A QUASI-EXPERIMENTAL STUDY LOOKING AT THE EFFECT OF PROJECT-BASED LEARNING ON SIXTH-GRADE STUDENTS' SELF-CONCEPT

by

Miranda Carter

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Philosophy

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ABSTRACT

This quantitative, quasi-experimental study investigated the differences in self-concept among sixth-grade students across various school subjects, particularly reading and mathematics, by comparing those engaged in project-based learning versus traditional learning. In rural eastern Virginia, the researcher utilized a modified version of the Self Description Questionnaire-I (SDQ-I) and a nonequivalent control group, pre/posttest design with analysis of covariance (ANCOVA) during the 2023–2024 academic year. Focusing on a Virginia middle school, classes were randomly assigned to either treatment, which was project-based learning, or control, which included traditional learning methods. The mean self-concept scores across three SDQ-I subscales—reading, mathematics, and all school subjects—served as the dependent variable. This study represented the first research on the effect of project-based learning on self-concept, showing change for mathematics but no other subjects. Recommendations for future research included extending the treatment period, exploring alternative student assignment methods, using qualitative research to understand students' perceptions of project-based learning, expanding project-based learning across all classes for the treatment group, and investigating the effect of teacher training and support on project-based learning effectiveness.

Keywords: project-based learning, self-concept, middle school, projects, rural

Dedication

This manuscript and study are dedicated to my incredible husband, Mason, and my dear children, Avery and Riggs. I am grateful for your unwavering support and endless love throughout this dissertation journey. Your patience during the long hours of study and understanding amidst the chaos have been my pillars of strength. You have given me the motivation and purpose to continue; I am eternally thankful.

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Table of Contents

ABSTRACT....3

Dedication....4

List of Tables....10

List of Figures....12

List of Abbreviations....15

CHAPTER ONE: INTRODUCTION....16

- Overview....16
- Background....16
  - Historical Overview....17
  - Society-at-Large....18
  - Theoretical Background....20
- Problem Statement....21
- Purpose Statement....23
- Significance of the Study....24
- Research Questions....25
- Definitions....25

CHAPTER TWO: LITERATURE REVIEW....27

- Overview....27
- Theoretical Framework....27
  - Self-Concept Theory....28
  - The Constructivist Learning Theory....29
- Related Literature....30

Definition and Components of Self-Concept....31
Review of Research on Variables that Influence Self-Concept....32
How Self-Concept Can Change Over Time....35
Measuring Self-Concept....36
Project-Based Learning in Education....39
Research on How Project-Based Learning Affects Grades, Motivation, and Self-Efficacy....46
Research on How Project-Based Learning Affects Grades, Motivation, and Self-Efficacy in Reading....51
How Project-Based Learning Connects Mathematics Self-Efficacy, Motivation, Attitude, and Grades....53
Project-Based Learning's Effect on Students' Self-Efficacy, Motivation, Attitude, and Grades in All School Subjects....55
Summary....57
CHAPTER THREE: METHODS....59
Overview....59
Design....59
Research Questions....61
Hypotheses....61
Participants and Setting....62
Population....62
Participants....63
Setting....68

Instrumentation 69
Procedures 74
Training on Project-Based Learning 76
Control Group 77
Administering the SDQ-I Pre-Test 77
Treatment Period 80
Data Analysis 83
CHAPTER FOUR: FINDINGS 87
Overview 87
Research Questions 87
Null Hypotheses 87
Descriptive Statistics 88
Reading Self-Concept Descriptive Statistics 89
Mathematics Self-Concept Descriptive Statistics 93
All School Subjects Self-Concept Descriptive Statistics 97
Results 101
Hypotheses 101
Null Hypothesis $H_0$1 102
Results of Null Hypothesis $H_0$1 110
Null Hypothesis $H_0$2 111
Results of Null Hypothesis $H_0$2 117
Null Hypothesis $H_0$3 119
Results of Null Hypothesis $H_0$3 127

Summary 128

CHAPTER FIVE: CONCLUSIONS 130

Overview 130

Discussion 130

Research Question 1 132

Null Hypothesis 133

Research Question 2 135

Null Hypothesis 2 136

Research Question 3 138

Null Hypothesis 3 138

Implications 140

Limitations 142

Recommendations for Future Research 145

Summary 147

REFERENCES 148

APPENDIX A: Appendix H: Gold Standard Project-Based Learning 175

APPENDIX B: Permission to Use the Instrument 178

APPENDIX C: Modified SDQ-I Questionnaire Instrument 179

APPENDIX D: SDQ-1 Questionnaire Administration Script 180

APPENDIX E: IRB Approval 182

APPENDIX F: Parental Opt-Out 183

APPENDIX G: Site Approval 185

APPENDIX H: Control Group Agreement 186

APPENDIX I: ELA Lesson Plan 187

APPENDIX J: Mathematics Lesson Plan 203

List of Tables

Table 1. Breakdown by Gender, Race, Ethnicity, and Socioeconomic Status for Reading and All School Subjects 65

Table 2. Breakdown by Students' Native Language and Special Education Services for ELA and All School Subjects 66

Table 3. Breakdown by Gender, Race, Ethnicity, and Socioeconomic Status for Mathematics .. 67

Table 4. Breakdown by Students' Native Language and Special Education Services for Mathematics 68

Table 5. Cronbach's α for the Subscales of the Modified SDQ-I 71

Table 6. Descriptive Statistics for Covariate for Reading Self-Concept (Pretest Score) 89

Table 7. Descriptive Statistics for Covariate for Reading Self-Concept (Posttest Score) 91

Table 8. Descriptive Statistics for Covariate for Mathematics Self-Concept (Pretest Score) 93

Table 9. Descriptive Statistics for Covariate for Mathematics Self-Concept (Posttest Score) 95

Table 10. Descriptive Statistics for Covariate for All School Subjects Self-Concept (Pretest Score) 97

Table 11. Descriptive Statistics for Covariate for All School Subjects Self-Concept (Posttest Score) 99

Table 12. Tests of Between-Subjects Effects With Interaction Term for Reading Self-Concept 106

Table 13. Tests of Normality by Group for Reading Self-Concept 107

Table 14. Levene's Test of Equality of Error Variances for Reading Self-Concept 109

Table 15. Tests of Between-Subjects Effects Without Interaction Term for Reading Self-Concept 111

Table 16. Tests of Between-Subjects Effects With Interaction Term for Mathematics Self-Concept 115

Table 17. Tests of Normality by Group for Mathematics Self-Concept..... 116

Table 18. Levene's Test of Equality of Error Variances for Mathematics Self-Concept..... 117

Table 19. Tests of Between-Subjects Effects Without Interaction Term for Mathematics Self-Concept 119

Table 20. Estimated Marginal Means for Mathematics Self-Concept..... 119

Table 21. Tests of Between-Subjects Effects With Interaction Term for All School Subjects Self-Concept..... 123

Table 22. Tests of Normality by Group for All School Subjects Self-Concept 124

Table 23. Levene's Test of Equality of Error Variances for All School Subjects Self-Concept 127

Table 24. Tests of Between-Subjects Without Interaction Term for All School Subjects Self-Concept 128

List of Figures

Figure 1. Distribution of Covariate for Reading Self-Concept (Control Group Pretest Score).... 90

Figure 2. Distribution of Covariate for Reading Self-Concept (Treatment Group Pretest Score) 90

Figure 3. Distribution of Covariate for Reading Self-Concept (Control Group Posttest Score) .. 91

Figure 4. Distribution of Covariate for Reading Self-Concept (Treatment Group Posttest Score) 92

Figure 5. Reading Self-Concept Pretest to Posttest Score Treatment and Control Group 92

Figure 6. Distribution of Covariate for Mathematics Self-Concept (Control Group Pretest Score) 94

Figure 7. Distribution of Covariate for Mathematics Self-Concept (Treatment Group Pretest Score) 94

Figure 8. Distribution of Covariate for Mathematics Self-Concept (Control Group Posttest Score) 95

Figure 9. Distribution of Covariate for Mathematics Self-Concept (Treatment Group Posttest Score) 96

Figure 10. Mathematics Self-Concept Pretest to Posttest Score for Treatment and Control Group 96

Figure 11. Distribution of Covariate for All School Subjects Self-Concept (Control Group Pretest Score) 98

Figure 12. Distribution of Covariate for All School Subjects Self-Concept (Treatment Group Pretest Score) 98

Figure 13. Distribution of Covariate for All School Subjects Self-Concept (Control Group Posttest Score)..... 99

Figure 14. Distribution of Covariate for All School Subjects Self-Concept (Treatment Group Posttest Score) 100

Figure 15. All School Subjects Self-Concept Pretest to Posttest Score for Treatment and Control Group 100

Figure 16. Covariate and Dependent Variable Box-and-Whisker Plot for Reading Self-Concept 102

Figure 17. Grouped Scatterplot of Posttest by Pretest by Group for Reading Self-Concept..... 104

Figure 18. Normal Q-Q Plot of Reading Self-Concept Posttest for Control Group 107

