ABSTRACT

Title of Thesis: EXAMINING THE IMPLEMENTATION CHALLENGES OF PROJECT-BASED LEARNING: A CASE STUDY

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Project-based learning (PjBL) is a common instructional strategy to consider for educators, scholars, and advocates who focus on education reform. Previous research on PjBL has focused on its effectiveness, but a limited amount of research exists on the implementation challenges. This exploratory case study examines an attempted project-based learning implementation in one chemistry classroom at a private school that fully supports PjBL for most subjects with limited use in mathematics. During the course of the study, the teacher used a modified version of PjBL. Specifically, he implemented some of the elements of PjBL, such as a driving theme and a public presentation of projects, with the support of traditional instructional methods due to the context of the classroom. The findings of this study emphasize the teacher's experience with implementing some of the PjBL components and how the inherent implementation challenges affected his practice.

EXAMINING THE IMPLEMENTATION CHALLENGES OF PROJECT-BASED LEARNING: A CASE STUDY

By

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Dedication

The following thesis is dedicated to my wife, Patricia Brooks, for her continuous support while I was a graduate student at the University of Maryland. I am grateful for her encouragement and flexibility while I completed courses and the case study described in this document.

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Chapter 1: Introduction to the Study

1.1 Background and Context for the Study

Project-based learning (PjBL) is one of the common instructional practices that educators, scholars, and advocates reference in school curricula, education reform research, and advocacy publications from organizations such as Project Lead the Way. It is an instructional strategy that emphasizes student interest, experiential learning, inquiry, and critical thinking, and deemphasizes memorization and singular correct answers (De La Paz & Hernandez-Ramos, 2009; Grant, 2002; Krajcik & Czerniak, 2007; Strimel, 2014). PjBL typically allows students to have more freedom in their learning and enables teachers to act as guides (Kilpatrick, 1918; Knoll, 1997). Problem-based learning (PBL) is a similar teaching method to project-based learning, but problem solving is the foundation of PBL, while the project is at the center of PjBL.

PjBL is a relevant teaching strategy to examine because the educators who are interested in changing how students learn content have used it in many curricula to improve engagement and understanding. While there are a significant number of studies on the effectiveness of PjBL, there are a limited number of studies that focus on the implementation challenges. This study presents an opportunity to add data regarding one specific environment.

Progressive educators and corporate leaders support project-based learning in schools for different reasons. Progressive educators see promise in the shift away from passive learning toward student interests and projects that drive innovation and solve community issues (Jackson, 2015; Ritz, 2014). Corporate leaders and some

education reformers value the opportunity to increase student performance, to enhance knowledge in science, technology, engineering, and mathematics (STEM), and to gain a more skilled workforce. The two groups diverge in the execution of project-based learning. For example, Chevron and Lockheed Martin influence and provide support for the Project Lead the Way organization (Project Lead The Way). Progressive educators may be skeptical of a large company having such an influence on school curricula.

Engineering and technology corporations view PjBL as a valuable and potentially profitable method for companies to transform schools into places where students prepare for future careers at the same companies. This tactic has advantages and disadvantages. For example, in-school training can help students find more stable jobs and contribute to an improved economy. However, business investment in PjBL may influence the curriculum so that students are directed to follow a path in school and their careers that will benefit the corporations involved. School partnerships with companies could create rigid tracks that would not support all students' developmental needs and interests. In addition, PjBL could potentially develop future citizens that have a myopic focus on a few subjects instead of students having the opportunity to experience a multidisciplinary education. While schools and teachers can use PjBL in the humanities classes (English literature, history, social studies, creative writing, etc.), the corporate emphasis remains mostly on the STEM subjects.

Some schools have implemented PjBL in their curricula, and researchers have studied the implementation process. For example, De La Paz and Hernandez-Ramos

(2009) conducted a study to determine if a project-based learning environment can improve students' understanding. Park Rogers, Cross, Gresalfi, Trauth-Nare, and Buck (2011) identified many of the potential challenges with PjBL implementation. To assess the possibilities for student achievement, Hertzog (2005) conducted a three-year study to examine if PjBL could increase achievement for all students, and help better support gifted African American students who are typically underserved. These are some of the stronger examples of studies regarding PjBL that helped me understand the existing literature so that I could design and conduct my case study more effectively.

Recently, a high school in Montgomery County, Maryland piloted a project-based learning classroom to test its viability for other schools in the county; now the school offers biomedical science and engineering academies that the Project Lead The Way organization has certified (St. George, 2013; Project Lead The Way). In addition, two charter schools in Washington, DC offer curricula that use the core components of project-based learning (Mundo Verde Bilingual Public Charter School; Two Rivers Public Charter School). Advocacy organizations, such as the Buck Institute for Education and Project Lead the Way, are interested in PjBL because, they argue, it is needed to help students develop essential skills for the 21st century. These organizations believe that PjBL is the best method for improving educational outcomes for all students (Buck Institute for Education; Project Lead The Way).

The purpose of this study was to explore how one teacher attempted to implement project-based learning (PjBL) in a high school classroom. The study

aimed to enhance understanding of the benefits and inherent challenges of implementing PjBL. A limited amount of case study research has focused on this aspect of PjBL. This instructional strategy is a relevant practice to investigate due to the strong interest in strategies that potentially improve the achievement gap, and the pressure to develop 21st century skills for students. The organization of this thesis on PjBL addressed the following elements: an introduction to the project-based learning concept and purpose of the study; a review of the available literature and research studies on PjBL, and the existing theory of constructivism that undergirds the core components of PjBL; a discussion of case study methodology upon which I have developed this study; the findings based on the data gathered during this case study; and the meaning of the case study findings for this specific case, and the opportunities for future research and implementation.

Prior to understanding the present focus on PjBL, a look at the historical context of the concept is essential because education reforms tend to be recycled over time. The instructional strategy of project-based learning follows this common path in education. In addition, the historical context needs to be explained and understood fully to avoid the assumption that PjBL is a new, revolutionary solution. Many researchers and educators connect this concept to John Dewey's progressive education and William Kilpatrick's ideas of the project method of the early 20th century (Kilpatrick, 1918; Knoll, 1997). However, this simple explanation does not provide an adequate context for PjBL.

1.1.1 Historical Context

Historical researchers have found evidence that project-based learning is a concept that began in the 1500s in Italy. It is possible that PjBL began even earlier in other cultures, but researchers still need to find that specific evidence. The idea of projects began in an architectural school called *Accademia di San Luca*, where students competed against each other with their architectural projects. By 1671, the learning method had shifted to France at the *Academie Royale d'Architecture*, where students learned through projects (Knoll, 1997).

The project method began to gain more strength and clout in academia when the field of engineering was included as a course of study at universities; PjBL was an instructional practice for this subject. During the 1700s, the ideas of the project method were brought from Europe to the United States. Stillman Robinson, a professor of mechanical engineering at Illinois Industrial University, was an educator who aimed to develop engineers who were democratic citizens (Knoll, 1997). Project-based learning is one method for developing a student who appreciates and exhibits democratic behavior.

After educators and universities introduced the project method in the United States, John Runkle, President of Massachusetts Institute of Technology (MIT), and Calvin Woodward, Polytechnic Institute at Washington University, wanted to integrate projects into high school curricula (Knoll, 1997; Tyler, 1903). Woodward started the Manual Training School in St. Louis in 1879, and implemented the requirement of students completing a project for graduation. However, the school

took ownership of the projects after the students finished them, which does not seem to be fair to the students who worked on the projects.

Critics of Runkle and Woodard's ideas of manual training argued that creativity and preparation for social life were missing in the student projects. John Dewey and Charles Richards, professors of manual training at Teachers College, Columbia University, were the main critics of the ideas of Runkle and Woodard. Dewey focused on the lack of emphasis on social skills, and Richards emphasized the development of students' abilities and skills before they physically constructed a project (Knoll, 1997). Furthermore, Richards did not see projects as an end goal for education. Richards also wanted projects to focus on the development of a school community.

The critiques of project learning led William Kilpatrick, one of John Dewey's colleagues at Teachers College, to develop a "project method" that would shift away from the focus on manual training to an emphasis on experiential learning and student interests (Knoll, 1997). Specifically, Kilpatrick based his ideas on Dewey's theory of experience, which asserted that children learn well when they develop problem-solving skills in social settings (Dewey, 1938; Knoll, 1997). Despite some initial criticisms of Dewey's lecturing style, Kilpatrick said, "The work under Dewey remade my philosophy of life and education" (cited in Beyer, 1997, p. 5). Edward Thorndike, an educational psychologist, developed laws of learning that also influenced Kilpatrick. Thorndike argued that sustained student engagement is more likely to occur when teachers emphasize students' interests (Knoll, 1997; Sutinen, 2013).

Kilpatrick defined a project as purposeful action that students direct based on their interests. The main purpose of the project method was to give students freedom to learn in their own way instead of assignments that have strict requirements (Kilpatrick, 1918; Knoll, 1997). Educators from across the spectrum of beliefs criticized Kilpatrick's theory. The progressive educators, like John Dewey, criticized Kilpatrick's myopic focus on child-centered learning. Dewey stressed the importance of teachers providing the necessary guidance for students with their projects. Dewey believed teachers needed to help students effectively manage failure and challenges that arise with projects. Knoll (1997) did not specifically indicate the criticisms from conservative educators, but they were most likely concerned with the greater student freedom and less emphasis on a required method to complete a project. After receiving the various criticisms, Kilpatrick reconsidered his project method and admitted his conception was vague.

While America and Europe pioneered the modern conception of project-based learning, the idea began to spread as the 20th century progressed. For example, the Soviet Union implemented a project approach that was designed to challenge capitalism (Knoll, 1997). Eventually, the Communist Party decided that project-based learning did not help students meet the goals of the party. The Communist Party ultimately believed projects did not help students learn how to contribute to the industries of the USSR or develop the communist ideology.

As the project method moved towards Europe, Germany was considered the locus of its next stage in the 1960s (Knoll, 1997). During this time, educators in Germany argued that the project method was essential in their effort to implement

democratic and libertarian reforms in schools and the broader society. The use of the project method to improve democracy is reminiscent of Stillman Robinson's aims noted during the 1700s. However, Germany focused on reforming the overall democratic system, and Robinson emphasized individual citizens.

Throughout the history of the project method, two different models have emerged. In the first model, students learn the academic content and use the knowledge to complete independent projects (Knoll, 1997). Dewey's ideas would align with the first model as long as teachers would be able to guide the students during the development of the projects (Sutinen, 2013). In the second model, the project is located at the center of learning and teaching, which is closer to Kilpatrick's project method. This idea aligns well with the idea that a PjBL approach refers to students learning content through the creation of a project. However, both models include elements of the definition of PjBL. Michael Knoll concluded that the history of the project method highlights the importance of the progressive education movement in the early 20th century because the project method incorporates many of the progressive ideals. Most importantly, Knoll emphasized how the historical context is crucial for research on education reforms because they typically repeat in a cyclical pattern. Specifically, historical context is relevant and essential to consider when one studies or implements project-based learning. With an understanding of the context, it is possible to recognize that PjBL will not be a magical solution that will solve the major education problems in schools. Finally, historical context can help improve the effectiveness of ideas and avoid the vague and ambiguous nature of education reforms.

1.1.2 Contemporary Context

Recent research supports the effectiveness of the PjBL teaching strategy in classrooms. Schools in the United States see value in PjBL because they would like to improve students' science and mathematics skills due to the recent relatively low international rankings of student performance in those areas (Park Rogers et al., 2011). In addition, educators are interested in the promise of preparing students for their 21st century careers. Researchers have wanted to find evidence of the effectiveness of PjBL, the best structure and culture for a school that uses PjBL, and how PjBL may help typically disenfranchised students improve their opportunities to learn. One of the gaps in the existing research is evidence of how teachers manage and mitigate the inherent challenges with using PjBL.

The existing recent research provides some evidence for the effectiveness of PjBL in specific classrooms and contexts. For example, researchers have conducted studies that focus on the implementation of PjBL in history and mathematics classrooms (De La Paz & Hernandez-Ramos, 2009; Park Rogers et al., 2011). De La Paz and Hernandez Ramos found that in a school, where group projects were the main method for learning history, students had considerably higher mean scores on social studies knowledge tests than the comparison school. Park Rogers et al., conducted a study of two science teachers and a math teacher who implemented PjBL in their science and math classrooms. The researchers found evidence that when a teacher is more focused on the class curriculum, he or she may be more resistant to PjBL. However, if a teacher focuses on student skills that will help in future careers, he or she is more open to the teaching strategy.

In another PjBL study, researchers examined the effectiveness of project-based learning curricula in terms of students' motivation and willingness to face challenging content (Meyer, Turner, & Spencer, 1997). Specifically, the researchers categorized the students into two groups: "challenge seekers" and "challenge avoiders." The researchers found that students needed guidance from teachers during the project to ensure that the students did not avoid the goals of each project. In addition, they found a higher percentage of females in the class were "challenge seekers" than the males. Due to stereotypes and cultural expectations of females, the researchers were surprised by these data. The researchers also identified some of the common challenges with implementing PjBL, including the difficulty of providing effective guidance during the development of student projects, and the potential struggle for teachers to present thought-provoking activities that allow students to push themselves.

To study the different views of teachers that work in different PjBL environments, Ravitz (2010) found that each PjBL environment is different and cultural changes in schools are necessary for PjBL to be an effective learning strategy. Ravitz provided evidence that reform model schools have stronger teacher and student cultures, as well as assessment systems that may help the use of PjBL compared with small and large schools. Students at reform model schools also exhibited more autonomy in their learning and had a better support system from their teacher and peers, which are important elements of PjBL. Finally, group projects are more prevalent in reform schools than the other comparison schools. These findings

are meaningful and helpful for understanding the best environment for PjBL because Ravitz had access to a large data collection base and a variety of school types.

