

For instance, some teachers indicated that it was not possible to have standing, incomplete projects for multiple class periods throughout completing a project. Due to lack of space, many teachers voiced that they were forced to have students finish projects at home, although that is not suitable for PjBL during science instruction. Former research carried out by Lewis et al. (2019) revealed that teachers not being able to monitor students during PjBL to ensure fidelity was a problem. Similarly, teachers in my study found that PjBL works best when they are present to guide student learning. Students easily got off track or received help from parents when doing PjBL at home.

All the teachers in my study said that successful PjBL focused on the use of technology along with classroom instruction. Technology use was a vital component of PjBL for students to conduct research. Participants also pointed out that we live in a digital age where leveraging the internet is vital for students to showcase multimedia work. Technology integration during PjBL included but was not limited to, informal and formal assessments, video learning, course gamification, board animations, and student activity projects. The teacher participants determined that technology made it easier for them to communicate project content and requirements, learning objectives, and collecting learner data.

Findings Related to Research Question 2

Research Question 2 addressed Grades 6 to 8 science teachers' perceptions of the benefits of implementing PjBL. Two themes emerged from this research question. Theme 3 was Grade 6 to 8 science teachers perceive PjBL to be an effective student-led approach that encourages critical thinking and learning skills that are related to workforce training. Theme 4 was Grade 6 to 8 science teachers perceived PjBL as beneficial for increasing student engagement, motivation, and academic performance.

Finding 3: Grade 6 to 8 Science Teachers Perceived PjBL to be an Effective Student-Led Approach That Encourages Critical Thinking and Learning Skills That are Related to Workforce Training

The third finding was that Grade 6 to 8 science teachers perceived PjBL to be an effective student-led approach that encouraged critical thinking skills that are related to workforce training. The study participants identified that student learning skills related to problem-solving, teamwork, and the ability to use higher-order thinking increased with the use of PjBL. Other researchers have found that 21st-century skills are necessary for the future of employment, education, digital citizenship, and active citizenship in the world (Baird, 2019). Dewey (1961) theorized that constructive learning is an active process that requires consistent practice to solve problems, unlike that of memorizing content. Teachers in my study agreed that PjBL empowered their students to develop 21st-century learning skills and promoted those skills through repeatedly participating in real-world industry projects and experiences. Teachers used essential questions to further determine student understanding and nurture collaboration amongst peers. Discovering new information as students seek answers to essential questions allows students to learn at a metacognitive level because they can further explain and elaborate on the answers given. Even more, constructivism as a learning theory in connection with PjBL drew students to engage in more demanding tasks through continuous reflection.

PjBL differs from traditional coursework in that student voice and choice are included in making decisions about projects, such as what they will create and how. The PjBL learning environment creates a constructivist learning environment that contributes to an inquiry-based science curriculum, which promotes critical thinking and learning skills necessary for developing students for the 21st-century workforce (Martinez, 2022). The teachers in my study said that giving students a voice and choice made learners feel like they had agency over their work, which liberated their learning. Previous research supported that PjBL is a pedagogy that includes active exploration from students that the teacher only facilitates (Almulla, 2020).

By teachers providing students with project guidelines, they were able to independently explore real-life situations, tasks, and issues related to society or their community. The teachers in my study also perceived that PjBL was beneficial for their low-achieving and special-needs students, whose instruction required more inventive thinking (Culclasure et al., 2019). Teachers found that a constructivist approach was better for low-achieving and special needs students because student-centered learning builds from what the learner already knows, which allows students of differing abilities to learn at their own pace rather than being a recipient of a body of knowledge they do not grasp conceptually. That independence allowed students to engage in active questioning and analysis with peers, and prompted students to uncover information and apply that information authentically. Teachers in the current study also used PjBL as a multidisciplinary tool to engage authentic learning at varying ability levels across subjects. Teachers described that using multidisciplinary PjBL produced positive attitudes among students, and thus, encouraged students to have a positive outlook on their future careers.

Teachers who successfully used PjBL in their classrooms focused on supporting deep content learning, engaging students in work that felt authentic to the real world, supporting student collaboration, and building a culture where students were focused on the revision of work, rather than just completion of work (Grossman et al., 2019). Teacher participants defined authentic learning as learning that can be applied beyond the classroom and transferred as students pursue their professional interests. Allowing students to engage in relevant topics helped them build critical thinking skills, evaluate what they learned, and connect what they learned to their ability to synthesize information into their interpretation (Saad & Zainudin, 2022). Just as Dewey's (1961) theory endorsed, the participants in my study found that the traditional role of the teacher only regurgitating facts to students is not effective in exercising and promoting the critical thinking and problem-solving skills necessary for the preparation of 21st-century learning.