Figure 19. Normal Q-Q Plot of Reading Self-Concept Posttest for Treatment Group..... 108

Figure 20. Scatterplot Matrix for Reading Self-Concept..... 109

Figure 21. Covariate and Dependent Variable Box-and-Whisker Plot for Mathematics Self-Concept 112

Figure 22. Grouped Scatterplot of Posttest by Pretest by Group for Mathematics Self-Concept 114

Figure 23. Scatterplot Matrix for Mathematics Self-Concept 116

Figure 24. Covariate and Dependent Variable Box-and-Whisker Plot for All School Subjects Self-Concept..... 120

Figure 25. Grouped Scatterplot of Posttest by Pretest by Group for All School Subjects Self-Concept 122

Figure 26. Normal Q-Q Plot of Standardized Residual for All School Subjects Self-Concept Posttest for Control Group..... 125

Figure 27. Normal Q-Q Plot of Standardized Residual for All School Subjects Self-Concept Posttest for Treatment Group 125

Figure 28. Scatterplot Matrix for All School Subjects Self-Concept 126

Figure 29. New Model for Gold Standard Project-Based Learning 176

List of Abbreviations

Analysis of Covariance (ANCOVA)

Modified version of the Self-Description Questionnaire-I (SDQ-I)

Statistical Package for the Social Sciences (SPSS)

CHAPTER ONE: INTRODUCTION

Overview

The purpose of this quantitative, quasi-experimental study was to determine if there is a difference in sixth-grade students' self-concept in all school subjects, specifically reading and mathematics, between students who participated in project-based learning and traditional learning. Chapter One provides a background for self-concept, project-based learning, and traditional learning methods. Included in the background is an overview of the theoretical framework for the study. The problem statement examines the scope of the recent literature on this topic. The significance of the study follows the purpose of this study. Finally, the research questions are introduced, and definitions pertinent to this study are provided.

Background

The COVID-19 pandemic brought forth many challenges for students, profoundly impacting their self-concept (Vira & Skoog, 2021). As the educational landscape shifted dramatically to remote learning, students grappled with self-doubt, anxiety, and reduced motivation (Perkins et al., 2021). The importance of this research was rooted in its objective to investigate the influence of project-based learning on the self-concept of sixth-grade students using a quantitative, quasi-experimental methodology. Students across grade levels who engage in project-based learning have been shown to benefit through improved learning outcomes and confidence compared to traditional learning environments (Krajcik et al., 2023). Amid the COVID-19 pandemic's challenges, students experienced disruptions to their self-concept that were unlike anything seen before (González-Valero et al., 2020). Isolation, remote learning, and the absence of traditional classroom interactions took a toll on students' confidence, particularly in subjects like reading and mathematics (Lee et al., 2021). This study was driven by recognizing

that project-based learning could be vital to student self-concept. Project-based learning allows students to participate actively in meaningful, real-world projects (Bolstad et al., 2021). It gives them a sense of accomplishment and competence as they apply their knowledge and skills to practical challenges (Bolstad et al., 2021). This active engagement can potentially rebuild and reinforce their self-concept in mathematics and reading (Lee et al., 2021). Thus, this study was grounded in the belief that by understanding how project-based learning can enhance self-concept, researchers and educators can help shape a more positive and resilient educational environment, aligning with the pressing needs of modern education.

Historical Overview

Project-based learning and its connection to self-concept have had roots dating back to the early 20th century. Project-based learning as an educational approach can be traced back to educational reformers like Dewey, who advocated for learning by doing and incorporating real-world experiences into education (Chen, 2023). However, in the mid-20th century, project-based learning began to gain more prominence in educational discourse (Brandenburger, 2022). Educational theorists and practitioners, including Bruner, developed the concept of discovery learning, emphasizing the importance of self-directed, experiential learning in fostering students' cognitive development and self-concept (Thao et al., 2020). While these early proponents of experiential learning did not specifically explore self-concept, they laid the foundation for understanding the relationship between project-based learning and students' self-concept (Thao et al., 2020).

The integration of project-based learning and self-concept began to gain more attention during the late 20th century. During the 1970s and 1980s, researchers like Gardner studied the idea of multiple intelligences, suggesting that students have diverse ways of learning and

excelling (Klitgaard, 1984). This shift in perspective contributed to recognizing the importance of self-concept in the learning process (Klitgaard, 1984; Wang & Yu, 2023). In the 1990s, Bandura's (1993) research on self-efficacy became a key component of understanding how self-concept influences educational outcomes. Researchers and educators started looking at the effect that project-based learning had on students' self-concept in various subjects, seeking to determine how hands-on, experiential learning could enhance self-confidence, motivation, and a sense of competence (Bandura, 1993).

In the 21st century, project-based learning (Fujita, 2023) and self-concept (Suwendra et al., 2023) had become a focal point in educational research and practice. Recent studies have demonstrated that project-based learning can significantly boost self-esteem and academic achievement, particularly in mathematics (Fisher et al., 2022) and reading (Ariani, 2023). Educators have recognized that project-based learning empowers students by engaging them in real-world problem-solving scenarios, encouraging them to take ownership of their learning and building their self-esteem (Reid-Griffin et al., 2020). As educators have continued to refine instructional methods, understanding the historical trajectories of self-concept and project-based learning can inform effective strategies for creating inclusive, engaging, and student-centered learning environments (Reid-Griffin et al., 2020). Through the transition from the historical foundations of project-based learning and self-concept, it was imperative to look at the present-day societal context, shedding light on the pivotal role that project-based learning has played in improving student self-concept.

Society-at-Large

In the current social context, the relevance of this research has been evident, as it sought to assess the influence of project-based learning on the self-concept of sixth-grade students using

a quantitative, quasi-experimental approach. The effect of project-based learning on sixth-grade students' academic success and self-esteem has become a subject of significant interest in contemporary educational research (Bravo et al., 2021). Project-based learning's role in shaping students' self-concept has become crucial, especially in the context of the challenges posed by the COVID-19 pandemic, which further underscored the importance of this study. In recent decades, the traditional approach to education has increasingly given way to innovative methods that prioritize student engagement and real-world applicability (Nilimaa, 2023). Project-based learning, a strategy that immerses students in meaningful, hands-on projects, has become a vehicle for holistic learning (Guo et al., 2020). However, as project-based learning has advanced, so has the awareness of its potential impact on students' self-concept. Students actively engaging in project-based learning activities have often demonstrated heightened self-confidence, problem-solving skills, and a sense of accomplishment (Shin, 2018). This evolution in educational philosophy paved the way for a closer examination of how project-based learning influences self-concept, particularly in subjects, such as mathematics and reading, which have been considered fundamental to students' academic journey (Chen & Yang, 2019; Shin, 2018).

The absence of in-person interactions and support systems has left students feeling socially isolated—a key element in forming self-identity (Williams et al., 2020). Isolation and resource disparities have significantly impacted students' self-esteem, spurring educators and researchers to bolster their confidence and resilience (London & Ingram, 2018) in today's education. The current study measured the potential effect that project-based learning has on sixth-grade students' self-concept in reading and mathematics. Project-based learning's dynamic, engaging approach has not only enhanced academic skills but has also instilled self-confidence,

autonomy, and a resilient mindset, which are crucial in navigating the complexities of modern education.

Theoretical Background

Project-based learning (Almulla, 2020; Chen & Yang, 2019; Krajcik et al., 2023; Shin, 2018) and self-concept (Marsh et al., 2012) have been subjects of individual study in the past, with research often emphasizing their distinct effects on student learning and development. Project-based learning has been traditionally studied from an instructional design and pedagogical perspective, focusing on its effectiveness in improving students' academic knowledge and skills (Chen & Yang, 2019). Self-concept has been explored through psychological (Shavelson et al., 1976) and educational lenses (Skaalvik & Skaalvik, 2006), examining its role in shaping students' motivation and self-perception. However, there has needed to be more literature concerning the joint examination of project-based learning and self-concept. The connection between these two elements in educational settings has recently garnered attention.

As a result, this study sought to fill the existing gap in the literature by investigating the intricate relationship between project-based learning and self-concept. It aimed to examine how the project-based learning approach influences students' self-concept in the context of sixth-grade education in mathematics and reading. By examining these two elements, the current research study contributed to a more comprehensive understanding of how project-based learning affects sixth-grade students’ self-concept in reading and mathematics. The study drew upon existing theories from both instructional design and psychology to provide valuable insights into how project-based learning can be optimally employed to foster the development of a strong and positive self-concept in students.