Project-based learning can also support student understanding of concepts. Boaler (1998) found evidence that the project-based learning strategy helped students understand mathematical concepts instead of memorizing formulas and strategies to solve specific textbook problems. Boaler's research suggests that PjBL helps students become more adaptable to new problems that they encounter, and traditional methods of mathematics teaching do not lead to deep understanding. The evidence from this study is interesting because it shows the promise of understanding math instead of memorization.

In 2015, the research studies remain limited in their generalizability because teachers use and implement PjBL differently, depending on student needs and the specific subject area. However, generalizability is not necessarily the most important goal. Case studies on the practices used in one or two classrooms can improve the understanding of a phenomenon or specific curricular practice, like PjBL in these singular cases, which then can lead to other studies. The researchers who have conducted studies on project-based learning encourage others to develop studies on how PjBL works in a variety of learning environments. In addition, these researchers recommend that future studies examine the evidence regarding the effectiveness of PjBL for all different types of learners, and the inherent challenges that a teacher faces when he or she uses PjBL.

1.2 Purpose and Structure of the Study

The purpose of this study was to describe how one teacher attempted to use PjBL in the classroom, and examine the teacher's experience regarding the potential benefits and challenges associated with the instructional strategy. Additionally, this study examined the teacher's goals for implementing PjBL. To accomplish these goals, I used an exploratory case study methodology to observe a PjBL environment, conducted discussions with the classroom teacher who attempted use of PjBL, and spoke with the school administrator. Previous studies of project-based learning environments have used the idea of constructivism to inform the research and test the existing hypotheses. However, I did not use constructivism as a theoretical framework because I conducted an exploratory case study in which I examined the implementation benefits and challenges. I was not attempting to examine how the students learned based on a theory of learning like constructivism. I still drew upon the ideas of constructivism, which can be foundational to the ideal PjBL environments and its core components, to help gain a deeper understanding of project-based learning. With this case study, I sought to understand the potential implementation challenges of PjBL while recognizing I only observed one teacher's experience.

The definition of a case study is a type of research that provides a rich description and analysis of a phenomenon within set boundaries (Merriam, 2009). Stake (1995) emphasizes the study of a case, which is "a specific, a complex, functioning thing" (p. 2). To conduct this research, I used the exploratory case study methodology. Typically, the exploratory method for case studies has a purpose of

examining relevant issues for which researchers have not conducted a large number of studies or tested many hypotheses. Additionally, this type of methodology highlights the applicable and important research questions that researchers need to address in future studies (Yin, 2014). In this study, I have discussed the exploratory methodology in detail in Chapter Three, and I have provided recommendations for future research on PjBL in Chapter Five.

Prior to understanding how I conducted this case, it is important to define its boundaries. Merriam (2009) indicated that a bounded case can refer to "a single person who is a case example of some phenomenon, a program, a group, an institution, a community, or a specific policy" (p. 40). To determine boundaries of a case, a researcher has to make a choice regarding the "limit to the number of people involved who could be interviewed or a finite time for observations" (Merriam, 2009, p. 41). Based on these definitions, I used a bounded system that focuses on one example of a teacher's attempt to implement project-based learning in one classroom during a one-month time period where I observed and described the student projects from beginning stages to the final product. The case study was bounded because there was a specific beginning and end to the study, and I limited my interviews to two people. The bounded case allowed me to observe how the teacher attempted to implement and experienced the inherent challenges of implementing PjBL.

To provide a foundation for this case study, I used the information about the PjBL components in Biological Sciences Curriculum Study (BSCS)'s five-stage instructional cycle of inquiry-based learning (engagement, exploration, explanation, elaboration, and evaluation) and the Buck Institute's "Essential Project Design

Elements," as a conceptual framework to help me understand the ideal PjBL environment and how the teacher used the PjBL components in his classroom (Buck Institute for Education; Krajcik & Czerniak, 2007). Specifically, I used the model from BSCS to develop my observation guide and first research question. Subsequently, I found the Buck Institute's Essential Project Design Elements and used them to analyze my findings and consider potential conclusions. The PjBL components from the two sources helped define the ideal environment for this instructional strategy. While a traditional conceptual framework provides a visual representation of the relationships between variables or factors, researchers can use another form of conceptual framework that focuses on developing categories of information to help organize research and understand findings (Shields & Rangarajan, 2013). I used the PjBL components and elements to name the categories in the conceptual framework (Appendix A). This framework enabled me to understand the observed classroom environment and organize the ideas in my findings. The exploratory case study methodology allowed for openness during the data collection process; however, I introduced some structure with the specific criteria related to PjBL to help guide my observations.

My exploratory study addressed the following research questions:

1. How did a teacher implement project-based learning (PjBL) in terms of the distinct inquiry-based stages of engagement, exploration, explanation, elaboration, and evaluation as well as the other core components of PjBL?
2. What were the challenges of implementing PjBL, and how did a teacher manage these challenges?

An exploratory case study is designed to help discover the most promising research questions and theories to study in the future. I used the five stages of inquiry-based instruction from Biological Sciences Curriculum Study (BSCS) and the core components of project-based learning for the development of my observation guide, which allowed me to identify how PjBL occurred in the classroom (Buck Institute for Education; Krajcik & Czerniak, 2007).

This case study identified the potential implementation challenges of project-based learning and described how a teacher works toward the potential benefits of the teaching and learning strategy. With this exploratory case study, I do not offer generalizations for other environments due to the nature of this methodology and focus on one classroom. However, I highlight the challenges that the teacher experienced to contribute to the understanding of one teacher's attempted implementation of a hybrid version of PjBL. Project-based learning classrooms are typically student-centered environments that encourage students to connect learning to their own interests and communities.

Prior to the discussion of the study methodology, it is necessary to describe and analyze the existing research regarding project-based learning to provide a solid foundation from which to build my study. Chapter Two provides this foundation.

Chapter 2: Literature Review

To understand the project-based learning strategy more fully, this chapter provides a more detailed examination of the existing literature related to PjBL. Specifically, the chapter is organized around the following elements: the purpose and components of PjBL, the connection of constructivism to the learning strategy, and the common benefits and implementation challenges of PjBL. In addition, the literature highlights some of the identified strategies for teaching PjBL, including the examination of multiple viewpoints of different concepts and the support for more student freedom. This chapter, then, connects the purpose of my study to the relevant literature, as well as the research methodology.

2.1 Purpose and Key Components of Project-based Learning

The literature on project-based learning (PjBL) offers a few typical goals related to this teaching and learning strategy. For example, Joseph Krajcik and Charlene Czerniak (2007) contended that PjBL is designed to help schools become more relevant to students' lives due to its connection of the curricula to students' interests. William Kilpatrick, the creator of the project method, and John Dewey would agree with this argument. Krajcik and Czerniak also asserted that educators can use PjBL to develop solutions to address or improve community problems. For example, a student could invent a new technology or discover a new method during a project that solves problems existing in the community. Performance in school is an important outcome for students, and educators continuously look for solutions, like PjBL, to close the achievement gap. While the existing studies provided evidence of

improvement in students' test scores, constructivism is a useful idea to help educators understand how students learn in certain environments. Specifically, when a teacher is interested in improving student engagement, it is valuable to consider using the idea of creating an active learning environment in which students are able to work on projects that connect to their lives.

2.1.1 Goals for Project-Based Learning

Some of the advocacy organizations, like Buck Institute for Education (BIE) and business-sponsored think tanks like Project Lead the Way, view the purpose of PjBL as an opportunity to "train" students in 21st century skills. Specifically, they are interested in science, technology, engineering, and mathematics (STEM) skills. However, the value of PjBL doesn't have to be limited to STEM curricula. A curriculum that uses PjBL as a learning strategy can be used in classes such as history, English literature, foreign language, cultural studies, and many others. In some cases, the purpose of PjBL focuses on other goals. For example, Krajcik and Czerniak (2007) described how teachers and schools can use PjBL to increase students' understanding of the content. In a PjBL environment, educators measure understanding based on students' ability to create relevant artifacts during the project process. Typically, teachers use rubrics or student portfolios to assess project artifacts. A limited number of studies have demonstrated how PjBL improves students' understanding of key concepts of a subjects like history and math.

Other educators are concerned about the less measurable variable of student engagement. Some studies, like Nancy Hertzog's (2005) referenced in the first chapter, have indicated improvement in student engagement in PjBL classrooms, but

it can be difficult to measure this outcome. Hertzog took photographs of students to demonstrate the change in their level of engagement over time with the introduction of PjBL. The researcher also shared the photographs with the teachers to show them the differences in the students' body language after the implementation of PjBL. In some cases, the photographs helped counter the teachers' assumptions about specific students' levels of engagement and helped them identify better teaching strategies. Photographs represent an important type of evidence for qualitative studies because they can show the actions and observable emotions of study participants. Even though this method does not measure actual student engagement, photographs are useful tools for improving educators' understanding of PjBL. While positive effects of PjBL can be difficult to measure, the qualitative studies referenced in this literature review provide evidence that educators can use PjBL as a strategy to increase relevance of learning materials, technical skills, and the understanding of curriculum content.

One of the other alternative purposes of PjBL is to introduce the number of multiple viewpoints of knowledge and encourage students to examine information critically. Strimel (2014) recently wrote about authentic education and how understanding multiple viewpoints and nuances are important concepts for students to learn. Moreover, Strimel contended that PjBL is useful when there is no clear solution or answer to a question or problem. De La Paz and Hernandez-Ramos (2009) conducted a quasi-experimental study in which they compared PjBL and traditional history classrooms, and highlighted evidence that supported the following claim: as social interactions among students increases during projects, the number of

perspectives on a topic increases as well. A learning environment that supports multiple perspectives can be positive because it encourages students to develop their critical thinking skills and avoid quickly accepting conventional wisdom without thorough consideration.

2.1.2 Components of Project-Based Learning

Within the existing group of project-based learning (PjBL) research studies, scholars highlight several key components that help students learn. The creator of the project method, William Kirpatrick, argued that projects allow students to have more freedom in their learning (Kroll, 1997). While John Dewey criticized Kirpatrick's ideas about the level of student freedom, he believed that learning needed to be aligned more with student interests. PjBL also enables students to learn without the constant pressure to find the correct answer quickly. Hertzog (2005) described how PjBL is an emergent curriculum that helps students learn with nuance. Projects also enable students to understand the importance of failure in the learning process. Students will likely face challenges and make mistakes during projects, which will provide the opportunity to manage and learn from failure (Kilpatrick, 1918; Kroll, 1997; Meyer et al., 1997).

In project-based learning environments, some researchers have asserted that projects are the main teaching tool for the curriculum (Karaman & Celik, 2007). The teachers in this environment help students structure the projects with research questions that lead the students to discover new knowledge and solutions to research questions and problems in their communities. These research questions are described as "driving" questions that build the foundation of the subsequent student research

(Krajcik & Czerniak, 2007; Wilhelm & Sherrod, 2008). These questions help organize the relevant concepts and principles for students. To create effective driving questions in a PjBL environment, teachers facilitate the process, and the students lead their own learning experience. In general, the emphasis is on discovery, exploration, and experiential learning instead of rote memorization and recitation (Kaldi, Filippatou, & Govaris, 2010). Projects also allow students to explore the core concepts of a specific discipline, and make decisions throughout the process.

To address the potential lack of rigor in a project-learning environment, some educators use interim lessons to ensure each student has the knowledge and skills to complete the projects. Specifically, teachers benchmark the progress of students and ensure they have the necessary support (Wilhelm & Sherrod, 2008). While students typically have more freedom in a PjBL environment, regular feedback from teachers and peers can support learning and understanding. This feedback allows time for students to make revisions in their projects. Wilhelm and Sherrod based this research on Joseph Polman's (2000) interpretative case study of an earth science teacher who effectively used feedback as a part of project-based learning. When teachers support students through constructive feedback, it can help contribute to continuous learning even after the completion of projects. Although the benefits of feedback are widely known, more research is necessary to determine if strong evidence exists for the benefits of feedback in a project-based learning environment.

The Buck Institute for Education, which is one of the leading research organizations on PjBL, developed the "Essential Project Design Elements." These elements include the following: Key Knowledge, Understanding, and Success Skills,

Challenging Problem or Question, Sustained Inquiry, Authenticity, Student Voice & Choice, Reflection, Critique & Revision, and Public Product. While there are overlapping themes with other researchers' views of the elements of PjBL, Buck Institute's design elements include more of a complete process from beginning to end. As I mentioned in Chapter One, I used these elements as a conceptual framework for analyzing the observations and findings of this case study.

The "Key Knowledge, Understanding, and Success Skills" category refers to how effective projects should help students achieve their learning goals, which are based on standards and the essential life skills of critical thinking, problem solving, collaboration, and autonomy. The "Challenging Problem or Question" element refers to what other researchers call the driving question. The Buck Institute describes this element as how a "meaningful problem to solve or a question to answer" provides structure for the project and sets the degree of difficulty. The "Sustained Inquiry" element is the process in which students ask probing questions, locate and attain resources, and apply the relevant information. "Authenticity" refers to how a project includes a connection to the community outside school and to students' lived experiences, issues, and interests. "Student Voice & Choice" is the opportunity for students to have autonomy to make decisions about the topic of the project, and how they develop the project throughout the process. The "Reflection" design element is the element of PjBL when students and teachers evaluate their work and learning during a project in terms of the quality, challenges, and the ability for the inquiry to meet the project goals. The "Critique & Revision" category is the time when students provide and receive feedback on their projects, and incorporate the recommendations

to enhance the projects and their work processes. Finally, the "Public Product" element refers to students sharing their project with the broader community through a display or presentation. These elements are useful because they help improve understanding of PjBL through a more complete explanation of the components.