Finding 4: Grade 6 to 8 Science Teachers Perceived PjBL as Beneficial for Increasing Student Engagement, Motivation, and Academic Performance

The fourth finding was that Grade 6 to 8 science teachers perceived PjBL as beneficial for increasing student engagement, motivation, and academic performance. A constructivist approach requires students to be actively engaged in the experience of learning, thinking, feeling, and perceiving. In the current study, I found that Grade 6 to 8 science teachers perceived PjBL as being a positive teaching tool that heightened student participation during science instruction. For instance, participants in the study observed that PjBL deepened students' understanding of science-related concepts through the application of design and engineering practices. My study on Grade 6 to 8 science teachers' perceptions and use of PjBL during science confirms the findings of Wu et al. (2021) that authentic inquiry experiences are associated with significant gains in self-perception of interest and understanding of the scientific skills and processes for all types of students. Dewey's constructivist learning theory also supported that active, hands-on experiences scaffold ongoing learning for students to prepare for a dynamic world. In my study findings, teachers identified that students felt purpose in teachers allowing them to investigate topics in their community, which made it easier for students to connect their learning to science theories. My study also confirms the constructivist learning theory encourages students to build upon their own knowledge. Likewise, when consistently implemented and scaffolded, Wu et al. found that PjBL had a huge impact on student engagement and student performance, and a result, increased student achievement.

I found that the participants expressed student-led project-based instruction to be the most effective way to engage Grades 6 to 8 science students. They also expressed that students were much more engaged when instruction was grounded in real-life examples. A vital proponent of the constructivist learning theory model is the ability of students to connect their learning to everyday life and be able to synthesize information. Using issues that were familiar allowed students to conceptualize what was being taught and why, which increased student interest, and subsequently, had a direct effect on increased student achievement. Additional research also found that a student-led approach was favored by students because the approach encouraged errors as opportunities for students to learn (Saad & Zainudin, 2022). Comparably, another qualitative study reported that participating in PjBL helped their students improve collaboration, problem-solving, creativity, self-direction, and interpersonal skills (Culclasure et al., 2019).

Teachers in this study also expressed how student led PjBL instruction felt more meaningful to students because they were prompted to use problem solving skills that involved social and emotional learning. Participants also communicated that before PjBL implementation, they would carry out traditional coursework like knowledge and recall and their students did not understand the science behind the concepts. Students merely memorized facts but were unable to apply them in their daily lives and found it uninteresting. Moreover, Matriano (2020) found that a hands-on approach was more suitable for teaching science phenomena. Similarly, I concluded from my study findings that inquiry learning was preferred over subject-based learning. A constructivist approach allows students to demonstrate and explain their learning.

Findings Related to Research Question 3

Research Question 3 addressed Grades 6 to 8 science teachers' perceptions of the challenges of implementing PjBL. Two themes emerged from Research Question 3. Theme 5 was that most Grade 6 to 8 science teachers perceived lack of resources, control, training, and time as challenges of implementing PjBL. Theme 6 was Grade 6 to 8 science teachers feel unprepared and unsupported by the administration when implementing PjBL.

Finding 5: Grade 6 to 8 Science Teachers Perceived Lack of Resources, Control, Training, and Time as Challenges of Implementing PjBL

The fifth finding revealed that Grade 6 to 8 science teachers felt they needed more resources, and more time to plan, collaborate, and practice the instructional strategy to implement it consistently over time. Resources included adequate space, storage, technology, professional development, leadership, and collaborative time. When these resources were lacking, teachers and students were impacted. Previous research illustrated that a lack of a wide variety of resources hindered teachers' experience as they experimented with PjBL methodologies (Herro et al., 2019). The author also determined that both inadequate teacher training and inadequate resources were barriers to implementing PjBL. Similar to prior research, in my study, teachers expressed difficulty with PjBL implementation because of a lack of mentoring, planning time, and implementation experience. However, Zhang et al. (2021) found that teachers working in schools with adequate instructional resources were more likely to implement student-centered instruction than those in schools with a shortage of instructional resources.

Proper resources, training, and time should be provided to teachers to strengthen and improve their science instruction.