Two essential theories, the self-concept theory and the constructivist learning theory, were used to investigate the effect of project-based learning on the self-concept of sixth-grade students through a quantitative, quasi-experimental design. These two theories complemented each other in the pursuit to fill the existing gap in the literature. The self-concept theory, rooted in psychology, analyzed the aspects of students' self-perception and confidence (Casino-García et al., 2021), providing a comprehensive lens to measure the changes in self-concept brought about by the project-based learning approach. Rogers et al. (1978) also investigated the relationship between academic achievement and self-concept in a classroom setting, utilizing the framework of self-concept theory. Rogers et al. (1978) found a positive correlation between academic performance and individuals' self-perceptions. In tandem, the constructivist learning theory, firmly grounded in educational philosophy, focused on how project-based learning actively engages students in real-world projects, providing opportunities for them to construct knowledge and meaning, fostering autonomy and a sense of accomplishment (Condliffe et al., 2017), which are fundamental to a positive self-concept. Combining these theories, this study aimed to reveal a holistic picture of how project-based learning influences self-concept in sixth-grade students, providing valuable insights for educators and researchers seeking to optimize the educational experience. Historically, no research has combined project-based learning and self-concept to understand the relationship between the two concepts. As a result, this study filled the gap in the literature by examining the effect that project-based learning has on sixth-grade students' self-concept in reading, mathematics, and all school subjects.

Problem Statement

Current research needed to adequately explore the potential effects of project-based learning on sixth-grade students' self-concept—an essential aspect of their psychological

development. While project-based learning has gained recognition as an innovative instructional approach that fosters active learning and critical thinking (Barak & Yuan, 2021), more attention needed to be given to how it influences students' perceptions of themselves and their overall self-concept. The existing literature primarily has focused on the academic and cognitive benefits of project-based learning (Almulla, 2020; Chen & Yang, 2019; Guo et al., 2020), neglecting the examination of its impact on students' self-concept. Self-concept, the way that individuals perceive themselves, has been crucial in shaping academic achievement, motivation, and overall psychological well-being (Marsh et al., 2019). As sixth-grade students undergo significant developmental changes and begin to form their self-identity (Harris & Orth, 2020), understanding the influence of project-based learning on their self-concept has been vital for educators, parents, and policymakers seeking to implement effective and holistic educational practices that promote students' overall growth and success.

However, due to the scarcity of empirical research in this domain, a comprehensive understanding of the potential link between project-based learning and sixth-grade students' self-concept needed to be improved. While most studies have touched upon self-concept in the context of broader educational outcomes (Wu et al., 2021), they have not directly investigated the specific influence of project-based learning on students' perceptions of themselves. Furthermore, the existing research predominantly has focused on older students, such as adolescents and high schoolers (Brumariu et al., 2022; Haktanir et al., 2021), leaving a shortage of knowledge concerning the developmental impact of project-based learning on self-concept in sixth graders. The problem was that the literature needed to address the intersection of project-based learning and self-concept among sixth-grade students.

Purpose Statement

This quantitative, quasi-experimental study examined how project-based learning affects sixth-grade students' self-concept across various academic subjects, particularly reading and mathematics. By conducting this research, educators, school staff, and stakeholders gained valuable insights into the effect that project-based learning has on student self-concept in the specific areas of reading and mathematics, after controlling for prior levels of self-concept based upon the pretest. The independent variable was the type of instructional method: project-based learning method or traditional learning method. There were three dependent variables: reading self-concept, mathematics self-concept, and all school subjects' self-concept. The study involved three covariates: pretest scores for the reading, mathematics, and all school subjects' subscales. Self-concept was defined as the individuals' perception and understanding of themselves, encompassing beliefs, feelings, and thoughts about their identity, abilities, and characteristics (Tourangeau et al., 2009). The self-concept score was utilized to assess variations in students' self-concept between those engaged in project-based learning and those involved in traditional learning methods.

The study population utilized sixth-grade students enrolled in a rural, southeastern Virginia school during the 2023–2024 academic year. The participants in this study involved students from the regular education classrooms, with teachers who willingly volunteered to participate. Students with learning and physical disabilities who were prohibited from completing the questionnaire were excluded from the study. Understanding the broader implications for education and student development was crucial to fully understand the study's aim of assessing how project-based learning influences students' self-concept.

Significance of the Study

Marsh et al. (2019) found that higher self-concept leads to improved academic performance, motivation, psychological well-being, interpersonal relationships, resilience, and overall life satisfaction. The study investigated the effect of project-based learning on sixth-grade students' self-concept, which held substantial implications for educators, policymakers, parents, and students. Firstly, the research informed other locations and educational institutions seeking innovative teaching approaches that nurture students' academic growth and psychological well-being (Chen & Yang, 2019; Marsh et al., 2019; Shin, 2018). By understanding project-based learning's potential impact on self-concept, schools can design targeted interventions and curricular adjustments to foster a supportive learning environment that empowers students to thrive academically and personally (Chen & Yang; Marsh et al.; Shin). Secondly, the findings benefitted organizations and educational policymakers by offering insights into the long-term benefits of incorporating project-based learning into the curriculum. Understanding the link between project-based learning and self-concept informed resource allocation and supported professional development, ultimately enhancing teaching practices and student outcomes (Chen & Yang, 2019; Marsh et al., 2019; Shin, 2018). Furthermore, the study's significance extended to the general population, as it provided evidence of project-based learning's potential impact on self-concept during a critical stage of students' schooling. The research outcomes stimulated discussions on holistic educational practices that integrate students' emotional and cognitive growth, promoting well-rounded individuals who are equipped to face future challenges.

The focus on sixth-grade students was significant, addressing a gap in the literature regarding the developmental impact of project-based learning on younger students. Examining the effect of project-based learning on self-concept within sixth-grade students, the current study

offered valuable insights into how educational experiences shape self-perceptions, attitudes toward learning, and overall well-being (Chen & Yang, 2019; Marsh et al., 2019; Shin, 2018). Educators can facilitate opportunities for students to use project-based learning in classrooms, potentially improving their self-concept and the entire school system (Chen & Yang, 2019).

The significance of the present study rested in its potential to empower educators to foster students' self-concept through project-based learning implementation. Improving students' self-concept can lead to enhanced academic performance, positive social interactions, higher motivation, and improved emotional well-being and mental health (Chen & Yang, 2019; Marsh et al., 2019; Shin, 2018). Thus, the research positively impacted students' perceptions of themselves by providing teachers with knowledge and strategies to improve their self-concept.

Research Questions

RQ1: Is there a difference in reading self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of reading self-concept?

RQ2: Is there a difference in mathematics self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of mathematics self-concept?

RQ3: Is there a difference in all school subjects self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of all school subjects self-concept?

Definitions

1. *Academic Self-Concept* - An individual's perception and belief about their academic abilities, achievements, and competence compared to others *(*Haktanir et al., 2021).

2. *Overall Self-Concept* - An individual’s perception and evaluation of themselves across various domains, including social, academic, emotional, and physical aspects, resulting in a comprehensive and integrated self-view (Shavelson et al., 1976).
3. *Physical Self-Concept* - An individual’s perception and evaluation of their physical appearance, abilities, and health-related attributes, shaping their self-image about their body (Palenzuela-Luis et al., 2022).
4. *Project-Based Learning* - An instructional approach rooted in inquiry, where learners actively construct knowledge by completing meaningful projects and creating real-world products (Guo et al., 2020).
5. *Self-Concept* - An individual's perception and beliefs about themselves, encompassing their attributes, identity, and understanding of who they are (Baumeister, 1999).
6. *Self-Esteem* - An individual's comprehensive assessment of themselves, encapsulating their personal belief or understanding of how they are valued within society (Jiang et al., 2021).
7. *Social Self-Concept* - An individual’s perception and evaluation of social skills, relationships, and interactions, influencing their sense of identity within a social context (Shavelson et al., 1976).

CHAPTER TWO: LITERATURE REVIEW

Overview

The purpose of this literature review was to outline the core components of project-based learning and explore student self-concept, delving into the factors influencing its development. Additionally, it sought to examine the relationship between project-based learning and student self-concept. Commencing with the theoretical framework, this study grounded itself primarily in Rogers' (1978) self-concept theory, emphasizing individuals' innate drive for self-actualization (Rogers et al., 1978). Moreover, Piaget's constructivist learning theory was another fundamental aspect of this research. The review extensively covered literature relevant to project-based learning in educational contexts. It investigated its relationship with self-concept across various subjects, including reading, mathematics, and other school domains, culminating in a comprehensive summary.

Theoretical Framework

This section explains the two theories relevant to the study: self-concept theory and constructivist theory. Self-concept theory was a fundamental framework for comprehending how project-based learning potentially affects sixth-grade students' self-concept. Likewise, the constructivist theory illuminated that students are active participants in their learning, constructing their understanding through interactions with their environment. Through this lens, a deeper understanding was gained of how project-based learning can impact students' self-concept by actively involving them in the learning process, thereby providing insights into the potential benefits of project-based learning for developing self-concept among sixth-grade students.

Self-Concept Theory

The self-concept theory, closely associated with American psychologist, Rogers, developed over the mid-20th century, primarily in the 1950s and 1960s (Rogers et al., 1978). Rogers, a prominent figure in humanistic psychology, sought to understand and explain human behavior and motivation (Joseph, 2021). His theory of self-concept revolved around the idea that individuals have a fundamental need for self-actualization or becoming their best selves (Shavelson et al., 1976). In this framework, self-concept referred to an individual's perception of themselves and their self-worth, encompassing aspects, such as self-image, self-esteem, and self-identity (Shavelson et al., 1976).