Joseph Krajcik, one of the main researchers of project-based learning, and Charlene Czerniak described a model for lesson planning from the Biological Science Curriculum Study (BSCS) that is applicable to project-based learning. While the Buck Institute's Essential Project Design Elements provided structure for the analysis, the model from BSCS was the part of the conceptual framework that helped me observe the PjBL components that the teacher used in the classroom and understand the ideal PjBL environment. The model illustrates the cyclical nature of PjBL using 5 consecutive stages, including engagement, exploration, explanation, elaboration, and evaluation (Krajcik & Czerniak, 2007). The "engagement" stage is the time when students link their learning with past experiences so that they become more interested and invested in the class project. The "exploration" stage allows students to have experiences with the phenomenon they study and develop a deeper understanding of concepts. Similar to the engagement stage, the second stage describes students who actively participate in the research so that they can gain a thorough understanding of the phenomenon of their projects. The "explanation" stage offers teachers the opportunity to share additional and necessary information and knowledge about the student explorations. The "elaboration" stage provides students the ability to conduct more research in an attempt to gain greater understanding about a phenomenon. In this fourth stage, the students are continuing to research the core

aspects of their projects to fill any gaps in understanding that they identified during the process. Finally, the "evaluation" stage is the time when teachers provide constructive feedback on student projects to help enhance learning.

The authors state that this 5-stage inquiry-based cycle is a flexible structure that is a useful tool for teachers and students in a project-based learning environment so that all participants can create the conditions for in-depth learning through teacher guidance, constructive feedback, and understanding of each student's risk tolerance (Krajcik & Czerniak, 2007). The Biological Science Curriculum Study (BSCS) reported that some studies have found evidence that the 5E Instructional Model described above helps students master science content, develop a higher level of scientific reasoning, and increase student interest in science (Bybee, Taylor, Gardner, Van Scotter, Powell, Westbrook & Landes, 2006). However, inadequate evidence exists that indicates the use of the 5E Instructional Model improves scientific understanding or develops practical and teamwork skills. While the Biological Science Curriculum Study designed the instructional model for science classrooms, each stage is applicable to other project-based learning environments.

The key components of PjBL that I described in this section (including student freedom for learning, identification of driving questions to guide projects, lower emphasis on the correct answer, feedback from the teacher and students, and application of the stages of the 5E model) provide the background information regarding this learning strategy. This information about the components of PjBL provided a conceptual framework for me to use so that I could recognize them in the classroom during observation. In addition, it was important to understand the

foundational ideas of project-based learning for deep understanding of the instructional strategy.

2.2 The Relevant Ideas of Project-Based Learning Environments

The ideas of constructivism, student engagement, and risk tolerance support the learning patterns that can occur in a PjBL environment. A discussion of these ideas is essential so that the reader understands how teachers and students interact in a PjBL classroom. This section discusses these important concepts to provide grounding for the study.

2.2.1 Constructivism

Project-based learning is based on the theory of constructivism, which suggests that students learn and engage with the curriculum when they are able to use their life experience and existing knowledge to collaborate with their peers on a learning activity (Grant, 2002; Splitter, 2008). Constructivism is a controversial idea because it contends that each learner constructs new knowledge based on his or her previous experiences and understanding of the world (Splitter, 2008). According to Splitter, educators and researchers should not confuse the idea of constructivism with the idea that all knowledge and facts are socially constructed. In this study, constructivism is a tool that helped me understand the ideal project-based learning environment.

The core principles of constructivism include the following ideas: students learn through an active process, learning occurs when students reflect on their past experiences and understandings as they interact with their peers and examine new information, and educators develop meaningful learning experiences when they

recognize and include each student's understanding of their "perspectives, beliefs, values, and attitudes" (Splitter, 2008, p. 139). Jean Piaget, a child psychologist, discovered how children investigate their environment and gain knowledge through their experiences (Fox, 2001; "Jean Piaget Society," 2000). Specifically, each learner has unique perspectives and knowledge based on his or her experiences, and the process of learning requires an active approach that helps students evaluate new information (De La Paz & Hernandez-Ramos, 2009).

Laurance Splitter argued that it is important to differentiate between constructivism and social constructionism. Specifically, he contended that constructivism refers to a learning environment in which students recognize and use previous life experiences to develop new understanding as they cooperate with other students and consider alternative perspectives. This explanation of constructivism contrasts with social constructionism, which involves students' learning of socially-constructed facts, and that reality is comprised of each individual's perspective. Educators can avoid the frequent disagreements and dilemmas that can arise when objective facts and reality are not broadly accepted through the use of student inquiry in the learning process.

PjBL incorporates some of the principles of constructivism like the importance of active, social, and experiential learning, which suggests how the instructional strategy encourages greater student engagement with curriculum, collaboration, student inquiry, and learning with the recognition and potential use of previous experiences. The idea of constructivism helped me understand how students

can learn in a PjBL environment while I explored the implementation challenges of PjBL for one teacher.

2.2.2 Student Engagement and Risk Tolerance

Meyer, Turner, and Spencer (1997) emphasize the issues of student motivation and openness to challenges in their PjBL study. Specifically, these researchers used Csikszentmihalyi's theory of emergent motivation and Clifford's theory of academic risk taking to inform their research in a small study of 14 students in one mathematics middle school classroom that uses PjBL. Through the use of survey data from the 14 students, the researchers identified two groups of students: the "challenge seekers" and the "challenge avoiders" (Meyer et al., 1997, p. 508).

The researchers used the School Failure Tolerance Scale that measures how students respond to failure, and the Patterns of Adaptive Learning Survey to measure the "mastery of learning goals," "student self-efficacy," and whether students use group or independent learning strategies (Meyer et al., 1997, p. 507). The researchers tested the correlation between self-reported tolerance for failure (SFT) and patterns of adaptive learning to identify and validate the "challenge seekers" and "challenge avoiders." The study provided evidence that the "challenge seekers" became more motivated and were more willing to take risks than the "challenge avoiders" in a project-based learning environment. It is possible that challenge-seeking students generally may thrive in a PjBL classroom. One of the core concepts of motivational theories is that students can develop an intrinsic attitude toward learning that increases as the student gains more competence in a subject area (Meyer et al., 1997). The theory of academic risk taking highlights the students who focus on learning

information with less emphasis on their performance. These students also have a tolerance for failure so that they can play with and absorb ideas. In the study described above, the "challenge seekers" have a high tolerance for failure. The motivational and academic risk taking theories both contribute to the understanding of how students can participate in a PjBL environment.

The researchers of the study about student risk tolerance also use theories about general personality characteristics and students' ability to control their own behavior to identify the factors that influence learning in a classroom. Despite the small sample size, the study suggests that educators should consider how PjBL affects students with the various learning styles. In future studies, it would be important for researchers to find evidence for how to use PjBL with all types of learners.

To answer this study's research questions, it is also important to understand the potential benefits and challenges of the instructional strategy. The next section draws upon the literature available in this regard.

2.3 Potential Benefits and Challenges of Project-based Learning

Before gaining a full understanding of PjBL, it is necessary to consider the possible benefits and challenges related to the learning strategy. Krajcik and Czerniak (2007) described how PjBL helps to support the development of students who are interested in long-term learning. In other words, PjBL allows students to cultivate a desire for learning that extends beyond traditional schooling. In some cases, students in PjBL classrooms do not require as much disciplinary action because they are typically independent learners who are motivated by relevant projects. In addition, PjBL can help students develop deep connections with the content. In terms

of the established learning objectives and standards, it is possible that PjBL can enhance student performance when educators and administrators implement it effectively. Project-based learning classrooms and schools also have the potential for supporting a diverse student population better because of the conscious effort to connect learning with community and student experiences.

As mentioned earlier, one study from Meyer, Turner, and Spencer (1997) suggested that PjBL benefits students identified as "challenge seekers" who thrive when they struggle through a problem or project. However, it is still not as clear how the PjBL strategy helps students who are more comfortable with structure and are motivated by performance. When educators consider implementing a PjBL environment, it is important to understand that the benefits described above may not occur in all or most circumstances.

Tamim and Grant (2013) used a multi-case approach for a study of six teachers who implemented project-based learning. Through semi-structured interviews with teachers and an analysis of classroom lesson plans and evaluation tools, their research suggests that students improve critical thinking abilities, develop creativity, and become more motivated and engaged with the content in a PjBL environment. In addition, students in a PjBL environment can learn how to collaborate with other students, which is a skill that will apply to many situations in their lives.

Boaler (1998), another well-known researcher in PjBL, conducted a three-year ethnographic study that compared one traditional school (Amber Hill) to a PjBL school (Phoenix Park) in the United Kingdom during the late 1990s for three years.

The researcher found evidence that PjBL improved students' understanding of mathematical concepts so that they could solve specific textbook problems without a reliance on the memorization of formulas and strategies. Specifically, 38% of students at Phoenix Park enjoyed the open-ended math problems, whereas only 14% of students at Amber Hill did. In addition, Boaler's study also showed that 55% of the students at Amber Hill were able to apply their mathematical knowledge correctly to a practical problem, compared to 75% of the students at Phoenix Park. Boaler reported that 71% of students passed the General Certificate of Secondary Education (GCSE) at the traditional school, while 88% of students at Phoenix Park scored a passing grade on the test. According to Boaler, this result was unexpected since the GCSE measures traditional mathematical skills, which was not something Phoenix Park emphasized. Boaler's research suggested that PjBL helps students become more adaptable to new math problems that they encounter, and traditional methods of mathematics teaching do not necessarily lead to deep understanding.

The challenges of project-based learning are related to the difficulty of implementation. According to Krajcik and Czerniak (2007), the availability of resources, lack of time for a new teaching strategy, limited student experience with PjBL, and various internal organizational and external pressures, such as school performance and degree of content coverage, can negatively impact the effectiveness of PjBL. Specifically, Krajcik and Czerniak (2007) found that educators can struggle to monitor and absorb the new knowledge related to their content area due to competing priorities, which is useful in a PjBL classroom. The researchers also indicated that teachers using a PjBL strategy also may not have the confidence to

respond to students who question accepted knowledge. In addition, Krajcik and Czerniak (2007) reported that it may be difficult for teachers to prioritize PjBL when they have to meet national standards and prepare for standardized tests. The researchers found that teachers sometimes hesitate to implement a PjBL curriculum due to skeptical administrators and parents. Educators also feel pressure to cover as much material as possible, which makes it difficult to work on a project on one topic for an extended period of time (Krajcik & Czerniak, 2007).

As mentioned above, the multi-case study of six teachers by Tamim and Grant (2013) highlighted some additional challenges of project-based learning. Their findings included: the ambiguous nature of the learning environment due to the student-focused curriculum, the difficulty of selecting the more beneficial subject areas or content for PjBL, the guidance of multiple student projects, and the assessment of students based on multiple aspects of the project and the process.

Ravitz (2010) conducted an analysis of a large survey of 395 teachers who use project-based learning in their classrooms, and found that implementation is difficult if a school and its educators do not have a clear vision and goals for how to change instruction, as well as teacher and student culture. Park Rogers et al. (2001) conducted a collective case study of two science teachers and a math teacher who implemented PjBL in their science and math classrooms. The researchers decided to use a multiple case study design so that they could identify patterns across the individual cases. For the data collection of this study, Park Rogers et al. conducted semi-structured, hour-long interviews with the three teachers about their experiences with PjBL, administered a survey asking the teachers questions about their teaching

philosophy, and observed the teachers and students in six classrooms. As mentioned in the previous chapter, the researchers found evidence that a teacher's acceptance and use of project-based learning may be contingent upon a teacher's orientation to the classroom. For example, when a teacher is focused on a class curriculum and needs to cover a significant amount of material, he or she may be more resistant to PjBL. However, when a teacher focuses on student skills that will help in future careers or expand the independent thinking of students, he or she is more open to PjBL. The researchers developed a spectrum from a teacher who has a "content-focused orientation" to a teacher who has a "career skills-focused orientation."

Park Rogers et al. (2001) also found evidence from interviews and observations that teachers need support from school personnel and professional development sessions for successful PjBL implementation. Because each teacher uses PjBL in a different way, a combination of a strong vision for a school and substantive training is necessary for an effective implementation of PjBL. The limitation of this study is that the researchers were only able to identify one teacher for each of the two extremes and one teacher who had an orientation between content-focused and career skills-focused. This result was due to the researchers observing and interviewing only three teachers. While it is useful to conduct multiple case studies to compare three teaching styles, the generalizations are limited. However, the study does contribute to the understanding of the importance of teaching orientations during the implementation of PjBL.

In an analysis of existing research, English and Kitsantas (2013) argued that self-regulated learning is a key component of PjBL that allows students to explore

and inquire when developing their projects. The authors demonstrated the links between the phases of self-regulated learning and PjBL. They also identified the development of self-regulated learning as a challenge because students do not typically have this skill without guidance.

Another aspect of implementing project-based learning relates to the challenge of translating an instructional policy into practice. David Cohen (1990) wrote a well-known essay about a teacher, Mrs. Oublier, who described her experience with implementing a new mathematics curriculum. Cohen also observed Mrs. Oublier in the classroom as she implemented the new mathematics framework. During his observations and interviews, Cohen noticed Mrs. Oublier used a combination of the new and traditional mathematical teaching techniques even though she thought that she was fully implementing the new framework. The mathematical curriculum directed educators to teach math for understanding through the use of physical materials so that the students can fully explore the problems. The new framework also deemphasized right and wrong answers, which is similar to PjBL. In the essay, Cohen recognized that the students learned more math in Mrs. Oublier's classroom compared with others. However, he argued that the teacher struggled with fully implementing the new framework because she had limited mathematical skills. Cohen highlighted the need for more professional development and training for teachers who implement new policy. This argument is relevant to the implementation of PjBL and this case study, and I discuss it more fully in Chapter Four (case study findings and discussion).

Teachers are not the only people who struggle with PjBL. Students may also resist the new teaching strategy because it alters the expectations of school, and they may not immediately see the value of PjBL (Krajcik & Czerniak, 2007). Teachers can help students by encouraging them to ask questions and take intellectual risks. Based on the research of Meyer, Turner, and Spencer (1997), students who typically avoid learning challenges and focus on performance may struggle in a PjBL environment.

2.4 Chapter Summary

This literature review has described the various purposes of project-based learning, discussed the key components and design elements of PjBL as a conceptual framework for this study, and highlighted the research studies that address ways in which PjBL has been investigated for its contributions to improved student engagement and understanding. In addition, this chapter discussed how the idea of constructivism, and the theories of motivation and risk tolerance are valuable for understanding how students learn in an ideal PjBL environment. Finally, the discussion of the benefits and challenges of PjBL suggests that additional research, detailed planning, and administrative support are necessary for a positive implementation of PjBL.