Zhang et al. (2021) showed that teachers participating in training related to the implementation of adaptive instruction, technology, and small-group learning showed a significant difference in the frequency with which they implemented 21st-century learning approaches. Based on this evidence, the role of the instructor is influential in setting the standard for the role of the student. Previous findings have already established that in general, teachers encountered several challenges when they shifted their instructional delivery to an inquiry-based curriculum (Gholam, 2019). Setting aside time for teachers to practice PjBL implementation, especially within their professional learning communities, was imperative. The findings in my study data analysis also highlighted the need for developing better collaborative practices amongst science teachers when planning for the implementation of project-based instruction, as well as for administration scheduling enough time for teachers to work in their professional learning communities continually. Further, the evidence supports that there is a disconnect between instructional leaders having realistic expectations for teacher’s ability to incorporate inquiry-based approaches consistently during science class. For example, data analysis from a similar study carried out by Swift et al. (2020) to examine what prevented teachers from enacting PjBL revealed themes regarding time management and classroom discipline issues. My research also showed that despite its positive attributes, PjBL instruction was time-consuming and required better time management.

Conversely, in a comprehensive examination, researchers found that teachers showed substantial improvements in their disciplinary content knowledge and the ability to translate their knowledge into instructional practices when they attended consistent professional development (Pringle et al., 2020). The participants in my study also believed that professional learning communities were vital to gather with other teachers who were implementing PjBL, so they could exchange lesson ideas and share constructive feedback. Likewise, prior research indicated that teachers needed professional development that demonstrated how to align instruction to the PjBL framework and how to integrate engineering practices during instruction (Brand, 2020). In my basic qualitative study, the findings indicated that teachers also wanted to be included in creating the instructional PjBL framework.

Middle school science teachers struggled with implementing PjBL due to other factors like being unable to buy into to professional development being presented by non-classroom teachers. Furthermore, the participants in my study reported that it was difficult to consistently implement PjBL because they did not receive proper, ongoing PjBL training, have enough space to store exemplar models or have the space to carry out projects for multiple large class periods simultaneously and keep up with the district pacing guides and the school-wide testing demands. A similar previous study discovered that PjBL implementation was hindered by factors including the pressure associated with testing, the minimal amount of training and district support provided for PjBL implementation, and the complexities of implementation (Culclasure et al., 2019). Another researcher found that the absence of proper professional development to align with science reform efforts must happen first before expecting teachers to implement the practice (Pringle et al., 2020). In my study, teachers perceived that their teaching schedules did not account for the large amounts of time loss due to school activities and quarterly testing beyond their control. Teachers were still expected to keep up, which made them feel overwhelmed, and resulted in their inconsistent implementation of PjBL during science instruction.

Next, I concluded from my data analysis that although PjBL calls for teachers to act as facilitators, many teachers felt the need to be in control of what happened in their classrooms. Unlike a lot of the past literature, my study indicated that when transitioning to PjBL, a huge challenge for many teachers was the need to give up some degree of power in their classroom and trust their students. Previous research showed that teachers being able to adjust to the characteristics of new pedagogy was a vital component of student-led learning. The effect of teachers acting as facilitators embraces more open, guided approaches, while teachers who act as shepherds adopt more directed approaches to inquiry (Correia & Harrison, 2020). In a similar study, Meierdirk and Fleischer (2022) investigated whether mindset matters in teacher education and the findings showed that teachers who modeled and promoted a growth mindset by acting as a resilient and optimistic facilitator created a more positive classroom culture.

Finding 6: Grade 6 to 8 Science Teachers feel Unprepared and Unsupported by Administration When Implementing PjBL

The sixth finding was that Grade 6 to 8 science teachers felt unprepared and unsupported by the administration when implementing PjBL. Aside from having to use their own money to purchase teaching materials, Grade 6 to 8 science teachers also perceived that PjBL was mandated abruptly, with no true protocol or resources in place for teachers to carry out the instructional method. Skilled PjBL teachers scaffold student learning and allow for flexibility in their plans to adjust as a project unfolds. The teachers in my study perceived that they were not given time to scaffold PjBL nor were they prepared by the administration to do so. Likewise, Gray et al. (2020) collected data in the form of interviews, lesson plans, and classroom observations from teachers after teaching at a school that recently adopted inquiry-based learning. The study results supported a need for increased professional development for teachers to implement inquiry-based instruction. Preceding evidence from An and Mindrila's (2020) study also revealed that if instructors do not have enough guidance or support, they gravitate back to implementing familiar activities, instead of the inquiry-based instruction that is most productive for learning in science. In my study, regardless of teaching status, teachers needed continuous professional development. Attending PjBL workshops motivated teachers to implement PjBL and gave them the confidence to cultivate hands-on pedagogy in their classrooms (Gray et al., 2020). Additionally, in the current study, teachers also explained how they struggled with implementing a new instructional philosophy having no extensive workshops, PjBL instructional coaching, clear grading policies, and guidelines for creating PjBL benchmark assessments.