Rogers's self-concept theory was primarily developed to address the core human need for self-perception (Bartnicka-Michalska & Oleś, 2022). The theory investigated self-perception, encompassing self-image, self-esteem, and self-identity (Shavelson et al., 1976). Rogers believed that when individuals experience congruence, where their self-concept aligns with their ideal of self or aspirations, they are more likely to experience personal growth, emotional well-being, and motivation (Rogers et al., 1978). Therefore, the theory was developed to provide a framework for understanding how self-concept influences various aspects of human life, from mental health and interpersonal relationships to academic and career success.

In the context of investigating project-based learning on sixth-grade students' self-concept, Rogers's self-concept theory was highly relevant. The theory emphasized the malleability of self-concept and how it could be influenced by external factors, including educational experiences like project-based learning (Rogers et al., 1978). It offered a theoretical lens through which the researcher investigated whether project-based learning, as an external factor, leads to a shift in sixth-grade students' self-concept. Additionally, the congruence aspect

of Rogers's theory aligned with the idea that project-based learning might contribute to students' self-concept becoming more congruent with their academic abilities, potentially boosting their confidence and motivation to excel in their studies. Thus, this theory provided a strong foundation for understanding the complex relationship between project-based learning and sixth-grade students' self-concept in reading and mathematics. Given the groundwork laid by self-concept theory in comprehending the impact of project-based learning on the self-concept of sixth-grade students, it was equally important to grasp the role of constructivist learning theory in this context.

The Constructivist Learning Theory

The constructivist learning theory, often associated with Swiss developmental psychologist, Piaget, also emerged in the mid-20th century, with Piaget's groundbreaking work conducted from the 1930s onward (Hendry et al., 1999). Piaget was recognized as the leading proponent of constructivism, although other educators and researchers have contributed to its development over time (Kritt & Budwig, 2022). The theory was developed to comprehensively understand how individuals construct knowledge and meaning from their experiences (Chuang, 2021). It posited that learning is an active, social, and cognitive process, emphasizing that students actively build their understanding of the world through interactions with their environment.

In examining how project-based learning affects student self-concept, the constructivist learning theory held a particular relevance. Constructivism aligned with the idea that students are not passive recipients of knowledge but instead are active participants in their learning process (Candra & Retnawati, 2020). Project-based learning, an educational approach emphasizing hands-on, inquiry-based learning, has been inherently constructivist in nature (Almulla, 2020). It

allowed students to engage with real-world problems, collaborate with peers, and construct their knowledge through exploration and problem-solving. Therefore, this theory was essential for the study since it provided a solid framework for understanding how project-based learning could affect students' self-concept by actively engaging them in the learning process (Guo et al., 2020).

Constructivism was particularly fitting for the study because it emphasized the importance of the social and cognitive aspects of learning. By participating in project-based learning activities, students interact with their peers, teachers, and environment (Almulla, 2020), which can significantly impact their self-concept. As students actively engage in project-based learning tasks, they experience a sense of accomplishment and a heightened sense of self-efficacy, which are integral components of self-concept (Schunk, 1989). Therefore, the constructivist learning theory offered a strong foundation for examining how project-based learning, as a constructivist approach, could influence students' self-concept in the context of sixth-grade education.

Related Literature

The purpose of this literature review was to examine and synthesize existing research related to the interplay between self-concept and project-based learning in secondary education. The review aimed to provide insights into the relationship between the potential effects of project-based learning on various aspects of sixth-grade students' self-concept, specifically their reading and mathematics self-concept. Furthermore, the review investigated how project-based learning influenced students' academic achievement, motivation, and self-efficacy in different subjects, as well as the role of self-concept in mediating or moderating these effects. By examining and synthesizing research across these interconnected areas, this literature review

sought to contribute to a deeper understanding of the complex dynamics between self-concept and project-based learning in the field of education.

Definition and Components of Self-Concept

In the section of this literature review, the definition of fundamental self-concept is explained, as well as the components of self-concept, its theoretical underpinnings, measurement tools, and previous research in the field of education. Self-concept referred to an individual's perception and beliefs about themselves, encompassing various dimensions of self-perception, self-esteem, and self-identity (Shavelson et al., 1976). Understanding the multifaceted nature of self-concept was essential for comprehending how it could be influenced by external factors like educational experiences.

Self-concept, a central construct in both psychological and educational research, has served as a foundational element in understanding how individuals perceive themselves and how they navigate the world around them (Moneva et al., 2020). At its core, self-concept encompassed the cognitive and emotional evaluations that individuals make about their own identity (Baumeister, 1999). These evaluations encapsulated a multitude of dimensions, such as academic self-concept, social self-concept, and physical self-concept, each of which shapes an individual's self-perception (Shavelson et al., 1976). Academic self-concept, for instance, pertained to one's self-assessment of one's abilities in an educational context, while social self-concept involved the evaluation of one's role within various social interactions (Wu et al., 2021). Additionally, physical self-concept related to how an individual perceives their physical appearance and abilities (Pérez-Mármol et al., 2021). This multifaceted nature of self-concept has emphasized its dynamic quality and alignment with self-concept theory, emphasizing the

idea that self-concept evolves as a result of one's experiences and interactions with the world (Shavelson et al., 1976).

In the context of academic and psychological development, self-concept has played a pivotal role. Academic self-concept, for example, can significantly affect a student's motivation, engagement, and overall academic performance (Guay et al., 2019). When students perceive themselves as capable and competent in their studies, they are more likely to be intrinsically motivated, approach learning tasks with confidence, and achieve better academic outcomes (Alamri et al., 2020). Conversely, low academic self-concept can hinder motivation and progress (Möller et al., 2020). Beyond academics, self-concept has also influenced psychological development by shaping an individual's self-esteem, emotional well-being, and sense of identity (Bogaerts et al., 2021). It impacts how one perceives one's place in the world and the extent to which one can cope with life's challenges (Bogaerts et al., 2021). Recognizing the interplay between self-concept, academic development, and psychological well-being has underscored the significance of further research and understanding in this area, which was crucial for educators and psychologists seeking to support individuals in their growth and development.

Review of Research on Variables that Influence Self-Concept

This section provides a comprehensive overview of several research studies that examined the relationship between self-concept and various influential factors. These studies have encompassed a wide range of themes, including motivation (Vaknin-Nusbaum et al., 2018), academic achievement (McArthur et al., 2020), cooperative learning (Agwu & Nmadu, 2023), reading abilities (Choi et al., 2019), foreign language learning, physical activities, creative experiences, and student perceptions (Wu et al., 2021). Despite their diversity in focus

and methodology, these studies have collectively emphasized the substantial roles that internal and external elements play in shaping individuals' self-concept.

This section presents a thorough examination of the intricate relationship between self-concept and various influencing factors, investigating the multidimensional nature of self-concept and its vulnerability to both internal and external influences. These investigations have resonated with self-concept theory, which posited that an individual's self-perceptions in various domains, such as academic, social, and physical, shape their self-concept (Shavelson et al., 1976). Furthermore, constructivist theory, which investigated the role of social interactions, motivation, and experiential learning in constructing knowledge, aligned with the studies exploring the influence of pedagogical strategies, motivation, and creative experiences on self-concept (Hendry et al., 1999).

Contemporary educational investigations have embraced diverse pedagogical approaches, aligning with constructivist theory's emphasis on active learning and social interactions in knowledge construction (Hendry et al., 1999; McBreen & Savage, 2021). Approaches, such as personalized learning experiences, peer collaboration, and intrinsic motivation (McBreen & Savage, 2021), have reflected a shift toward student-centered education, empowering learners to construct their knowledge. These strategies have promoted the development of self-concept by tailoring education to individual strengths and interests (McBreen & Savage, 2021) and fostering social learning, communication skills, and shared understanding.

Intriguingly, studies like one by Marsh and Craven (2006) investigated the multidirectional and domain-specific relationship between self-concept and performance, echoing self-concept theory’s notion that self-perceptions can influence one’s performance. Similarly, Agwu and Nmadu’s (2023) research on cooperative learning emphasized its positive

impact on self-concept and aligned with constructivist theory's focus on collaborative learning for building understanding. Furthermore, Perinelli et al. (2022) and McArthur et al. (2020) investigated the connections between academic achievement, self-concept, and changes in self-perceptions, reinforcing the interplay between learning outcomes and self-concept. Perinelli et al. specifically conducted a study on academic self-concept change in junior high school students and its relationships with academic achievement, providing valuable insights into the dynamics of academic self-concept in this demographic. The results of Perinelli et al.'s (2022) study revealed significant associations between changes in academic self-concept and academic achievement among junior high school students, showing the importance of considering self-concept dynamics in educational settings. Meanwhile, McArthur et al. (2020) conducted a systematic review and meta-analysis on self-concept in poor readers, providing comprehensive insights into the self-concept of individuals with reading difficulties. The study's findings revealed significant associations between poor reading and lower self-concept across various domains, emphasizing the effect of reading difficulties on individuals' self-perception (McArthur et al., 2020). Additionally, Vaknin-Nusbaum et al. (2018) conducted a study on student motivation and self-concept in low-achieving students using a structural equation modeling approach, providing insights into the complex interplay between motivation and self-concept in the context of academic performance. The findings of Vaknin-Nusbaum et al.'s (2018) study revealed significant relationships between student motivation, self-concept, and academic achievement and the importance of understanding these factors in supporting low-achieving students.