In addition to providing the key definitions of PjBL, the research studies demonstrate that there is some evidence that PjBL improves student understanding and engagement, but there are opportunities to conduct more research to confirm these findings. The existing research on the benefits and challenges are useful for this exploratory study; however, future researchers could document more experiences of

teachers implementing this instructional strategy in the classroom. Overall, I characterize this literature related to PjBL as helpful context for how the ideal PjBL operates and the challenges experienced by teachers who have implemented the strategy. These studies directly informed the observations and analysis of this study. The next chapter provides the methodological grounding for the study as well as the plan for engagement.

Chapter 3: Study Methodology

In this chapter, I describe how I conducted the study based upon the methodological framework that guides case study research. The chapter also describes the strategies I used to collect and analyze the data. Throughout the chapter, I include the rationale for using the study methodology and research strategies.

3.1 Exploratory Case Study Methodology

A qualitative case study is a methodological process that enables researchers to collect data at a specific site and broaden understanding of a phenomenon. Merriam (2009) defined a case study as an "in-depth description and analysis of a bounded system" (p. 40). Stake (1995) defined a case study as a self-contained entity that offers opportunity for understanding a phenomenon. These definitions were beneficial when I set the case study boundaries during the case study design phase so that I could collect and analyze the data effectively.

The study follows the exploratory case study methodology, which, according to Mann (2006), researchers use for studies that have a larger scope and examine a phenomenon at a deeper level. In addition, the exploratory methodology helps researchers develop relevant research questions about a phenomenon that they can explore and test in future case studies (Mann; Yin, 2014). Some of the main goals of an exploratory case study are: the development of new hypotheses about the phenomenon, refinement of existing research questions and procedures, and preparation for potential future research (Yin). Furthermore, Yin contended that

exploratory case studies need to discuss the purpose of the study, what the study will explore, and the criteria used to determine whether the results fulfill the study's purpose. Stake's (1995) idea of understanding the phenomenon and "complex interrelationships" aligns well with exploratory case study methodology because of the lack of specific expectations or outcomes involved (p. 37). One of the benefits of exploratory case study methodology is the openness during the data collection and analysis stages. This case study is exploratory in nature because researchers have not conducted a lot of studies or tested theories regarding the inherent challenges of implementing project-based learning. Researchers use an exploratory case study methodology when a limited research base or theoretical foundation exists about a phenomenon.

When a researcher conducts an exploratory case study, it is not necessary to have a theoretical framework to guide the research questions and analysis because the purpose is to identify the most beneficial areas in which to conduct further research. However, I found it useful to draw upon a conceptual framework (Appendix A) comprised of the PjBL components so that I could make effective observations and analyses during this case study. Specifically, the framework helped provide foundational information to conduct a study that led to a description of an attempted implementation of PjBL and identification of a teacher's implementation challenges.

In this case study, I identified the benefits and challenges that one teacher at the Woodland School[1] experienced when he attempted to implement PjBL. The study participants requested that I use pseudonyms for the school name and their

[1] Pseudonym

given names. Throughout this thesis, I use "the teacher" and "the administrator" as simple pseudonyms because there are only two participants in this case study. I developed the research questions for this study based on the exploratory methodology. In other words, I did not attempt to test any hypotheses or ideas from previous case studies. Instead, the questions explore relatively untested ideas and concepts related to project-based learning. As mentioned in the first chapter, the following are my research questions:

1. How did a teacher implement project-based learning (PjBL) in terms of the distinct inquiry-based stages of engagement, exploration, explanation, elaboration, and evaluation as well as the core components of PjBL?
2. What were the challenges of implementing PjBL, and how did a teacher manage these challenges?

In the first research question, I explored how a teacher implemented PjBL using the BSCS' 5-stage inquiry-based cycle and components of PjBL as guidance. Through the use of this information, I linked my observations and interviews related to the implementation of PjBL in the classroom to the specific PjBL stages. The second research question asked how the teacher managed the challenges of PjBL implementation. The question recognizes the challenges that exist in a PjBL classroom due to the complexity of each student's learning needs and a lower emphasis on the correct answer in every learning activity. In other words, the second question considers many of the potential challenges, including the ones related to how students learn.

In general, the exploratory case study approach is the most viable option for this study because limited research exists on the implementation challenges of PjBL. In addition, I used this methodology because my purpose of the study was to observe a teacher's attempt with implementing PjBL and document the challenges he experienced. Furthermore, I did not intend to support any claim about PjBL in general with evidence collected at the case site.

3.2 Case Study Design

For the design of my case study, I used guidance from the case study methodologists: Stake (1995) and Merriam (2009). Specifically, Stake informed the development of my case study due to his recognition of how singular cases contribute to particularized understandings of a phenomenon. In addition, I defined my case study with Stake's description of a case in mind: a bounded, "complex, functioning thing" (Stake, 1995, p. 2). In my study, a single case with a single teacher was attempted to refine the understanding of project-based learning. When I analyzed and evaluated my findings, I used Stake's idea of a petite generalization, which is a finding or explanation of a phenomenon that may provide meaningful descriptions of experiences to other people. In addition, I used Stake's concept of "particularization," or how the researcher recognizes the unique qualities and circumstances, to ensure that I do not make an unsubstantiated generalization about this case.

Merriam (2009) described a case study as an "in-depth description and analysis of a bounded system" (p. 40). I define the unit of analysis as the teacher's use of the project-based learning strategies that are part of the curriculum at the

Woodland School. The phenomenon of my case study focuses on the implementation and maintenance of a project-based learning environment within the context of the students' social environment. To identify a phenomenon of interest, Merriam (2009) suggested that researchers need to detect the "experience as it is 'lived' or 'felt' or 'undergone'" and how all the components of a phenomenon or experience interact with each other (p. 6). Moreover, she claimed that case study methodology and qualitative researchers "are interested in understanding the meaning people have constructed…how they make sense of their world and the experiences they have in the world" (Merriam, 1998, p. 6). This case study aims to improve the understanding of PjBL through the experiences with implementation of one teacher and school administrator. Merriam also offered valuable advice about how to develop data categorization strategies during the case analysis. Overall, I most closely followed the ideas of Stake for the exploratory nature of the case study design, and I used Merriam's guidance during my data collection and analysis phases.

3.2.1 Site Selection

An extensive search of the schools in the Washington, DC area that use a project-based learning curriculum produced a number of potential public and private schools for the site of this study. I pursued research at the Woodland School because they have implemented the strategy for grades 6-12. In addition, the administrators of the school are in complete support of PjBL, which helps to achieve a successful implementation. The administrator offered two potential teachers for me to observe. One teacher was using PjBL to direct students to build boats for an annual boat race, and the other teacher wanted to use PjBL in a chemistry class to help students learn

about the value of waste materials for alternative energy. The administrator indicated that the students in the chemistry class struggled with intrinsic motivation and engagement. I believed the chemistry class was a promising site because the teacher had a driving question connected to a large community problem, and I was interested how the students would react to PjBL.

When I began my case study, I intended to observe a full implementation of project-based learning in a high school chemistry classroom in which students would develop projects to explore alternative sources of energy from waste materials. I understood that the students in the class experienced learning challenges, and that the teacher was interested to see how PjBL helped students in this environment. However, when I conducted my first interview with the teacher, I began to realize that the teacher did not intend to implement an ideal version of PjBL. Instead, he planned to use a hybrid model, which combined some elements of PjBL and some traditional components like teacher-guided instruction, laboratory experiments, and lab reports. After I learned this information, I decided to move forward with the same case study questions because they were still relevant and the data from the case would still help me identify the implementation challenges that the teacher and school faced. In addition, it was not practical to change the site of my case study due to the extensive search that I had conducted.

I conducted this exploratory case study in a high school chemistry classroom at the Woodland School, which is a private educational institution in Maryland, where the mission statement is to foster an environment in which students improve their academic and creative capabilities, and identify the interests that inspire them to

create positive action. In addition, the Woodland School emphasizes the needs of students as they develop from traditional learners into abstract ones. The school also believes that a curriculum needs to include both theoretical and practical learning, which align well with the purposes of project-based learning. In order to protect the identity of the school, I have paraphrased the mission statement, and I did not include the school's website in the references.

According to the administrator of the Woodland School, they began to implement the project-based learning strategy in grades 6-12 beginning in 2011, and used the research from the Buck Institute as a guide. The head of the school was interested in implementing a common instructional strategy for the school because it was operating with a structure that separated people from each other instead of a collaborative one. In addition, they needed a strategy that would help the transition from the Montessori traditions used in the elementary school to develop 21st century skills. Based on my interview with the administrator, the school has since completed the implementation in most classes except mathematics due to the difficulty of supporting meaningful projects. The administrator indicated there is a wide range of how teachers have used PjBL. Specifically, some teachers only assign regular class projects and others use PjBL as the core strategy. The teacher of this case study was not convinced that PjBL would result in a substantial change of performance for the majority of students compared to traditional instructional techniques. However, he was open to seeing how it would help the students in his chemistry class.

3.2.2 Data Collection

During my research study, I observed one class of 19 students, conducted three formal interviews with the classroom teacher, reviewed relevant documentation, analyzed my findings about the benefits and challenges of PjBL, and used the ideas of constructivism and the core components of PjBL to inform my understanding. Specifically, I observed the chemistry classroom at the Woodland School a total of six times with a frequency of once or twice a week for 45 minutes depending on the classroom schedule. I also observed the Science, Technology, Engineering, Arts, and Math (STEAM) fair for 2 hours. The total observation time for this study was 6.5 hours. Given that the projects only lasted approximately four weeks, I spent enough time in the classroom so that I could observe projects from beginning stages to the final presentation. However, it would have improved my descriptions of the classroom environment if I had been able to observe the majority of the class time. The observation time helped me understand how the teacher introduced a project, how the students learned while working on a lab experiment, how the teachers and students interacted with each other, and the benefits and challenges of project-based learning.

After I began observing and interviewing the study participants, it became clear that the teacher would not fully implement the project-based learning instructional strategy because he always planned to use a modified approach due to the students' level of readiness for less curriculum structure and a limited amount of available preparation time. While my research questions remain relevant, I present the findings and conclusions as a story of the attempted implementation of PjBL

based on the teacher's experience and my observations. During the course of my research, I observed the classroom and conducted interviews to document whether the teacher guided the students during their projects and customized the curriculum for each student. In addition, I identified the potential challenges of PjBL. I drew upon the 5-stage inquiry-based model and the Buck Institute's Essential Project Design Elements to help me determine if the teacher had implemented the instructional strategy.

3.2.3 Observation Strategy

During my observations of the classroom, I acted as a nonparticipant observer during the case study, which helped me avoid the potential bias involved with participating in a classroom. To collect the data, I recorded notes regarding any information related to my research questions, including the nature of the interactions between the teacher and students, the degree of freedom each student exhibited while working on the project of choice, and the frequency and amount of feedback the teacher provided throughout the project. In addition, I identified the instances when the teacher customized the PjBL curriculum for students. I also identified evidence of the teacher facing challenges while using the PjBL strategy, and confirmed the observation data about challenges during the interview with the teacher and administrator. Similarly, I recorded any clear indications that students were actively learning while working on the projects. I did not participate in any of the classroom activities. To be as unobtrusive as possible, I took notes while I observed the classroom at the left side of the classroom. I entered all of the observation notes into a password-protected computer to maintain the privacy of study participants.

To observe the nature of interaction of the teacher and students, I developed rich descriptions of what I noticed, including body language, conversations, teacher guidance, and student responses. For my observation of a student's degree of freedom in the classroom, I made note of how often students were independently learning, and how often they were receiving assistance from the teacher. During any instances of feedback, I observed how the teacher provided feedback during a project and how often he provided the feedback. I have provided detailed information regarding the criteria I used in the observation guide.

3.2.4 Observation Guide

To assist my observations, I used criteria so that I would maintain consistency throughout the process. I was informed by the Biological Sciences Curriculum Study's (BSCS) five-stage instructional cycle of inquiry-based learning and the nature of PjBL to create the criteria included in Appendix C. This guide was not intended to restrict the exploratory nature of the case study, but rather it provided the general categories and criteria I sought to examine. Each category is related to the study's purpose to observe how PjBL can increase student engagement with the curriculum and how teachers manage the inherent challenges. During my observations, I realized that the teacher was not implementing project-based learning in the classroom as I expected, which limited my ability to use this guide. However, I still used the criteria and Buck Institute's Essential Project Design Elements as a conceptual framework to compare my observations to the expected stages that are applicable to PjBL. This guide allowed me to address the aspects of both research questions. Specifically, I attempted to describe the five areas of engagement, exploration, explanation,

elaboration, and evaluation during my observations in Appendix C. In addition, I used the following methods of recording my observations:

1. Wrote detailed notes on every interaction between students and the teacher that I observed.
2. Developed rich descriptions through notes on how the students and teacher presented themselves to each other.
3. Wrote notes that describe the level of student engagement during the teacher's lectures and laboratory experiments.

3.2.5 Interview Strategy

Another aspect of my data collection for this study included semi-structured interviews. I used an interview guide that lists the potential questions for the teacher and administrator, but I had flexibility to add follow-up questions. Specifically, I interviewed the teacher of the classroom outside of class hours at the beginning, middle, and end of one project period (see Appendix B for interview questions). I used the first interview to ask how the teacher was planning to approach the PjBL implementation and any of the challenges he expected. I used the second and third interview sessions to determine if his answers changed during the course of the project. I also conducted one interview with the head of the school (see Appendix C for interview questions) to discuss her view of PjBL, the school's support of PjBL, the challenges involved with implementing the instructional strategy, and its future at the school.

In addition, I did not interview the students in the classroom due to the extensive and difficult approval process with the school and the Institutional Review

Board at the University of Maryland. Instead, I relied on observations of a classroom and interviews with the teacher and one school administrator to understand the context. During my interviews, I made sure that I always used active listening and wrote high-quality notes. Throughout this thesis, I have kept all references to students anonymous and verified the accuracy of all information with the interviewees.