After analyzing the data from the participants, I found that the protocol around implementation practices needed to be re-examined to include more instructional time, more time for teachers to plan PjBL projects, improved reflective practices that science teachers can apply to re-teaching concepts that students misunderstood, and better student placement per class period based on learning ability to boost shared experiences. Another issue that the participants pointed out was the fact that the administration would purchase one-off PjBL curriculum materials that did not follow the gold standard PjBL framework. Teachers explained that PjBL was not a method where you can implement random inquiry lessons and activities. It is an inquiry-based pedagogy that requires consistent practice for both teachers and students to grasp and become familiar with. This information is essential because Cassata and Allensworth's (2021) research showed that students and teachers responded better academically to next-generation aligned standards compared to the traditional, scripted curriculum. Once teachers believed that they were prepared to apply science and engineering practices, they were more willing to make changes to their teaching strategies in response to the NGSS.

The teachers in my study clarified that PjBL was habitually treated as an occasional instructional tool instead of being used as the primary method for teaching science standards and curriculum. Providing consistency for teachers to practice their use of PjBL is important. When Herro and Quigley (2017) examined the perspectives and classroom practices of teachers who participated in science, technology, engineering, art, and mathematics (STEAM) professional development, the results suggested that after STEAM professional development, teachers' understanding increased teaching content and they felt more prepared. Furthermore, the data from Margot and Kettler's (2019) research showed that many teachers were unable to effectively carry out fundamental project concepts and strategies because they were not prepared. It is also cited in previous literature that teachers improved their content knowledge and quality of inquiry-based instruction after participating in constant professional development programs (Lotter et al., 2020).

Administrators are the instructional leaders of their schools, meaning they are responsible for delivering the preparation and support needed for teachers to lead and guide the implementation of best practices (Alvai & Gill, 2017). Like Correia and Harrison's recent examination (2020), there was evidence from my study in which I concluded a need for administrators to better prepare teachers who are not structuring their instructional delivery in a project-based way. More importantly, I gathered from the data in my study that Grade 6 to 8 science teachers desire to implement PjBL and highly recommend that teachers of other subjects have the opportunity as well. Most teachers believe that the expectations to build deeper understanding through using PjBL by building 21st-century learning skills will remain unfulfilled due to a lack of preparation, and administrative and instructional support.

Limitations of the Study

The study's limitations included the interviews being held virtually due to the COVID-19 pandemic. Finding a large number of participants to interview was a challenge. My study was limited to Grade 6 to 8 science teachers with five or more years of teaching experience in the United States. Another limitation was some teachers commenting that their students have had a difficult time adjusting back to face-to-face learning, which affected students being motivated and working together a challenge sometimes.

Recommendations

I recommend more ongoing PjBL training, workshops, and instructional coaching is needed for Grade 6 to 8 science teachers. Many teachers understand PjBL in theory but do not consistently implement it due to lack of confidence and control. Teachers need better time management skills to consistently implement PjBL. Most teachers find that implementing PjBL consistently during science instruction is overwhelming because of unrealistic expectations, a lack of resources, space, and storage.

Recommendations for Practice

It would be beneficial for instructional leaders to provide professional development by PjBL experts who currently teach, as well as incorporating a PjBL curriculum with clear guidelines, expectations, and assessments. Teachers must become more knowledgeable of PjBL strategies for the practice to work. PjBL encompasses community involvement, so creating more connections within the community may help teachers and students foster relationships that can be nurtured over time to promote recurrent community projects, so students feel a sense of purpose first-hand. Buy-in all across the board is a vital aspect of PjBL. Teachers will not be able to successfully implement the practice if there is no interest from higher-ups in investing in PjBL to support science education.

Recommendations for Further Research

Additional research from a broader scope of participants could improve PjBL implementation. Recommendations from my chair and committee members may include replicating my study to include Grade K-5 and 9-12 teachers in the United States. I would also say duplicating this study with the perceptions of novice (1-3 years) teachers trying to implement PjBL as a beneficial study topic to research.

Implications

Consistent use of PjBL provides students with 21st-century learning skills that prepare them for a globally competitive society driven by influential fields like science, technology, engineering, mathematics, and more. This study on Grade 6 to 8 science teachers' perceptions of PjBL, its benefits, and challenges, added to the scholarly literature and established a foundation for understanding the instructional framework for the consistent implementation of this inquiry-based strategy during science instruction. Moreover, this study provided significant information for school leaders regarding teacher needs during project-based instruction.