Collectively, these studies (McArthur et al., 2020; Vaknin-Nusbaum et al., 2018) have deepened the understanding of how the multifaceted nature of self-concept has been influenced

by a variety of educational and psychological factors, aligning with self-concept theory's and constructivist theory's principles. They examined the importance of considering self-concept as a dynamic construct shaped by multiple elements, thereby contributing to the complex dynamics of educational and psychological processes. This reinforced the need for continued exploration to unravel the intricate mechanisms underlying the formation and evolution of self-concept, providing valuable insights for educators, researchers, and policymakers in promoting holistic student development (McArthur et al., 2020; Vaknin-Nusbaum et al., 2018).

How Self-Concept Can Change Over Time

Self-concept, as previously discussed, has been a multifaceted construct influenced by various factors. These factors can be instrumental in shaping how self-concept changes over time (Marsh et al., 2019). One prominent factor has been academic performance and experience. If students consistently excel in their studies and receive positive feedback, their self-concept tends to be higher (Li et al., 2020). Conversely, if they encounter challenges or academic setbacks, it can lead to a lower self-concept (McArthur et al., 2020). These experiences have aligned with self-concept theory, which posited that individuals' self-perceptions evolve in response to their achievements and experiences (Marsh et al., 2019). Constructivist learning theory has played a crucial role in this context, as it emphasized creating educational environments that encourage active learning, problem-solving, and the application of knowledge (Şenler, 2022). Constructivist pedagogies can provide students with opportunities to succeed, fostering a positive self-concept as they engage in real-world challenges and achieve personal growth (Saeed, 2022).

Social interactions have also significantly influenced self-concept and its potential for change (Harris & Orth, 2020). Positive and supportive relationships with peers, teachers, and family members can boost self-concept by offering encouragement and validation (Pellerone et

al., 2023). In contrast, negative social interactions, such as bullying or a lack of support, can erode self-concept (Harris & Orth, 2020). Self-concept theory presented the role of social feedback and experiences in self-perception, with constructive social interactions reinforcing positive self-concepts (Corsano et al., 2022). In this regard, constructivist learning theory has encouraged cooperative and collaborative learning, which can create an environment of support and teamwork, fostering positive social interactions and, subsequently, a higher self-concept (Azhari et al., 2020). In sum, the factors influencing self-concept can significantly impact how it changes over time, with self-concept theory and constructivist learning theory providing a lens through which to understand the dynamic interplay between these factors and evolving self-perceptions.

Measuring Self-Concept

Assessing self-concept involves a variety of measurement tools, with the modified SDQ-I being one commonly used instrument (Hay et al., 1997). The SDQ-I is a multidimensional instrument designed to assess various facets of self-concept, including academic, social, and emotional dimensions (Arens & Morin, 2016). It was developed by Marsh in 1982 and has been widely used in educational and psychological research to measure students' self-perceptions across different domains (Alkhateeb et al., 2022; Hay et al., 1997). The SDQ-I comprises multiple subscales that delve into different aspects of self-concept, allowing researchers and psychologists to comprehensively assess how individuals perceive themselves in specific domains (Marsh, 1990). In this section, the history and development of this widely used instrument are discussed.

Marsh et al.'s (1991) study centered on understanding the self-concepts of young children aged five to eight years old, emphasizing both the measurement techniques and the

multidimensional structure of self-concept. This research was pivotal in laying the groundwork for assessing self-concept in younger age groups, exploring the complexities of how these children perceive themselves across various domains (Marsh & Hocevar, 1991). The SDQ-I underwent modifications following insights gleaned from studies, such as Marsh et al. (1991). Initially designed for older populations, the adaptation of the SDQ-I aimed to cater to younger age groups, particularly elementary and early childhood, by making the questionnaire more comprehensible and relevant to their developmental stage (Marsh et al., 1998). The changes involved simplifying language, adjusting response scales, and incorporating age-appropriate examples and visuals to ensure that children in the five-to-eight-year age range could effectively engage with the questionnaire (Marsh et al., 1998). The modification was crucial to enhance the reliability and validity of assessing self-concept in younger children, aligning the questionnaire with their cognitive and emotional development while preserving its accuracy and effectiveness in measuring self-perception.

Additionally, Marsh et al.'s (1998) research delved into the intricate evolution of self-concepts among young children. Their study encompassed various cohorts and multiple occasions, aiming to unravel the structural patterns and developmental trajectories of self-concept during crucial formative years. This research contributed significantly to understanding how self-perception forms, evolves, and stabilizes throughout early childhood. Additionally, insights from studies like Marsh et al. have played a role in the modification of the SDQ-I. As research expanded its focus on the self-concept of younger children, the need arose to adapt assessment tools like the SDQ-I to cater to this age group more effectively. Modifications to the SDQ-I involved simplifying language, adjusting response scales, and incorporating age-appropriate examples and visuals, ensuring accurate measurement of self-concept in young

children while considering their developmental stage and cognitive abilities. This adaptation was crucial to enhance the questionnaire's applicability and validity in assessing self-perception among children in their early developmental years (Marsh et al., 1998).

In the domain of education, the SDQ-I has been a valuable tool for understanding self-concept among middle school students (Huebner et al., 1999). Research utilizing this instrument has emphasized its role in uncovering the intricate relationship between self-perception and academic achievement during the crucial middle school years (Skaalvik & Skaalvik, 2006). The use of the SDQ-I in middle school has been the focus of several studies, emphasizing the various aspects of students' experiences and perceptions. For instance, Bain and Bell (2004) conducted a study comparing social self-concept, social attributions, and peer relations in fourth, fifth, and sixth graders who are gifted versus high achievers. The results indicated that gifted students demonstrated higher levels of social self-concept and more positive social attributions compared to high achievers. Additionally, the study found that gifted students exhibited more positive peer relations than high achievers (Bain & Bell, 2004). Marsh et al. (1999a) conducted a study focusing on the separation of competency and effect components of multiple dimensions of academic self-concept, which comprised distinct components, including competency and effect, which evolve over time. The findings indicated that as children develop, their academic self-concept becomes more differentiated, with separate components for competency and effect (Marsh et al.). This developmental perspective provided valuable insights into the multidimensional nature of academic self-concept and its evolution across different stages of childhood and adolescence (Marsh et al., 1999b).

Niehaus and Adelson's (2013) study investigated the intricacies of self-concept among third-grade students, specifically examining how native language backgrounds influence this

aspect of self-perception. Their research focused on measurement invariance and cross-group comparisons, aiming to uncover whether the measurement of self-concept remains consistent across different native language groups. Through meticulous analysis, the researchers aimed to ascertain whether the self-concept measures applied equally and accurately across diverse language backgrounds, shedding light on potential variances in self-perception among third-grade students (Niehaus & Adelson, 2013). The current study's findings significantly contributed to understanding the interplay between language, culture, and self-concept, offering valuable implications for educational practices catering to diverse student populations.

The integration of the adapted SDQ-I within the ECLS-K study provided a comprehensive view of the self-concept development of young learners, aligning with constructivist theory's emphasis on active exploration and experiential learning. Pollack et al. (2005) explained how the instrument enabled researchers to investigate the interplay between self-concept and various developmental factors, such as academic, social, and emotional growth, aligning with the constructivist notion that knowledge is constructed through interaction with the environment. This comprehensive examination extended to tracking students' self-perceptions across various domains, reflecting the constructivist principle that learning is a multifaceted process influenced by social interactions, experiences, and self-perceptions (Pollack et al., 2005; Tourangeau et al., 2009). The SDQ-I's role in elucidating how early self-perceptions can influence children's educational trajectories resonated with constructivist theory's emphasis on the dynamic nature of knowledge construction and its impact on learners' well-being.

Project-Based Learning in Education

Project-based learning is an innovative educational approach that centers on students engaging in real-world projects, typically collaborative in nature, to address complex problems

or questions (Duke et al., 2021). In project-based learning, learners are presented with an authentic, open-ended challenge that requires them to investigate, problem-solve, and create solutions (Tamim & Grant, 2013). The principles of project-based learning encompass students taking ownership of their learning, working on projects that have real-world relevance, and developing critical thinking, collaboration, and communication skills (Sukackė et al., 2022). By immersing students in hands-on, inquiry-based experiences, project-based learning aims to create an environment where learners actively construct knowledge and meaning from their experiences (Chen, 2021).