3.2.6 Data Analysis

I followed the guidance of Merriam (2009) and conducted my data analysis concurrently with my data collection. Stake (1995) also informed my research with the view that a singular case can be meaningful without generalizations because of how it helps others think about their own circumstances. Based on Merriam, I classified the collected data into the following three major categories: the school's rationale for PjBL, the teacher's approach to PjBL, and the teacher's implementation of PjBL. For each category, I created additional categories related to the goals, PjBL components, and benefits and challenges of PjBL. Subsequently, I added all of the collected data to the categories from my observations and the interviews of the teacher and administrator at the Woodland School. I also used Merriam's (2009) advice on the methods of data categorization so that my "mutually exclusive and conceptually congruent" categories allowed me to answer the research questions (p.186). Finally, I highlighted all of the areas of my interviews and observations that were meaningful and relevant to the research questions of this study. These highlighted areas helped me during the discussion of my findings.

Throughout the data collection and analysis stage, I compared the teacher's approach to the examples of PjBL that other researchers have examined, and consistently reviewed the data. This strategy allowed me to adjust my data collection strategy and interview protocol if I was not documenting or gathering the data that would answer my research questions. The analysis process included the comparison of the observations, interviews, and documents that I collected to triangulate my findings and confirm their accuracy and logic. Due to the scope of the study, I was not able to compare multiple investigators' observations. However, as I indicated above, I triangulated the data sources and methods of data collection, which strengthens the validity of the study (Merriam 2009).

During the data collection phase, I observed the students and the teacher; interviewed the teacher and administrative staff; and reviewed lab worksheets and concept summaries on four class topics to ensure that I triangulated the data for the analysis. I attempted to triangulate all of these sources of data to answer my research questions and determine if the data led to the same findings. To ensure the logic and consistency of my arguments, I also shared my thesis with one critical colleague, Dr. Karen Vatz, who has studied second language acquisition at the University of Maryland. As Dr. Vatz reviewed my thesis, she identified the key themes from the case findings and determined that case findings aligned with the collected data. In addition, she indicated that the findings effectively answered the research questions.

Case studies can be a risky methodology because researchers may conduct a case study to confirm their own opinions (Yin, 2014). In other words, researchers are at risk of confirmation bias. In addition, the participants reviewed my findings'

summary before I finalized my thesis. This process helped me avoid any incorrect information and mitigate any misinterpretations that I had of the data. Based on the guidance from Merriam (2009), I understand that the final case study likely will include some bias despite the precautions because all researchers have their own perspective as they observe and interview participants, and analyze the data. Because this bias is usually unintended, it is difficult to eliminate.

In an attempt to ensure the case study's internal validity, I used the conceptual framework that describe the PjBL components to inform my understanding of the ideal implementation of PjBL. While the framework does not always reflect a real-world PjBL classroom, it helped to ground the observations that I made in the case. To ensure credibility, validity, and reliability, the potential ethical issues are also important to address and mitigate.

3.2.7 Ethical Issues

Ethics are intertwined into every aspect of conducting a case study. Because people are typically the subjects of case studies, the process of conducting a study will always involve ethical considerations. Before conducting my case study, I received "informed consent" from all study participants (Yin, 2014, p. 78). I made a concerted effort to avoid negatively impacting any of the participants in the case study, to protect each participant's privacy, and to safeguard the study's vulnerable participants (Yin, 2014). For an example of the study participant consent form, please see Appendix E.

During the data collection phase, I was cognizant of Merriam's (2009) advice that interviewers can be judgmental or too sympathetic to the interviewees. I

attempted to limit these emotions during my interactions with the study participants. In addition, as Merriam recommended, I informed and received consent from all study participants before beginning my data collection phase. One of the most difficult ethical situations is when the researcher has to make a decision whether to intervene in an observation situation where he or she disagrees with a practice. I did not intervene during this case study at any time because I did not see any practices with which I significantly disagreed. However, if I observed the teacher doing something that I thought would harm a student, I would confront the teacher about the issue.

Ethical issues during qualitative case study research are important to address because they can affect the credibility of the researcher and study. I hope that I have recognized the ethical issues that had potential to affect my case study.

3.2.8 Limitations of the Study

While the design of this study follows the best practices of Merriam (2009) and Stake (2005), clear limitations exist due to the scope and availability of sites. Due to the difficulty of finding a school that would allow me to observe a classroom, I was not able to select my site from a number of options. In addition, the Woodland School had two teachers who were implementing PjBL at the time I needed to conduct the study. This study focused on one teacher in one classroom at one school, which eliminated the ability to make any generalizations. The other limitations of this study included the inexperience of the teacher implementing PjBL, the implementation of a hybrid PjBL due to the circumstances in the classroom, the inability to observe another classroom that implemented more PjBL components, and

the small amount of time that I was able to observe the class due to my job responsibilities. In addition, the PjBL unit was approximately only one-month long, which limited the total amount of time I could have observed. After the consideration of these limitations, I was able to identify some meaningful findings about the specific implementation challenges that the teacher faced because I had designed a strong exploratory methodology and used tests for credibility, reliability, and validity as much as possible.

3.3 Chapter Summary

This chapter discussed how I designed this study so that I could observe the classroom, interview the participants, and collect artifact data at the Woodman School. Specifically, I discussed how I selected the site of the case, designed my observation and interview strategies, and ensured validity, credibility, and ethical principles in this study. In addition, I examined the value of this case study as an exploratory approach that has a purpose of highlighting the implementation challenges of PjBL to encourage further research. The exploratory nature of this study allowed me to be open to new data that may contribute to the complexity of implementing PjBL. Finally, I discussed the limitations of this study, which were mostly due to its scope, site selection, and circumstances of the classroom.

The following chapter discusses the findings of this study for which I collected and analyzed the data based on the exploratory case methodology. While this study does not offer any generalizations, my intention is that the results of this study will highlight some of the potential issues related to the implementation of project-based learning.

Chapter 4: Findings and Discussion

4.1 Project-Based Learning (PjBL) in the Classroom

The exploratory case study methodology helped guide the data collection and analysis of an implementation of a hybrid version of PjBL. This modified instructional strategy included traditional activities in a high school chemistry classroom due to students' readiness and the teacher's planned curriculum. Based on my literature review in Chapter Two, there are relatively few studies that have examined the implementation challenges of PjBL compared to the number of studies on PjBL effectiveness. I have used this study's three main findings as a foundation for the organization of this chapter. The main findings include the teacher's decision to transition from a traditional curriculum to an implementation of a hybrid PjBL instructional strategy, the teacher's rationale for using specific PjBL components, and how he adjusted his approach based on the specific students in the class. Prior to the discussion of the findings, I have included the setting of the case study in the next subsection to help provide context for the findings. The findings respond to the following research questions:

1. How did a teacher implement project-based learning (PjBL) in terms of the distinct inquiry-based stages of engagement, exploration, explanation, elaboration, and evaluation as well as the core components of PjBL?
2. What were the challenges of implementing PjBL and how does a teacher manage these challenges?

4.1.1 The Setting

In 2011, the Woodland School decided to implement PjBL across the majority of its classes, and the administrator of this case study said they now consider the instructional strategy as the main methodology for the school. The only exception is the school's mathematics classes because the leadership believes it is difficult to develop meaningful projects for this type of class. According to the administrator, the school wanted to improve the learning environment for the 10th grade students in the chemistry class because they had shown "executive functioning" issues, which affect their ability to have intrinsic motivation for school work. When students exhibit a low level of executive functioning skills, they struggle with focusing on required tasks and completing independent work. The administrator indicated the school and teacher were interested in using a different strategy due to the significant learning challenges.

4.2 First Finding: From a Traditional Curriculum to Hybrid PjBL

During the beginning of the year, the teacher in this case study used a traditional chemistry curriculum that included use of a textbook. The teacher had collaborated with a colleague to lead a project related to the periodic table elements for a different class, and he saw value in giving students more freedom in their learning. Based on this previous experience, he saw the benefit in designing a PjBL experience with interdisciplinary components such as the combination of history and chemistry concepts.

Due to the different definitions of PjBL, it is helpful to understand how the study participants view the term. My interviews with the teacher highlighted his

definitions of project-based learning. The teacher believes that PjBL is an inquiry-based, interdisciplinary instructional strategy where a class can focus on essential topics, the students can have more control over their learning, the projects can connect to students' lives for authenticity, and the students have an opportunity to present a culminating project to the public. This definition aligns with much of the PjBL components from the Buck Institute, and the teacher intends to add opportunities for continuous feedback and reflection in the future. The teacher articulates his thinking about PjBL in the following way:

> Project-based learning, ideally, is something you learn through doing it…The authenticity and the relevance [of the project]…put it in a context that is actually real and isn't just abstract thinking in a book…Once you are experienced in designing these projects, student voice and choice can come in where the challenge seekers will choose a more ambitious project than the rest of the class. They decide their own learning. That can be really good with the students who will take the initiative to do that.

The administrator's definition of PjBL is similar to the teacher's thoughts in terms of a focus on active learning that allows students to have more autonomy. In addition, she sees PjBL as an opportunity for students to contribute to the world and build their collaborative work skills. The definitions from the teacher and the administrator help provide context for the implementation of a hybrid version of PjBL in this case study.

The administrator and teacher wanted to see how a project-based learning environment would work for these students despite some concerns about the lack of

structure for them. Prior to his implementation of the PjBL approach, the teacher participated in a couple professional development sessions to prepare him to use the instructional strategy and become more comfortable with it. These sessions helped him understand the Buck Institute's guidance for PjBL in the classroom.

When planning an implementation of an instructional strategy like PjBL, case studies can increase understanding about complexity of change in a classroom. As David Cohen (1990) observed, a teacher who is completely dedicated to implementing a strategy may not be able to do so in practice. The teacher in Cohen's case study believed that she was implementing the new strategy for math and that wasn't really happening according to Cohen. This observation may be relevant to the choices the teacher made in this implementation of project-based learning. Specifically, the teacher attempted to implement a combined approach of PjBL and traditional techniques due to the students' lack of engagement with the teacher and content demonstrated earlier in the school year. In addition, the teacher was in his first year of teaching, and he was developing his philosophy for managing disruptive student behavior and attempting to teach a sufficient amount of chemistry material, which made it difficult to implement PjBL.

4.2.1 Pre-Implementation

In the original plan, the teacher intended to implement a project named, *Trash or Treasure*, which was designed to encourage students to explore how readily available waste materials can create or store energy that does not contribute to climate change. The teacher planned to demonstrate some of the relevant chemical reactions to the class, and he intended to organize students into groups of four so they could

work on a product that demonstrated their knowledge from the experiments. He also wanted the student groups to explore the driving question related to alternative energy and the importance of batteries. He described his use of PjBL as follows:

> Project-based learning, ideally, is something you learn through doing it. I would say my current project is a little of A and a little of B. It's not going to be entirely through doing and it's going to be some learning ahead of time and then seeing it real life…We are going to learn and then apply what we learn, which is a little more project, but it still ties together with an essential [driving] question.

The explanation above demonstrates that the teacher understands PjBL is about students' learning through the process of planning and creating projects. He also highlights that students need to learn specific concepts before creating their projects that provide a response to a driving question. Even though the teacher intended to mix elements of PjBL and traditional instruction, he originally thought it was possible he would allow more independent work at the end of the project. For example, he said:

> In this particular project, I think it will go from highly structured to maybe a little less structured in the end. In the end, I hope to get their own proposal. That is my hope – we will let it evolve how it evolves.

The teacher indicated that PjBL in a chemistry classroom needs to build on the core skills and knowledge in order for students to create effective projects. This belief led the teacher to design a hybrid approach that provided students the necessary

information through lectures, discussions, and worksheets that they could use to conduct and learn through their proposed projects.

With the various potential definitions of a hybrid PjBL, it is important to discuss the definition before understanding how the teacher used the modified strategy. A hybrid PjBL approach in this case study is defined as a combination of a traditional curriculum activities like lectures and assessments with more active PjBL elements that connected classroom activities to a larger theme and provided opportunities for students to demonstrate their learning outside the class. The teacher believed that PjBL allows for different types of implementation. He said:

> The idea of project-based learning leaves a lot of room for differentiation. And so when you are doing something, you can have those front row students doing something that is more involved and more challenging than the back row students who may or may not be interested in science.

With the knowledge of differentiation of PjBL, the teacher was able to plan the implementation of a hybrid version of the instructional strategy and adjust it based on the situation in the classroom.

As the teacher planned his implementation of PjBL, he had the goal to condense the traditional chapters in the textbook into worksheets that students would complete after the lab demonstrations and experiments. The ability to make the content more consumable for students was useful to cover the essential content so that they could have the opportunity to understand their project work. In the existing research regarding PjBL, the coverage of more material is not a typical benefit of

PjBL since other educators have struggled to cover enough concepts and topics with projects due to the emphasis on in-depth examinations of a few topics.

The administrator in this case study offered some additional context for the attempted use of PjBL at the school. She indicated that one of the core benefits of PjBL is "student voice and choice" or the ability for students to have some freedom in their education. This belief aligns with the existing research and ideas from Kilpatrick (1918) and the Essential Project Design Elements from the Buck Institute for Education. In addition, the administrator sees that PjBL environments can help students develop skills useful for college such as independent learning, research, and teamwork. During the course of a project, she also believes that a connection to community service can help students become active members of society. Specifically, she said young people "need to feel like they are playing a role in the world." The existing research regarding PjBL aligns with the benefits that the administrator identified, and helps support the school's goals.

With the use of PjBL, the administrator and teacher also hoped to increase the students' engagement with a more active curriculum that shifted away from the standard textbook. However, the administrator highlighted some areas of disagreement about the use of PjBL in this situation when she asked, "Does PjBL meet the needs of students who may have executive function issues? There is a very strong contingent at the school who thinks not." Earlier in the year, the teacher indicated that the students learned from a more traditional textbook curriculum in the chemistry class, and they wanted to try something different. As my observations began, I recognized that the students had learning challenges, but I was interested to

understand how the teacher's implementation of PjBL would progress. In the next subsection, I discuss how the teacher decided to use the combination of traditional and PjBL elements.