This study is credible, relevant, and can be applied to different contexts within similar environments, such as elementary and high schools. The findings provided an in-depth exploration of teachers' perceptions of the PjBL environment and identified possible policy changes in the curriculum. The implications of using a qualitative study and conducting interviews were that teachers discussed their perceptions in their authentic teaching environment. Study participants understood the phenomenon of PjBL to provide information deemed reliable regarding their perspectives and their implementation of PjBL during science instruction.

As an agent of social change, I confirm that this study can help guide instructional decisions at the district and administrative level that promote positive changes to foster student-led teaching and learning environments. Further, instructional leaders hold the responsibility to maintain student success, hence providing necessary resources and tools for teachers to improve student achievement. Accordingly, educational stakeholders can use this information from teachers to determine what changes need to be addressed to progress their ability to use PjBL during science instruction. Administrators can also use this information to determine ways to survey teacher's voice, inform instruction using data collected from teachers about their experiences, and to alter pacing guides that recognize challenges teachers encounter during PjBL instruction. If administrators consider teacher voice to drive instructional decision-making, teachers will get the support they need specifically related to their instructional needs, which is critical for increasing student's academic success.

The consistent implementation of PjBL instruction has implications for feedback, collaborative professional development, and community-involved learning. As a result, the perceptions middle-grade science teachers might inform and encourage other teachers' intentional and consistent implementation of project-based instruction to support science education. Additionally, other science teachers can use the information in my study to determine what aspects of their instructional delivery need amendment.

Therefore, current middle-grade teachers will gain support from instructional coaches that target the challenges faced when implementing a hands-on approach. The findings identified potential instructional changes from teachers' perspectives and types of professional development that teachers believed were helpful for their PjBL implementation. Consequently, instructional leaders can improve instructional design and use strategies to improve teachers' experiences with project-based instruction to support science education.

Conclusion

PjBL is a valuable inquiry-based student-led approach that is beneficial to support science education, although teachers face challenges with consistent implementation. The purpose of this study was to explore Grades 6 to 8 U.S. science teachers' perceptions about the implementation of PjBL instruction to support science education. I also explored teachers' perceptions of the benefits and challenges of implementing PjBL instruction to support science education. Six themes emerged from my study and previous literature. The themes included the definition of PjBL, the benefits of PjBL, and the challenges related to PjBL implementation. The findings from this qualitative study revealed six themes related to the PjBL framework and resources, teacher preparation, technology use, critical learning skills and workforce training, and student engagement, motivation, and academic performance. PjBL had a positive effect on student engagement, participation, and motivation during science instruction, but teachers believed they needed more time to plan, collaborate, and practice the PjBL strategy.

The study results highlighted the positive effect that PjBL implementation has on student motivation, engagement, participation, and academic achievement. Although participants noted challenges with their PjBL implementation, they all stressed the importance of its benefits and stated that those benefits outweighed the challenges. School-wide support and having abundant resources are crucial for teachers to consistently implement PjBL during science class. Overall, it was concluded that PjBL is an effective and transformative student-led instructional tool that enhances student learning and a dynamic inquiry that prepares students to become globally competent for real-world careers. It can be concluded that this study's findings promote positive social change by recommending effective change and solutions that encourage higher-order thinking and problem-solving skills through PjBL instruction. Furthermore, the data will help the development of professional educational networks to promote teacher success in the implementation of student-led learning using a hands-on inquiry-based approach.

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Appendix A: Interview Questions

Project-based learning is a teaching strategy that involves student-centered lessons. With this method, students learn through hands-on activities.

1. How do you define project-based learning?
2. In terms of ease of use, how would you describe the implementation of project-based learning?
3. In terms of time required to prepare lessons, how would you describe the implementation of project-based learning?
4. How does project-based learning effect active participation and student engagement?
5. Have you noticed a change in student motivation when using a project-based approach over traditional coursework?
6. What are the benefits of project-based learning as it relates to students' academic achievement?
7. What support would improve your project-based instructional delivery?
8. What are your perceptions of the barriers to implement project-based learning instruction?
9. Do you have any additional thoughts regarding your perceptions of project-based learning?

Appendix B: Project Based Learning Invitation Flyer

My name is Christian Smoke. I am a student at Walden University and I'm completing my dissertation titled, "Grades 6 to 8 Science Teachers Perceptions of Project-based Learning." I am seeking volunteers to complete a virtual interview via Zoom about project-based learning.

Activities:
Confidential 30 to 45-minute interview
Note: Individuals can withdraw at any time.

Eligibility Criteria:
Licensed grades 6-8 science teachers with 5 or more years of teaching experience
Have used or tried to use project-based learning during science instruction