This section offers a comprehensive examination of project-based learning through various research studies, shedding light on its multifaceted impact on education. Chen and Yang's (2019) meta-analysis and Yunita et al.'s (2021) comprehensive review collectively underscored the numerous advantages and positive outcomes associated with project-based learning within educational contexts. This synthesis was closely aligned with self-concept theory and constructivist theory, as project-based learning's student-centered approach has resonated with constructivist principles, enabling active learning, problem-solving, and collaborative exploration, all of which have played a role in shaping students' self-concept and educational experiences.

The research findings have consistently reported on project-based learning's favorable impact on various educational aspects. Chen and Yang's (2019) meta-analysis, for instance, revealed project-based learning's link to improved academic achievement across different subjects and age groups, reinforcing self-concept theory's idea that students' self-perception can significantly influence their educational outcomes. Yunita et al. (2021) conducted a systematic literature review to investigate the effectiveness of the project-based learning model in enhancing

students' mathematical ability, providing insights into the positive impact of project-based learning on students' mathematical skills. Utari and Afendi (2022) also conducted a study on the implementation of project-based learning in an elementary school. The results indicated that project-based learning provided the students with enjoyable and interactive learning experiences, offering flexibility and direct engagement with the environment (Utari & Afendi, 2022).

Furthermore, the implementation of project-based learning fostered a dynamic and effective educational approach, resonating with both self-concept theory and constructivist theory. As educators plan and facilitate project-based learning projects, they create a supportive environment where students actively engage with real-world problems, shaping their self-concept, learning experiences, and skill acquisition (Almulla, 2020). In an ever-evolving educational landscape, this synthesis of research findings has deepened our understanding of project-based learning's potential to reshape learning experiences and foster holistic student growth in the 21st century by integrating self-concept and constructivist perspectives.

Comparison of Project-Based Learning to Traditional Learning Methods

The comparison between project-based learning and traditional learning methods had a central theme in the reviewed literature, providing insights into their distinctive features and outcomes. Traditional learning has primarily relied on teacher-led instruction and content delivery (Arqub et al., 2023), often resulting in passive learning experiences for students. In contrast, project-based learning has emphasized student-centered exploration, hands-on projects, and real-world problem-solving, aligning closely with constructivist learning theory (Sukackė et al., 2022). The constructivist theory asserted that knowledge is actively formed by learners as they engage with their experiences and interact with the world (Maroš et al., 2023). Project-

based learning aligned with this theory by encouraging students to engage actively in problem-solving, collaborate with peers, and construct knowledge through practical experiences.

Within the literature, several studies have illustrated the advantages of project-based learning over traditional learning approaches. A study by Bravo et al. (2021) investigated the effect of project-based learning on the academic performance of middle school students. The research employed various methods, including qualitative documentary bibliographic review and the inductive-deductive method, to characterize project-based learning and analyze the academic results of students (Bravo et al., 2021). Kucharski et al.'s (2005) investigation into elementary project-based learning emphasized the positive impact of project-based learning on academic achievement and satisfaction. These findings aligned with self-concept theory, emphasizing that positive learning experiences and achievement contribute to an individual's self-concept. Furthermore, Shin's (2018) study on English language learning demonstrated how project-based learning can enhance motivation and self-efficacy. The studies reviewed by Mohamad and Tamer (2021) provided valuable insights into the effect of project-based learning on students' self-efficacy and attitudes, showcasing how project-based learning fosters enhanced confidence, interest, and enjoyment in learning.

While the reviewed literature revealed the benefits of project-based learning in terms of academic achievement (Kucharski et al., 2005), motivation (Shin, 2018), and self-efficacy (Mohamad & Tamer, 2021), a gap has remained in research concerning the impact on self-concept, particularly in sixth-grade students and rural settings. This gap emphasized the need for further exploration, as self-concept theory and constructivist learning theory suggested that holistic and context-dependent learning experiences can significantly shape students' self-concept. The studies collectively underlined project-based learning's potential to foster higher-

order thinking, motivation, and holistic learning experiences, calling for future research to investigate its mechanisms and long-term effects on students' self-concept (Shin, 2018).

Curriculum Principles

This section investigates the foundational principles of project-based learning and their application within educational contexts, emphasizing how project-based learning transcends disciplinary boundaries. Darling-Hammond (2008) provided guidelines for creating meaningful, driving questions and aligning project-based learning with curriculum and pedagogical approaches. This exploration investigated the core principles of project-based learning and their implications for curriculum design and implementation. In this section, the majority of the literature focused on pedagogical guidance rather than presenting research findings.

A fundamental aspect of project-based learning has been the formulation of a compelling driving question, which guides the entire project. Krajcik and Shin (2014) emphasized that a well-crafted driving question acts as a focal point, guiding students to explore, elaborate, and seek answers throughout the project. This question should be both feasible and meaningful, providing context and ethical significance to the project (Markula & Aksela, 2022). Revisiting the driving question aids students in deepening their understanding and achieving their learning goals. Targeting significant learning goals has been a cornerstone of effective project-based learning design. Project-based learning should impart essential academic content while fostering broader skills like critical thinking and collaboration (Buck Institute for Education, 2023). Incorporating authentic concepts related to the project's central problem enhances students' connection to real-world issues. The curriculum should align seamlessly with state standards, ensuring that learning objectives are communicated clearly to students. Time allocation also plays a vital role in project-based learning's effectiveness, requiring a dedicated approach rather

than superficial integration (Guo et al., 2020). Project-based learning should serve as the main course of the curriculum, guiding instruction throughout the entire course (Chen & Yang, 2019). The balance between project-based learning and other instructional strategies is crucial, with project-based learning driving curriculum and instruction.

Incorporating project-based learning within educational contexts has necessitated meticulous attention to its core design principles (Buck Institute for Education, 2023). Crafting meaningful driving questions, targeting significant learning goals, aligning with standards, and ensuring dedicated time allocation have all contributed to successful project-based learning implementation (Hafeez, 2021). As educators navigate the complex interplay between curriculum design and pedagogical execution, the holistic benefits of project-based learning on student learning (Chen & Yang, 2019) and self-concept become apparent, enhancing motivation and fostering deeper engagement in authentic learning experiences. These principles aligned with self-concept theory by empowering students to take an active role in their learning, which, in turn, influences their self-perception and motivation, while also aligning with constructivist learning theory, which emphasized experiential and problem-based approaches as effective means of deepening understanding and skill development.

Gold Standard Project-Based Learning

This section delves into three distinct research studies that incorporate the Gold Standard Project-Based Learning model across various educational settings. For an in-depth understanding of the Gold Standard Project-Based Learning methodology, please refer to Appendix A, which provides extensive details on this approach coined by the Buck Institute for Education (2023). This framework set high standards for project-based learning implementation, emphasizing criteria that ensured rigorous and meaningful educational experiences for students. The Gold

Standard Project-Based Learning focused on essential elements like authentic problem-solving, inquiry-based exploration, collaboration, and presenting findings to real audiences. It aligned with Bloom's Taxonomy, fostering critical thinking and application of knowledge within authenticity. The framework also incorporated elements, such as sustained inquiry, student autonomy, reflection, critique and revision, and public presentation of learning, all aimed at enhancing students' engagement and comprehension while integrating diverse perspectives. The detailed insights in Appendix A offer a comprehensive understanding of this impactful pedagogical approach and its alignment with higher-order cognitive processes.

Sayuti et al. (2020) concentrated on the utilization of Gold Standard Project-Based Learning techniques to assess students' English-speaking proficiency both prior to and following the implementation of Gold Standard Project-Based Learning. The findings of the study determined the effectiveness of the learning model in enhancing the learning process. Similarly, a study by Quinn (2019) investigated the implementation of Gold Standard Project-Based Learning to engage and motivate mixed-ability first-class children in the writing process. The findings of the study determined that the Gold Standard Project-Based Learning model enhanced student engagement and motivation in writing (Quinn, 2019). Together, these studies collectively emphasized the efficacy of Gold Standard Project-Based Learning in enhancing understanding, critical thinking, and collaborative skills. They investigated the potential of Gold Standard Project-Based Learning to address diverse educational challenges, such as online learning, mixed-ability classrooms, and sustainable design. However, they also underscored the need for further investigation into its broader applicability and the impact of participant demographics.

The integration of self-concept theory and constructivist learning theory into these studies enhanced the understanding of how Gold Standard Project-Based Learning can shape students'

self-concept (Quinn, 2019). By employing Gold Standard Project-Based Learning strategies that promote active engagement, critical thinking, and collaboration, these studies aligned with constructivist learning principles, which emphasized students' active involvement in constructing their knowledge (Loyens et al., 2023). As students work on authentic, complex projects in a Gold Standard Project-Based Learning framework, they not only acquire subject-specific skills but also enhance their self-concept by gaining confidence in their abilities and understanding the relevance of their learning (Buck Institute for Education, 2023). This integration of self-concept theory related to how Gold Standard Project-Based Learning can contribute to the holistic development of students, strengthening their self-perception and motivation within diverse educational contexts.