4.2.2 The Rationale for the Hybrid PjBL Approach

Despite the teacher's beliefs in the benefits of PjBL, he was unsure about whether PjBL is more effective for learning than a traditional curriculum. The teacher wanted to balance the necessary scaffolding with more active and authentic learning activities. With the use of PjBL, he hoped that the experience could help the students develop into informed citizens. He provided the overall reason that he elected to use a hybrid version of PjBL. For example, during our discussions he said:

> I think PjBL is a good idea. But is there data to suggest that it is valid? For that reason, that is why I'm mixing some traditional classroom stuff because I don't want to lose that…I think traditional classroom stuff has a lot of value. But I think there is value in the project-based learning.

The teacher had a balanced point of view of PjBL as shown by the quote above since he sees the challenges of implementing the instructional strategy as well as the potential benefits. The quote also indicates the teacher's support for a hybrid approach.

The teacher had three reasons for implementing some PjBL components. Specifically, the teacher attempted to implement specific elements of PjBL because the Woodland School encourages teachers to use the instructional strategy, and he wanted to compare it to a purely traditional curriculum that he used earlier in the year. Before the project unit that I observed, he did not connect the content to a larger

theme like the *Trash or Treasure* project, and he did not use any of the Biological Sciences Curriculum Study (BSCS)'s 5E Instructional Model or Buck Institute of Education's Essential Project Design Elements. This case study did not compare the implementation of PjBL in the classroom to any other time because it is strictly an exploratory study that aimed to describe and understand the inherent challenges of PjBL. The teacher's third reason for the PjBL implementation was to cover the five core concepts of the school's 10th grade chemistry curriculum rather than a broad curriculum based on the textbook. In general, the teacher was interested to see how the 10th grade students would adjust to a more active classroom environment and he recognized that the students needed a different format for learning the chemistry content. The hybrid PjBL approach allowed the teacher to implement some PjBL elements while adjusting the activities so that the students had support. The following subsection discusses how the teacher implemented PjBL in his classroom.

4.2.3 Implementation of Hybrid PjBL

During my observation of the class, the teacher spoke to the students about the purpose of the *Trash or Treasure* project in terms of whether it is possible to use waste or commonly available materials to create alternative energy. In addition, he provided a connection to this driving theme in the background and introduction sections of each experiment worksheet. The use of a driving question is connected to the Challenging Problem or Question element of the Buck Institute's Essential Project Design.

During the month of May, the students interacted with the four major laboratory experiments when it was safe to do so: development of a battery made of

pennies, production of energy through a thermite reaction, production of hydrogen from a zinc and hydrochloric acid reaction, and electrolysis of water (production of hydrogen after an electric current creates a chemical reaction in water). For example, I observed how the teacher had to conduct the thermite reaction (a reduction-oxidation or redox reaction) outside while the students only observed the experiment because the temperature was approximately 1,500 degrees Celsius or 2,800 degrees Fahrenheit. The majority of students were visibly excited by the explosion, but they were cautious due to the teacher's safety warnings. Some students were disappointed about the small size of the explosion, and the teacher explained that he had to increase the intensity of the reaction gradually for safety reasons.

During another experiment, the teacher handled the hydrochloric acid, and some of the students were more distracted by their friends and phones as compared to my observations of the thermite and the penny battery experiments (using pennies to create a battery stack that produces electric current). When it was safe, the students followed directions to conduct the experiments, but they did not design them because that component of PjBL was not the teacher's goal. Moreover, in the hybrid version of PjBL, the students did not have the opportunity to explore or examine the concepts and questions related to these projects on their own, and they developed final posters with significant guidance from the teacher.

The teacher provided an explanation of the main concepts related to the lecture or experiment at the beginning of each class. He connected the previous labs and lectures to the current ideas to help the students link the concepts for deeper understanding. The teacher used informative laboratory worksheets to support

students for each of the four experiments instead of using the textbook to communicate the necessary information. The teacher in this case study was able to condense some of the textbook chapters because of the nature of the specific textbook. Many of the textbook chapters were not related to the main concepts or "core knowledge" of the 10th grade chemistry curriculum, so the teacher was able to combine them in his worksheets, laboratory experiments, and lectures. The teacher explained how he was able to condense the content when he said:

> We were able to cover the really crucial stuff and we were able to get through it…if we went chapter by chapter, they would have been reading 30 pages [of the textbook] every five days to get through the rest of what we needed and that just wasn't going to happen [based on the students' work in the first part of the year]. [On] the very first handout I gave them, I was able to condense 2½ chapters of their book into 10 pages of my own handout.

In each worksheet, the teacher provided background and an introduction of the concepts related to the experiment and project theme, the materials and procedures necessary for the experiment, space for observations, and relevant questions for the students to consider and answer.

As the teacher attempted to cover the necessary information as scaffolding for the projects, he recognized that the majority of the students were still not engaged, and they struggled to complete the lab worksheets. The teacher said the students had a lack of understanding of the core concepts because the students did not finish the worksheets on time, which made the culminating poster project more difficult. According to the teacher, the worksheets were designed to help the students consume

the content better than the textbook because he was able to provide more useful explanations. However, I am not aware that their performance increased or other assessment results improved. The teacher indicated that it is possible that some of students became more engaged during this project. In addition, based on my observations, he was readily available to answer any questions that the students had during or after class. When the teacher asked the students to write a lab report, he presented the guidelines in a step-by-step manner. In general, the teacher was able to explain and build scaffolding effectively based on the four class experiments.

At the end of the project unit, the students created posters that represent the Public Product element of the Essential Project Design. The students worked in groups to produce a total of four posters with one poster for each lab experiment. The last group to turn in their poster was not prepared to explain the details of their poster or the broader relevant themes effectively. They presented the posters to judges at the STEAM fair. The posters presented the history and background of the chemical elements and the experiment procedures and results. I only found one student group's poster that included a connection to the driving theme of using waste resources for alternative energy.

I was not able to observe the teacher reviewing any of the student posters, but he indicated that he worked closely with each student group to help them prepare. After the STEAM fair, the teacher reflected on the process and said, "I would choose a different culminating event or I would somehow have structured it a little bit differently…it was our first science fair, so even our teachers didn't really know what to expect going into it…Next year, we might want to organize the flow, people, and

posters in a more coherent way. It was our first science fair, so we will get it." The teacher recognized that he would have liked to include regular constructive feedback in a purer version of PjBL.

This section described the transition from traditional curriculum to a more active environment with the inclusion of some PjBL components. The next section will discuss why the teacher decided not to implement other PjBL components.

4.3 Second Finding: Rationale of Using Specific PjBL Components

Earlier in this chapter, I described how the teacher planned to implement some of the PjBL components in combination with traditional activities to create a hybrid due to concerns that the students need more structure than PjBL provides. This section describes the reasons that the teacher used certain PjBL and traditional components in his hybrid implementation in the classroom. I drew upon the conceptual framework related to the PjBL components to understand the ideal components of PjBL. Specifically, I reviewed the Biological Sciences Curriculum Study (BSCS)'s 5E Instructional Model, Buck Institute of Education's Essential Project Design Elements, and the components identified by other researchers such as the importance of learning through mistakes and the value of multiple viewpoints. In the instructional model, BSCS defined the following five stages: engagement, exploration, explanation, elaboration, and evaluation. The Buck Institute's Essential Project Design Elements include eight categories including the following: Key Knowledge, Understanding, and Success Skills, Challenging Problem or Question, Sustained Inquiry, Authenticity, Student Voice & Choice, Reflection, Critique & Revision, and Public Product.

The teacher implemented a hybrid PjBL model that included lectures, assessments, and worksheets as the traditional elements. He also included the PjBL elements of a driving theme and question, a focus on a few topics, explanation of key concepts in a consumable manner, active experiments and demonstrations of four chemical reactions, and a public presentation of a project. Based on the PjBL defined components, the teacher included aspects of the engagement and explanation phases from the 5E Instructional Model, and aspects of Key Knowledge, Understanding, and Success Skills, Challenging Problem or Question, and Public Product elements from the Buck Institute in his implementation.

As explained earlier, a hybrid PjBL instructional strategy does not include every PjBL component. In other words, the teacher decided not to implement a pure PjBL implementation. Specifically, he decided not to include student autonomy in his hybrid PjBL where the students would have the ability to directed their own learning, which would align with the "Student Voice & Choice" element. He also did not design the project unit so that students could conduct in-depth inquiry on topics that were connected to students' experience, which would align with the Exploration, Elaboration, and Sustained Inquiry components. Finally, he was unable to incorporate opportunities for reflection and continuous feedback due to time constraints. As demonstrated in the teacher's comments about PjBL, he clearly understands these components would be included in an ideal environment. There were a set of related implementation challenges that contributed to the teacher's use of a hybrid strategy in which he did not use some PjBL components. The next few subsections discuss these challenges.

4.3.1 Student Engagement

The lack of student engagement was one of most consistent challenges that the teacher experienced during his attempt to implement some of the components of project-based learning along with traditional lectures and assessments. The majority of the students struggled with focusing on tasks, and the teacher did not feel comfortable with giving them more freedom. When we discussed engagement, the teacher said:

> A lot of their [students] behaviors are wanting an audience. So if you take away half the audience, the behaviors tend to stop as well. That is probably the biggest challenge, and then the other challenge is of course that…these students did not succeed in more traditional schools. They tend to come into a class that they consider difficult, especially if there is a quantitative aspect – math and science, they will come into it with not such a great attitude.

Despite the challenges with engagement, the teacher was always available to support the students in terms of their questions and concerns when I was in the classroom.

While student engagement was challenge in this class, I observed that the students were more engaged with the activities than with the lectures throughout my time in the classroom. Specifically, when they worked on the lab experiments, they were not as distracted by their friends or technology. In addition, the three most interested students in the front row asked some follow up questions after the class, and the teacher provided helpful support. The teacher also asked questions in an attempt to engage the students sitting in various areas of the classroom, and he explained the concepts related to the experiments. For example, the teacher's

worksheets and class discussions seemed to provide value to at least some of the students.

With the the challenges of student engagement described above, the teacher decided to incorporate more traditional elements like lectures, assessments, and assignments to ensure that students would have the necessary support for learning. Along with student engagement, a related challenge of whether the students were ready for independent work helped lead the teacher to use a hybrid PjBL strategy. I discuss the challenge in the following subsection.

4.3.2 Student Readiness

The teacher found that it can be challenging to understand his students' risk tolerance for learning fully so that he could set the appropriate guidelines and know when to push individual students. Specifically, the teacher said, "You have to know your class and how far you can push that particular part of PjBL." During the attempted implementation, the teacher was concerned about student readiness when he said:

> It comes down to knowing your students. If you were to throw something at them and say do it, and learn while you do it, some students would crumble a little bit when you ask them to do that, and it would ultimately be counterproductive to learning.

The quote above describes how teachers have to balance the degree of difficulty and academic pressure that they place on students. With PjBL, it is helpful for teachers to know their students' comfort levels and allow them to challenge themselves based on

their risk tolerance. The teacher also recognized that as he gains experience with PjBL he will be able to add more student autonomy when he said:

> Once you are experienced in designing these projects, student voice and choice can come in where the challenge seekers will choose a more ambitious project than the rest of the class. They decide their own learning. That can be really good with the students who will take the initiative to do that.

Based on my interviews and observations, the teacher was interested in providing a supportive learning environment for all students. As mentioned earlier, some of these students were not readily engaged, and the teacher did not want to set unrealistic expectations due to their academic and social struggles at other schools. As previously mentioned, students can fall into categories of "challenge avoiders" and "challenge seekers" according to Meyer, Turner, and Spencer (1997). I believe the teacher in this case was attempting to find the balance between high and low expectations for the students, and how to support each of them. The teacher in this case study concluded that as he gains more understanding of his students and their comfort levels, he will be able to support more students who are ready for PjBL.

4.3.3 Availability of Time

Given the amount of student guidance and support that PjBL requires, the availability of time presented a problem for the teacher. The teacher in this case study said, "No matter how much experience I have, I will always say I wish I had a little more time." Because of this typical circumstance, the teacher struggled to find time to plan and include additional components of PjBL. For example, he was unable

to include time for continuous feedback during the project unit. The teacher also recognized that time was more limited with his current experience when he said:

> Time is a resource and there is not much you can do in your first year except just put in more time….it becomes more feasible when your bread-and-butter teaching is all laid out, you have all of your materials, and you more experienced in terms of the classroom management. Then you can get into the subtle points of a given project and really start to refine it.

Since 2015 was the teacher's first year as an instructor, he spent a significant amount of time on the routine tasks that he plans to refine over time. He struggled with finding enough time for PjBL. In an ideal situation, the teacher wanted the students to design their own projects within set boundaries, but he said that it depended on the amount of time he had to set up the scaffolding.

The teacher explained that PjBL requires a significant amount of time in terms of preparation and support. The lack of time during the implementation of PjBL aligns well with the challenge that Krajcik and Czerniak (2007) identified. The teacher explained his experience further when he said:

> You are pretty busy with the routine stuff and you want to push beyond into project-based [learning], then time definitely becomes a factor. One of the things about PBL is that there is a lot of upfront work and then you kind of let it play out. Ideally, the students are designing the projects as they go and just staying within the bounds you have established, but again that depends on your students and how much time you have to scaffold the whole thing.

Despite the teacher's comments about insufficient time, he indicated that his next implementation of PjBL would be easier because he could use the worksheets he created this year to reduce his upfront work and focus on supporting student projects.

4.3.4 The Need for Curriculum Balance

Aside from the implementation challenges that the teacher faced, he also believed in the value of combining elements like a driving question and a public presentation with lectures, assessments, and worksheets in order to provide the necessary structure for the students' learning environment. The teacher was concerned about giving students autonomy and the ability to conduct inquiry-based projects because the students had issues with finishing their homework in the class. Based on these concerns, the teacher said:

> I wanted to mix in some more traditional assessments. I found that because – it may be specifically this class – I found that because homework compliance was so low, that students weren't keeping up and they weren't getting out of it as much as they could have. A test is much more cut and dry…It simplifies life for myself and for the students because it creates much clearer expectations.