Research on How Project-Based Learning Affects Grades, Motivation, and Self-Efficacy

The investigation of project-based learning and its effects on students' academic achievement and motivation among different age groups aligned with self-concept theory and constructivist theory. Self-concept theory posited that individuals' self-perceptions evolve over time and are influenced by external factors, educational experiences, and personal achievements (Marsh, 1990). Furthermore, constructivist theory emphasized the importance of active learning and experiential knowledge construction (Chuang, 2021). Project-based learning, as an instructional approach that encourages students to engage in real-world problem-solving and collaborative projects, aligned with constructivist principles, as it fostered students' active exploration and knowledge construction.

The studies revealed variations in their focus on project-based learning's influence on academic achievement, motivation, and self-concept. While all the studies examined the effects of project-based learning on academic achievement and motivation, only a few examined self-

concept, emphasizing a gap in the existing research. The studies by Duke et al. (2021) and Halvorsen et al. (2012) focused on academic achievement and motivation among low socioeconomic status students, emphasizing the potential of project-based learning to enhance achievement and motivation in such settings. Similarly, Çakıcı and Türkmen (2013) examined the effect of project-based learning on science achievement and attitude, indicating that project-based learning positively affects both aspects, leading to improved academic performance and a more positive attitude towards science among children (Çakıcı & Türkmen, 2013). Additionally, Karaçalli and Korur (2014) investigated the retention of knowledge and academic achievement in the context of electricity, illustrating that project-based learning leads to improved knowledge retention. Han et al. (2016) investigated the effect of science, technology, engineering, and mathematics (STEM) project-based learning on Hispanic and at-risk students' academic achievement, with results indicating a positive influence on Hispanic students. Finally, Bilgin et al. (2015) studied the impact of project-based learning on academic achievement and self-efficacy beliefs, showing that project-based learning enhanced both aspects. The common thread in these studies was the positive effect of project-based learning on academic achievement and motivation.

In contrast, these studies also presented a gap in research concerning project-based learning's effect on self-concept, especially among younger students, which emphasized the need for further exploration. While project-based learning's potential to enhance academic achievement and motivation has been well-documented, its influence on self-concept has been less thoroughly studied, particularly in the context of rural sixth-grade students. This gap pointed to the necessity for future research that could provide a more comprehensive understanding of project-based learning’s transformative impact, particularly in terms of self-concept

development, aligning with self-concept theory's emphasis on the evolving nature of self-perceptions and constructivist theory's call for active, context-dependent learning experiences.

Relationship Between Self-Concept, Self-Efficacy, and Project-Based Learning

Various studies have separately but intricately linked self-concept, self-efficacy, and project-based learning, revealing their interdependence and effect on learning outcomes. Both self-concept and self-efficacy play pivotal roles in shaping a person's motivation, resilience, and approach to learning. Although extensive studies have examined the connection between self-efficacy and project-based learning, there has been no specific research investigating how project-based learning affects students' self-concept.

Research has shown that self-efficacy is closely related to students' engagement and success in project-based learning (Shin, 2018). When students have a positive self-concept, they develop a strong belief in their abilities and are more likely to take on challenging tasks (Hamachek, 1995). This confidence in their own capabilities leads to higher levels of self-efficacy, which in turn, enhances their motivation and persistence in project-based learning activities (Saepuloh & Suryani, 2020). For example, a study conducted by Krsmanovic (2021) found that students with higher self-efficacy were not only more likely to engage in project-based learning but to also achieve better outcomes.

By engaging in authentic and meaningful projects, students can apply their knowledge and skills in real-world contexts (Boss & Krauss, 2018). This hands-on experience allows the students to witness the direct effect of their efforts (Ngereja et al., 2020), which can significantly boost their self-efficacy. In project-based learning, students are often given the freedom to choose their own topics or projects, which allows them to explore their interests and passions (Boss & Krauss, 2018). This autonomy and ownership over their learning can greatly contribute

to the development of a positive self-concept (Anderson et al., 2021). When students are able to pursue projects that align with their interests, they feel a sense of competence and accomplishment, which in turn, enhances their self-efficacy (Al-Abyadh & Abdel Azeem, 2022). Additionally, project-based learning often involves collaboration and teamwork, which provides opportunities for students to develop their interpersonal skills and build positive relationships with their peers (Syahril et al., 2021). These positive social interactions can further enhance students' self-concept and self-efficacy.

In conclusion, self-concept, self-efficacy, and project-based learning are interconnected and mutually reinforce concepts in education. A positive self-concept and high self-efficacy can greatly enhance students' engagement and success in project-based learning. On the other hand, project-based learning can also contribute to the development of a positive self-concept and self-efficacy. Therefore, it is essential for educators to create a supportive and empowering learning environment that nurtures students' self-beliefs and provides ample opportunities for meaningful project-based learning experiences. By doing so, educators can foster students' confidence, motivation, and persistence, ultimately leading to their overall academic and personal growth.

Differentiating Self-Concept and Self-Efficacy

Self-concept and self-efficacy are two important psychological constructs that play a significant role in shaping an individual’s behavior and perception of themselves. Self-concept referred to an individual’s belief about their own attributes and how they evaluate these qualities, influencing their perceived self (Fitrayanti & Purwanto, 2020). On the other hand, self-efficacy pertained to an individual’s confidence in their ability to perform behaviors that lead to desired outcomes (Hall et al., 2023). Thus, while self-concept focused on the individual’s perception of

themselves, self-efficacy was more about their belief in their capabilities to achieve specific goals or outcomes (Khan et al., 2020).

Self-concept encompassed various dimensions, such as academic, social, and professional self-concept, which contributed to an individual's overall self-perception (Xu et al., 2023). In contrast, self-efficacy was domain-specific and task-oriented, emphasizing the belief in one's ability to produce desired results in a particular area of functioning (Penalo & San, 2021). Both self-concept and self-efficacy have been influenced by personal and psychological factors, with self-efficacy being a crucial concept in understanding how individuals manage stress and challenges in various roles, such as caregiving (Khan et al., 2020). Bong and Skaalvik's (2003) research focused on academic self-concept and self-efficacy, underlining their distinct nature and providing insights for educators and researchers to better understand students' beliefs and motivations in academic settings.

In summary, self-concept revolved around an individual's beliefs and evaluations of their attributes, while self-efficacy focused on an individual's confidence in their ability to perform specific behaviors to achieve desired outcomes. Both constructs have been essential in understanding human behavior and motivation, with self-concept shaping an individual's overall self-perception and self-efficacy influencing their belief in their capabilities to achieve specific goals or outcomes.

How Self-Concept and Self-Efficacy Interact and Influence One Another

Self-concept and self-efficacy have been intertwined psychological constructs that mutually influence one another, creating a dynamic interplay in an individual's self-perception and motivation (Wang & Yu, 2023). Self-concept, encompassing the individual's overall perception of themselves, has included factors like identity, values, and beliefs about various

aspects of life. This self-perception significantly influences self-efficacy, as one's sense of competence and self-worth, derived from self-concept, shapes their belief in their ability to succeed in specific tasks or domains (Habrat, 2013). When an individual holds a positive self-concept, seeing themselves as capable and worthy, it often leads to higher self-efficacy (Marsh et al., 2019). This, in turn, promotes a greater willingness to engage in challenging tasks, persevere in the face of adversity, and approach goals with confidence (Marsh et al., 2019).

Self-efficacy has also played a significant role in shaping self-concept (Marsh et al., 2019). As individuals achieve success and experience mastery in various tasks, their self-efficacy grows (Yeh et al., 2019). These accomplishments contribute positively to their self-concept, bolstering their perception of competence and worthiness. On the other hand, repeated failures or a lack of success can undermine self-efficacy and, subsequently, negatively affect self-concept (Marsh et al., 2019). When individuals continuously encounter setbacks and believe that they lack the ability to excel, it can lead to a diminished self-concept characterized by self-doubt and low self-esteem (Marsh et al., 2019). This intricate interaction between self-concept and self-efficacy underscored the importance of nurturing both constructs simultaneously to promote individuals' overall well-being, motivation, and capacity to succeed in various life domains.

Research on How Project-Based Learning Affects Grades, Motivation, and Self-Efficacy in Reading

The relationship between project-based learning and academic achievement, self-efficacy, motivation, and attitude in reading has been an important topic for educators and policymakers. While there has been ample research in the field, there has still been a lack of understanding when it comes to the effects of project-based learning on reading self-concept among sixth-grade students. This section seeks to investigate the relationship between project-

based learning and reading self-efficacy, motivation, attitude, and academic achievement. The focus has been on increasing self-concept within reading for sixth graders, while also noting that self-concept and reading have not been studied together, leaving a gap in the literature.

Reading self-concept has been a psychological construct that expresses beliefs that individuals have about their own reading skills (Sewasew & Koester, 2019). It has been an important predictor of academic success and has been found to be connected to academic achievement (Sewasew & Koester, 2019). Studies have found that students with strong reading self-concept are more successful in various areas, including reading comprehension (Locher et al., 2021). Reading self-concept has been a key factor in how children view themselves as learners and affect their attitude and performance in reading (Locher et al., 2021).