The viewpoint that traditional assessments help create clear expectations is consistent with the teacher's belief in balancing active and passive learning activities in the classroom. The teacher identified accountability in a PjBL environment as a challenge in the interviews of this case study. Other PjBL teachers attempt to address the accountability issue through the use of well-defined rubrics and portfolio requirements. The teacher in this case study believes that tests can be more

motivating for students than an evaluation that utilizes rubrics. The administrator is also concerned that students in a PjBL classroom could "slip through the cracks" and become "freeriders" within the groups that work on projects. She wants to ensure that the teachers are able to hold all of the students accountable for work and not just a few. In addition, she believes effective rubrics that actually ensure that the students are learning can be difficult to develop. Based on the teacher's views, it is clear that he would include some traditional learning activities with PjBL components even if he was able to mitigate the implementation challenges.

As the teacher looked to the future, he planned to change the nature of the implementation in the following school year. Specifically, he would like to include more components of PjBL including, student ownership, independent student research, and inquiry-based project design. The teacher made it clear he did not have enough time to develop the PjBL implementation to include the student ownership aspect. In the next section, I discuss how the teacher adapted the hybrid strategy for the specific students in the classroom.

4.4 Third Finding: Adaptation of PjBL Strategy Based on Students

The third finding of this case study is that the teacher had to alter the implementation of the hybrid PjBL instructional strategy due to the students. I discussed the role of the students in the previous section regarding the reasons the teacher did not use specific components. This section explores the alteration of the overall strategy for the students further. In order to have a complete understanding of why the teacher adapted his implementation of

PjBL based on the students, it is important to reflect on my classroom observations of the students' level of engagement.

4.4.1 The Context for Altering the PjBL Implementation

My observations of the classroom documented that many of the students struggled with engagement and "executive functioning" issues, which affected their ability to focus in class and complete any independent work in class or at home according to the teacher. During a typical class, the students filed into the classroom and the energy and noise level began to rise. Many of the students spoke with their friends as they found their seats. The students became quieter ten minutes after the class began. This was a typical energy level in each class that I observed. Many students spoke to their friends loudly. Some were glued to their iPads, and others were gripped by a text that they just received from their friends. A focus on the teacher or on the current task was difficult for a large group of students in the class. However, these observations of low engagement were not always the case. Throughout my observations, some students asked questions relevant to the discussion and provided accurate answers to the teacher. In a few instances, the teacher regained control of the class when students were not paying attention using classroom management tactics. Typically he would inform the students that there were consequences for their lack of focus. For example, he told the students that he would give them a pop quiz several times if they did not pay attention. However, he never gave them a pop quiz when I was in the classroom. In an attempt to encourage the students to complete their work, he deducted points for lab worksheets when the students turned them in late. As mentioned previously, the teacher adjusted his

instructional techniques as he worked with students on attention and concentration issues.

The teacher said, “It’s not realistic that every single student will have a magical conversion where they are suddenly a curious scientist. I have to respect the fact that some students aren’t that interested in chemistry.” However, some of the students in the front row also had issues with becoming distracted by friends in the class. The students who sat in the back of the class did not consistently listen to the lectures or participate in the laboratory activities. In one situation, the teacher had to take a student’s tablet until the end of class because the student was not completing the lab experiment during class. For future classes, the teacher is considering a stricter technology policy in his classroom due to the the amount of distraction that devices can create.

Despite the struggles with student engagement, the teacher showed a video that effectively explained the penny battery experiment, and the majority of the students paid attention. Instead of looking at their phones or talking to their friends, the students watched the video and were more prepared to start creating the penny battery than the other experiments. It may be that students are more accustomed to viewing visual media in their personal life, and video may be effective for delivering content in class while maintaining students’ attention. During one class, the teacher asked questions of the less engaged students in an effort to involve them. For example, he asked these students, “How would you end the experiment?” In addition, the teacher used humor in one class to connect and encourage students to listen and learn. The teacher mentioned that students tended to enjoy competition as a part of

the class. In the penny battery experiment, the teacher indicated he would bring donuts for the pair of students who recorded the highest voltage from their battery. The majority of the students demonstrated engagement with the penny battery experiment because they showed they could work together productively without distraction and they successfully completed the lab experiment.

During one interview, the teacher said, "Although there was very good engagement during the [penny] battery [experiment], I have yet to see them demonstrate any knowledge from that experiment." Given that the students were following instructions to conduct the experiment, it is possible that the students would have shown more knowledge retention if they had more ownership of the activity. It would be interesting to determine whether the students need extrinsic motivation or whether they would respond to effective techniques that support intrinsic motivation. It is possible that in some project-based learning environments, students are engaged and motivated by their own interests when they design and work on their projects.

In general, the teacher was unsure that a more active curriculum would provide long-lasting engagement for the students in the class I observed. The teacher also believed that many of the distracted students in the class were likely to avoid challenges. Specifically he said, "There is a lack of wanting to challenge oneself." The teacher believed that some of the students think to themselves, "If I challenge myself and don't get it right, then I have failed. But if I don't try, then I just chose to fail." In addition, the teacher said, "You have to take the temperature of the class every once and while…am I pushing too hard? Is it beyond their capabilities in terms of their ability to research independently?" This mentality is clearly described in

Meyer, Turner, and Spencer's (1997) research about how to teach and adjust to "challenge avoiders" and "challenge seekers." In an ideal circumstance, PjBL environments are supposed to encourage students to make mistakes and learn from them. Students who avoid challenges require a significant amount of guidance from the teacher in a PjBL environment, which the teacher probably took into account when he decided to use a hybrid version of PjBL that provided the necessary structure.

With the clear lack of engagement from the students sitting in the back row of the classroom, I asked the teacher for his thoughts about why they have low engagement and how to engage them better. He indicated that he could not generalize about the students because the "student population is so diverse," and some of them have issues with English as a second language and others have learning challenges. The teacher also mentioned that he did not see a large difference between traditional and PjBL curricula for student engagement. I cannot make any conclusion about this argument because this is only one small group of students, and the teacher did not implement an ideal version of a project-based learning environment. Regarding this idea, the teacher indicated, "Had I been able to stick a little closer to the true PjBL architecture, maybe it would have changed, maybe it wouldn't…there probably isn't some sort of magic method" that makes students interested in chemistry. However, he said, "We talked about possibly giving them more voice and choice and more ownership [in the future] – that would help."

4.4.2 The Adjustment of the PjBL Implementation Strategy

The descriptions of the classroom in the previous subsection demonstrate why the teacher did not to give students more autonomy and challenges due to the low engagement the students exhibited. The teacher did not feel the students were ready to learn through independent or group projects. Due to their lack of diligence with regular assignments, he did not believe they could design and develop projects without significant support. He chose to use lectures, discussions, class experiments, and worksheets to explain the concepts, and then asked each student group to create a poster that depicted one of the four experiments. The student groups created the poster projects with significant guidance from the teacher, which showed the students may not have been ready for any greater autonomy. As the teacher becomes more experienced, it is possible that he will know when to push the "challenge seekers" and support the "challenge avoiders."

In this section, I discussed how the teacher in this case study tried to manage the relatively low level of engagement among the students, and how it affected his willingness to push the students to challenge themselves. This circumstance led the teacher to direct the assignments and activities in the classroom. The teacher recognized the various degrees of engagement across all of his students, and he used strategies, such as competitive activities, to help students to become more interested in learning during a chemistry experiment. With more experience, the teacher will find the most effective pedagogy to encourage individual students to challenge themselves.

4.5 Additional Implementation Challenges

The discussion of the three main findings of this study included a number of implementation challenges that influenced the use of PjBL in this case study. However, the three findings did not include some other implementation challenges that the study participants identified for PjBL that did not directly influence this specific implementation. The next two subsections cover these challenges.

4.5.1 Resource Constraints

The availability of materials and access to information for projects is a typical challenge for teachers who implement project-based learning in the classroom. The teacher of this case study indicated that he had limited access to some chemistry laboratory materials similar to any high school science class. For example, the teacher would have preferred smaller tubing, much smaller reaction vessels, and smaller collection vessels. This equipment would have allowed the students to conduct more individual work on the experiments. Because he lacked these materials, the teacher had to make a specific plan for what resources he needed for his classes. The teacher was optimistic about limited resources when he said, "If you do manage to put together a good project, despite whatever [the] financial constraints and given the skills of your students, it's kind of rewarding if you manage to pull that off." If the teacher or one of the students wanted to conduct more complex experiments that required additional materials, the cost may have been higher than the science budget allowed. Resources are particularly important in project-based learning environments because the students typically direct their own learning and

may require specific materials. However, a teacher in a PjBL environment would set parameters of what type of materials students can use in their projects.

In the class that I observed, the teacher was able to order the materials that he needed for the four experiments. He did not have to be concerned about the amount of materials because the teacher assigned the experiments, and the students did not influence the structure of the experiments. The teacher viewed the resource challenge as the easiest because there are less expensive lab materials he used in the place of more expensive ones. During the study, he enjoyed some of the pressure from the resource constraints because it was helpful to drive his creativity when he planned for classes.

4.5.2 Degree of Rigor

Some educators have difficulty with designing PjBL environments where the projects challenge students and help them meet standards (Krajcik & Czerniak, 2007). The necessity to improve student assessment scores and meet state standards can affect educators' freedom to implement alternative curricula. In this case study, the Woodland School has more freedom to implement a new instructional strategy because it is a private school. However, this status does not mean that the school avoids evaluating its students. The school is interested in using a rigorous curriculum that helps challenge students in a supportive learning environment. The administrator in this case study mentioned that ensuring a high-level of rigor is a challenge with the PjBL strategy. The teacher in this case study incorporated traditional lab reports, worksheets, lectures, and assessments to ensure a rigorous curriculum when he attempted to implement a hybrid version of PjBL. While the students in his class did

not design their own projects, the teacher was uncertain that they would be able to demonstrate any additional knowledge from the four experiments in the class compared to the curriculum earlier in the school year. However, the teacher did not see any disadvantages to using PjBL in terms of student learning, and he saw some advantages when he was able to cover the necessary material in a condensed format. Despite the potential difficultly, it is possible to have rigor within a PjBL classroom through clear and specific project guidelines that require students to meet content standards while working on their own projects.

In this chapter, I discussed six different implementation challenges of project-based learning that the teacher and administrator identified in this case study. These challenges included student engagement, availability of time, resource constraints, degree of rigor, student readiness, and student accountability. These challenges help provide the perspective of two school staff members at a PjBL school. Given that I did not observe an ideal implementation of PjBL, there could be other relevant challenges that would have been included. However, this group of challenges helps show these educators' experience with PjBL.

4.6 Chapter Summary

Although I expected to find a complete implementation of PjBL in terms of the core PjBL components, I was able to develop three main findings based on my observations of a hybrid version of PjBL in a chemistry class. During the class, students conducted and observed four experiments related to the theme of using readily available materials to create alternative energy. The student posters at the STEAM fair were presentations of the four experiments. In general, this chapter

discussed the setting of the case study, the three main findings of the case, and the other related implementation challenges that the study participants experienced.

The findings of this case study depict how the teacher transitioned from a completely traditional curriculum to a hybrid PjBL implementation. In addition, the findings describe how the teacher used specific PjBL components and did not use others due to some implementation challenges and the need to balance PjBL with some traditional elements. He indicated that he will work to reduce the impact of these challenges when he uses PjBL in the future. The third finding described complete rationale of the teacher when he adapted the hybrid strategy based on the students in the classroom.

The research questions of this case study inquired about the nature of the PjBL implementation that I observed and the related implementation challenges. The discussion of the case findings answers these questions throughout the chapter. However, I did not include specific sections that addressed the questions because I organized the chapter based on the three main findings. The next chapter discusses the questions and issues that the case findings have raised.

Chapter 5: Conclusions

As I discussed throughout this thesis, the purpose of this case study was to examine the benefits and implementation challenges of PjBL based on one teacher's experience in his classroom. My observations in the classroom and interviews with the teacher and administrator led me to determine three main findings. The findings of this exploratory case study have allowed me to identify some meaningful questions and ideas to consider. Even though I was not able to observe an ideal implementation of PjBL that included its core components, the three main findings are beneficial because they highlight how a teacher implemented a hybrid version of PjBL, the challenges of a teacher who decided to use some of the elements of PjBL, and how a teacher adapted his plan for a specific group of students. This case study should not influence the perceived efficacy of PjBL because the case focuses on one classroom in which the students did not research or direct their own projects. An exploratory case study provides an opportunity to describe the circumstances of one case, to add to the existing body of research, and to identify areas for future research.

In this final chapter, I consider the ideas that came out of the case study findings. I will state these ideas in the form of questions because this study did not collect data that would provide answers. The questions will serve as a guide for consideration. I close the chapter as I discuss the potential opportunities for future PjBL research based on this case study.

5.1 Issues for Consideration

Given the implementation challenges that occurred for the teacher in this case, I identified a number of issues and areas that may be relevant to the discussion about PjBL. However, the identification of issues and questions does not indicate that I am making any generalizations for other classrooms. The pertinent issues include the design of the PjBL environment, students' degree of readiness to learn in a PjBL environment, the risk tolerance of teachers and students, and the ability to incorporate the required concepts and content in a PjBL environment. The questions to consider related to this implementation of PjBL may be the following:

1. How can teachers design a PjBL experience so that all students can conduct in-depth inquiry?
2. How should teachers ensure that students learn the necessary content and concepts while the students learn through their own projects?
3. At what point do teachers take the risk and implement a full PjBL with students who have the necessary skills?
4. What can school administrators do to assist a teacher in taking these risks?
5. How can school administrators and teachers support students so that they feel comfortable taking academic risks in PjBL environment?
6. How can teachers mitigate the implementation challenges in order to facilitate a supportive PjBL environment?

The first question refers to the difficulty that teachers experience when they plan a PjBL implementation and work to support all students in their inquiry-based projects. This type of plan requires teachers to gauge each student's ability to

conduct their own inquiry on a driving theme or question. This question links to this case study because the teacher decided to implement a hybrid version of PjBL due to the students not demonstrating they were ready to create an inquiry-based project. It is an open question how to support all students in a PjBL environment.

The second question highlights the issue that PjBL teachers can have with balancing the curricular requirements about covering a sufficient amount content when students are focused on learning through an in-depth project. The tension between teaching a specific quantity of content and students conducting in-depth inquiries on one multidisciplinary topic can create a situation which makes PjBL difficult to fully use. In this case study, the teacher balanced passive and active techniques in order to support the students' learning. He also was able to use his hybrid PjBL implementation to condense the textbook-guided curriculum into four essential concepts while I observed the classroom so that the students could effectively consume the content. In other words, the teacher was able to balance the breadth and depth of the content, but it remains a potential issue in the future.

The next two questions refer to how teachers and school administrators manage the risk of facilitating a full PjBL environment with the students who are ready. Teachers who use PjBL have to decide when they will take the risk based on the readiness of the students. To phrase the first of the two questions another way, what are the decision criteria that teachers use to decide when to the take the risk to implement a PjBL environment that includes all of the components? The other question refers to how school administrators can provide support to teachers who take risks when using the PjBL instructional strategy. In this case study, the teacher used

a hybrid approach because he thought the students needed extra support from traditional instructional activities. He did not think it was worth the risk to implement more PjBL components. The administrator provided support through professional development sessions for the teacher. I do not know how the school leadership would support the teacher if he had used more aspects of PjBL because that situation did not occur in this case.

The fifth question addresses a different aspect of risk tolerance. Specifically, it refers to the challenge of supporting students so that they feel comfortable taking academic risks. It is possible that students are reluctant to challenge themselves in a classroom because they are concerned with failure. In a PjBL environment, teachers and administrators have the opportunity to give students the freedom to make mistakes and learn from them through the process. The teacher in this case study determined that the students were not ready to work more independently and challenge themselves beyond the assigned classroom and homework tasks. As the findings indicated, many of the students did not turn their homework in on time, and the teacher did not think the students had the skills to direct their own projects.

With all of the implementation challenges discussed in this case study, it is important to consider how teachers can manage and limit the effect of the challenges in the final question. Since teachers can experience issues with the implementation of any new instructional strategy, it is important to develop a plan to manage the challenges so that the transition proceeds as smoothly as possible. Even with a defined plan to mitigate the challenges, unexpected situations can occur in a real classroom. In this case study, the teacher discussed his current and future methods to

mitigate some of the implementation challenges like the amount of available time, student engagement, and the chemistry resource constraints. The teacher has shown he is willing to adjust his use of PjBL based on the challenges in the environment, and he has indicated that he will attempt to limit the effect of the challenges.

The potential questions I discussed in this section are helpful to consider as the study participants, researchers, and educators continue to explore the implementation of PjBL. As mentioned previously, the discussions in this section cannot be generalized due to the scope and purpose of this study. Instead, the questions can highlight areas in which further inquiry can occur. The next section discusses the possibility of further research based on the findings of this case study.

5.2 The Potential Opportunities for Future Research

The circumstances of the case study findings and the limited number of studies on the implementation challenges suggest that researchers in the field of education have an opportunity to conduct additional research on the implementation challenges of PjBL. The literature review demonstrated that researchers have mostly focused their studies on the components of PjBL in relation to the potential increase in student engagement and understanding. While other issues related to PjBL may arise, this section focuses on the studies that can address the issues identified in this case study.

Based on this case study, future research can continue to focus on the implementation challenges of student readiness for independent learning, how to use PjBL in an environment with low student engagement, development of effective strategies for accountability in a PjBL classroom, efficient use of material resources

in PjBL classrooms, effective time management, and use of a rigorous curriculum in a PjBL environment. These challenges may present opportunities for other researchers who will continue to build the conceptual frameworks for PjBL studies. Additional studies are important because PjBL continues to be an instructional strategy that is a part of education reform considerations.

For any of the future opportunities, it will be important for researchers to consider a variety of methodologies for studying this instructional framework. This study was exploratory because of the limited existing research regarding the inherent challenges of PjBL. Researchers may select descriptive, explanatory, exploratory, or comparative approaches as their design structure for other PjBL case studies (Yin, 2014). As with all case studies, the design and methodology are very important to evaluate and determine the best fit for the particulars of the research questions to ensure validity and reliability.

This section discussed the potential for new research related to project-based learning. While this study was focused on only one teacher and administrator of one school, it also identified areas where other researchers can focus in the future. The purpose of this case study was to explore the implementation challenges of PjBL, and I was able to observe and describe a teacher's attempt to use some components of PjBL in a chemistry classroom. I am interested in how other researchers approach this instructional strategy, and the findings they describe.

5.3 Chapter Summary

This purpose of this final chapter was to discuss the issues and questions I developed based on the case study data that I examined in the previous chapter. In

addition, I explored the potential areas of future research regarding the challenges of PjBL. The main takeaways of the case study are that the teacher decided to use a hybrid version of PjBL due to the students' needs and the belief in the value of traditional methods, and he experienced six different implementation challenges that he intends to mitigate in future uses of PjBL. Because of this case study's limited scope, this chapter only describes opportunities for future research related to the inherent implementation challenges identified in this case study. While this case study did not proceed as expected, it provided a valuable description of one classroom in which a teacher experienced implementation challenges. Hopefully, researchers will conduct case studies that continue to explore PjBL so that educators can gain a deeper understanding of this instructional strategy.

Appendix A: Conceptual Framework for PjBL Components

Ideal PjBL Components: Categorization of the PjBL Environment

Locus of Control

- Student Voice & Choice
  - Students have autonomy to make decisions about the topic of the project, and how they develop the project throughout the process.

Connection to Students' Lived Experience

- Challenging Problem or Question
  - With a teacher's guidance, students define a "meaningful problem to solve or a question to answer" that provides structure for the project and sets the degree of difficulty. It can also be referred to as a driving question.

- Engagement
  - Students link their learning with past experiences so that they become more interested and invested in the class project.

- Authenticity
  - Students' projects include a connection to the community outside school and to students' lived experiences, issues, and interest.

In-Depth Inquiry

- Exploration
  - Students have experiences with the phenomenon they study and develop a deeper understanding of concepts.

- Explanation
  - A teacher shares additional and necessary information and knowledge about the student explorations.

- Sustained Inquiry
  - Students ask probing questions, locate and attain resources, and apply the relevant information during the development of their projects.

- Elaboration
  - Students have the ability to conduct more research in an attempt to gain greater understanding about a phenomenon.

Continuous Constructive Feedback

- Reflection
    - Students and teachers evaluate their work and learning during a project in terms of the quality, challenges, and the ability for the inquiry to meet the project goals.

- Critique & Revision
    - Students provide and receive feedback on their projects, and incorporate the recommendations to enhance the projects and their work processes.

- Evaluation
    - A teacher provides constructive feedback on student projects to help enhance learning.

Project Completion

- Key Knowledge, Understanding, and Success Skills
    - Students achieve their learning goals in effective projects, which are based on standards and the essential life skills of critical thinking, problem solving, collaboration, and autonomy.

- Public Product
    - Students share their project with the broader community through a display or presentation.

(Buck Institute for Education;
Krajcik & Czerniak, 2007)

Appendix B: Interview Guide for the Teacher

During the beginning period of my observations, I will ask the following interview questions to the classroom teacher that uses project-based learning:

1. I am interested in understanding PjBL in the classroom. Can you help me understand how you implement PjBL in your classroom?
2. What are the challenges you have experienced with the use of this instructional strategy?
3. How do you manage these challenges?
4. How would you describe the school and your classroom before the implementation of PjBL? How has our experience changed?
5. How are you supported in your use of PjBL? How could this support change?
6. What strategies would you have liked to know before using PjBL in the classroom?

During the middle period of my observations, I will ask follow up interview questions to the classroom teacher:

1. How have you altered the implementation of PjBL in your classroom since our first interview?
2. What are the challenges with PjBL that you have faced since our first interview? Are these different challenges? If so, why have they changed?
3. How has the current project affected your views of PjBL and strategies to manage the inherent challenges?

During the final period of my observations, I will ask follow up interview questions to the classroom teacher:

1. How have you altered the implementation of PjBL in your classroom since our second interview?

2. What are the challenges with PjBL that you have faced since our second interview? Are these different challenges? If so, why have they changed?
3. How has the current project affected your views of PjBL and strategies to manage the inherent challenges?

Appendix C: Interview Guide for School Leader

I will ask the following questions to one or more of the school leaders at the Woodland School:

1. Why did the Woodland School decide to implement PjBL?
2. Would you describe the implementation of PjBL as gradual or rapid?
3. What are the challenges that teachers face on a daily basis when they use PjBL?
4. Has the Woodland School experienced resource constraints with the implementation of PjBL?
5. Do you believe PjBL works better in a private school than a public school?
6. What advice would you give to other educators and schools that would like to implement PjBL?

Appendix D: Observation Guide

Category	Criterion	Potential Observations
Engagement	Teacher assists each individual student with his or her PjBL work through the use of driving questions.	Student demonstrates physical and verbal behavior that helps/doesn't help him or her receive guidance from teacher; student moves/or doesn't move beyond challenge with project; teacher customizes curriculum for student to improve engagement with project.
	Student asks for guidance from the teacher about their project.	Student receives teacher advice and student clearly or doesn't clearly change approach to his or her project.
	Each student's life experiences influence his or her need for guidance.	Teacher works or does not work with students to recognize their personal life experiences to improve student engagement.

Exploration	Teacher allows students to spend time experiencing all aspects of the project even if they struggle.	Some students may demonstrate physical and verbal frustration if they are "challenge-avoiding" students.
Explanation	Teacher references another perspective when providing guidance to students. Teacher provides supportive information related to each project. Teacher helps students understand that one correct answer to a problem doesn't always exist.	Students experience the various viewpoints of their peers and teacher. Students ask additional questions about the new information indicating they are engaged. Teacher consistently presents the possibility that a problem has one solution; teacher highlights one answer in some or many situations.
Elaboration	Teacher allows students to conduct additional research for deeper understanding of the project.	Teacher observes students moving beyond the basic knowledge related to the project.

Evaluation	Teacher provides feedback to each individual student.	Teacher provides constructive feedback and student incorporates feedback into project; teacher does not consistently provide constructive feedback.
Benefits and Challenges of PjBL	Use of PjBL becomes challenging with students' individual learning needs; PjBL clearly benefits different learning styles.	Teacher and students demonstrate visible signs of frustration or concern; students with various learning styles show visible signs of being engaged and enthusiastic.

Appendix E: Participant Consent Form

Project Title	Examining the Benefits and Challenges of Project-Based Learning
Purpose of the Study	This research is being conducted by **Stefan Brooks** at the University of Maryland, College Park. My graduate advisor is Professor Francine Hultgren. We are inviting you to participate in this research project because you are an integral part of the school staff that support the project-based learning (PjBL) environment. The purpose of this research project is to explore how one teacher uses project-based learning at the Woodland School (pseudonym) mitigates the inherent challenges to create a supportive environment. In this study, I am seeking visual and auditory evidence of the nature of PjBL implementation. In addition, I will collect the views of study participants regarding their experiences with PjBL.
Procedures	The procedures of this study involve observation, interviews, analysis, and reporting. I plan to observe one class twice a week for up to three months or for the full length of time of a project at the Woodland School (pseudonym) in Maryland. I will conduct a 30-45 minute interview with the classroom teacher once at the beginning, middle, and end of the observation period to understand how and if the answers to the questions change. I will also conduct one a 30-45 minute interview with at least one school administrator. In addition, I will conduct 30-45 minute interview with one support staff member.
Potential Risks and Discomforts	While I do not expect a high level of risk in this study, it is possible that the proposed interviews will impact the study participants in terms of fatigue due to a busy schedule. I will be as flexible as possible to schedule interviews and his observation time. However, I will store the interview transcripts in a password-protected computer and the interview tapes will be stored in a locked desk of the researcher.
Potential Benefits	There are no direct benefits from participating in this research. However, a possible benefit includes the opportunity for the educators to reflect on their implementation and support for project-based learning. An outsider's perspective can help improve the understanding of a process. We hope that, in the future, other people might benefit from this study through improved understanding of how to mitigate the inherent challenges of project-based learning.

Confidentiality	Storing all observation and interview notes in a password protected computer will minimize any potential loss of confidentiality. I will securely shred all handwritten notes. When I write a report or article about this research project, your identity will be protected to the maximum extent possible. Your information may be shared with representatives of the University of Maryland, College Park or governmental authorities if you or someone else is in danger or if we are required to do so by law.
Right to Withdraw and Questions	Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify. If you decide to stop taking part in the study, if you have questions, concerns, or complaints, or if you need to report an injury related to the research, please contact the investigator: **Stefan Brooks** **2004 Baltimore Road** **Apt. C34** **Rockville, MD 20851** **202-744-1719** **stefan.f.brooks@gmail.com**
Participant Rights	If you have questions about your rights as a research participant or wish to report a research-related injury, please contact: **University of Maryland College Park** **Institutional Review Board Office** **1204 Marie Mount Hall** **College Park, Maryland, 20742** **E-mail: irb@umd.edu** **Telephone: 301-405-0678** This research has been reviewed according to the University of Maryland, College Park IRB procedures for research involving human subjects.
Statement of Consent	Your signature indicates that you are at least 18 years of age; you have read this consent form or have had it read to you; your questions have been answered to your satisfaction and you voluntarily agree to participate in this research study. You will receive a copy of this signed consent form.

	If you agree to participate, please sign your name below.	
Signature and Date	**NAME OF PARTICIPANT** **[Please Print]**	
Signature and Date	**SIGNATURE OF PARTICIPANT**	
	DATE	

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