While the connection between project-based learning and reading self-concept has been unexplored in the literature, existing research has extensively examined the impact of project-based learning on diverse aspects of reading. The investigation into how project-based learning influences motivation (Duke et al., 2021; Shin, 2018), attitude (Baş & Gezegin, 2015), and self-efficacy (Shin, 2018) in the reading context has revealed a varied perspective. Some studies have indicated a positive correlation between project-based learning experiences and reading self-efficacy (Shin, 2018), motivation (Duke et al., 2021; Shin, 2018), and attitudes (Baş & Gezegin, 2015).

These findings emphasized that engaging in project-based learning activities, particularly those requiring substantial reading and comprehension, can enhance students' perception of their reading abilities. However, it was essential to recognize that reading self-concept is influenced by a range of factors beyond project-based learning, including prior experiences (Haas & vanDellen, 2020) and motivation (Möller et al., 2020). This complexity underscored the need for

educators to consider multiple elements when aiming to nurture a positive reading self-concept. The multifaceted nature of reading self-concept has emphasized the importance of continued research to deepen the understanding of the intricate interplay between project-based learning and reading self-concept, ultimately contributing to more effective educational strategies.

Constructivist learning theory and self-concept theory have played essential roles in understanding this relationship. Constructivist learning theory presented the idea that individuals construct knowledge through active engagement with meaningful tasks (Lombardi et al., 2021). Project-based learning, as an approach rooted in constructivist principles, has offered a context for students to apply their reading skills to solve real-world problems actively (Jumaat et al., 2017), which can boost their reading self-concept. Additionally, self-concept theory emphasized the role of personal experiences and achievements in shaping self-perceptions (Davidson & Lang, 1960).

Project-based learning has been shown to have a positive effect on students' reading self-efficacy, motivation (Duke et al., 2021; Shin, 2018), attitude (Baş & Gezegin, 2015), and academic achievement (Sewasew & Koester, 2019). While there has still been a gap in the literature when it comes to the relationship between project-based learning and reading self-concept, the evidence has suggested that project-based learning can have a positive effect on students' reading self-efficacy, motivation, attitude, and academic achievement. As such, project-based learning may also be a useful tool for increasing students' self-concept in reading.

How Project-Based Learning Connects Mathematics Self-Efficacy, Motivation, Attitude, and Grades

Project-based learning has been found to be a beneficial teaching method, especially in the mathematics classroom (Xiong, 2021). Recent studies have investigated the effects of

project-based learning on students' mathematics self-efficacy, motivation, attitude, and academic achievement (Holmes & Hwang, 2016; Suciati et al., 2020). These higher levels of confidence and achievement can then lead to a higher self-concept in mathematics (Shanley et al., 2019). However, there has still been a gap in the literature where the effect of project-based learning on mathematics self-concept in sixth-grade students has not been studied. Throughout this section, the relationship between project-based learning and mathematics self-efficacy, motivation, attitude, and academic achievement in sixth-grade classrooms is investigated.

There has been evidence that project-based learning activities can help enhance student mathematics self-efficacy. Self-efficacy in mathematics has been defined as an individual's belief in their own capability to successfully complete tasks, such as solving math problems (Hoffman, 2010). Research has further found that project-based learning activities can lead to higher motivation in mathematics for students (Tyata et al., 2021). By experiencing success in project-based learning activities, students may be motivated to engage in mathematics more openly (Remijan, 2017). The collaborative nature of the activities can also foster an environment of higher engagement as students help one another (Volet et al., 2009). This encourages meaningful dialogue and makes mathematics more enjoyable for students (Xiong, 2021).

Project-based learning can enhance feelings of mastery, leading to greater mathematics self-efficacy in students (Nurbavliyev et al., 2020). These enhancements have contributed to an overall improved attitude and academic achievement as well (Alpacion et al., 2014). Görgün and Tican (2020) found that students exposed to project-based learning in middle school mathematics classes reported higher self-efficacy in mathematics. This suggested that project-based learning can empower students to believe in their ability to tackle mathematics challenges successfully (Pajares & Miller, 1994). Additionally, project-based learning has been associated with a higher

level of motivation and positive attitudes toward mathematics (Shin, 2018). A study by Johnson (2021) demonstrated that students engaged in project-based learning mathematics projects displayed higher levels of motivation and a more favorable attitude towards mathematics compared to their peers in traditional classroom settings (Tyata et al., 2021). This was significant, as motivation and attitude play pivotal roles in shaping students' engagement and success in mathematics.

Despite the accumulating evidence on the positive effects of project-based learning on mathematics self-efficacy, motivation, attitude, and academic achievement, there has been a noticeable gap in research when it comes to exploring the impact of project-based learning on self-concept, specifically in the context of mathematics. Self-concept theory posited that students' perceptions and beliefs about their abilities significantly influence their educational outcomes. As such, it was reasonable to assume that if project-based learning can enhance mathematics self-efficacy, it could also have a positive influence on students' broader self-concept, which encompasses various dimensions of self-perception.

Project-Based Learning's Effect on Students' Self-Efficacy, Motivation, Attitude, and Grades in All School Subjects

The relationship between project-based learning and students' self-efficacy, motivation, attitude, and academic achievement in all school subjects has garnered growing interest. Numerous studies have investigated how the project-based learning approach can affect students' self-perception, motivation (Beier et al., 2019), attitude (Al-Balushi & Al-Aamri, 2014), and overall performance across a range of academic subjects (Bravo et al., 2021; Geier et al., 2008). Researchers have found that students engaged in project-based learning activities reported higher

self-efficacy and motivation not only in mathematics (Hammad et al., 2022) but also in other subjects like science and social studies (İlter, 2014).

Moreover, project-based learning has been linked to positive attitudes toward all school subjects. Research by Chen et al. (2021) and Condliffe et al. (2017) both showed that students who participated in project-based learning projects in middle school exhibited more favorable attitudes and enthusiasm toward a wide range of subjects. Chen et al.'s research also found that students who engaged in project-based learning outperformed their peers, who were not exposed to project-based learning in all core academic subjects. This demonstrated the potential of project-based learning to foster a love for learning and a positive disposition across the academic spectrum (Chen et al., 2021). Project-based learning's student-centered approach, which promotes active learning, problem-solving, and collaborative exploration, has resonated with the principles of constructivism. In a project-based learning environment, students construct knowledge by applying their skills and understanding to solve complex, real-world problems (Mioduser & Betzer, 2008). This alignment with constructivist learning theory presented the potential for project-based learning to create a conducive environment for comprehensive student development across all academic subjects. However, more research has been needed to thoroughly investigate and validate this connection and its implications for self-concept.

Despite the evidence pointing to the beneficial impact of project-based learning on self-efficacy, motivation, attitude, and academic achievement in various school subjects, there has remained a dearth of research when it comes to exploring the impact of project-based learning on students' self-concept across all subjects. Self-concept theory has emphasized that students' perceptions and beliefs about themselves can significantly influence their educational outcomes. In light of the favorable impact of project-based learning on self-efficacy, it was reasonable to

conclude that it also had the potential to positively shape students' broader self-concept, involving their self-perception and confidence in various subjects.

Summary

This literature review examined the relationship between self-concept and project-based learning in secondary education, specifically focusing on sixth-grade students' reading and mathematics self-concept. Self-concept referred to an individual's perception and beliefs about themselves, encompassing various dimensions of self-perception, self-esteem, and self-identity (Shavelson et al., 1976). Understanding the multifaceted nature of self-concept was crucial for comprehending how it can be influenced by external factors like educational experiences.

The review explored the factors that influence self-concept, including motivation, academic achievement, cooperative learning, reading abilities, and student perceptions. These studies collectively emphasized the substantial roles that internal and external elements play in shaping individuals' self-concept. Constructivist theory, which presented the role of social interactions, motivation, and experiential learning in constructing knowledge, aligned with the studies exploring the influence of pedagogical strategies, motivation, and creative experiences on self-concept.

Project-based learning, an innovative educational approach, has centered on students engaging in real-world projects to address complex problems (Shin, 2018). The review investigated the impact of project-based learning on academic achievement, motivation, self-efficacy, and self-concept in different subjects. The studies revealed the positive effects of project-based learning on academic achievement, motivation, and self-efficacy. However, there was a gap in the research regarding the impact of project-based learning on self-concept, particularly in sixth-grade students and rural settings.

The review also explored the principles of project-based learning, including the formulation of compelling driving questions, targeting significant learning goals, aligning with standards, and ensuring dedicated time allocation. These principles aligned with self-concept theory and constructivist learning theory, as project-based learning empowers students to take an active role in their learning and construct knowledge through meaningful tasks.

Overall, this literature review provided insights into the complex dynamics between self-concept and project-based learning in secondary education. It featured the need for further research to explore the impact of project-based learning on self-concept, particularly in specific subjects and student populations. Understanding the relationship between self-concept and project-based learning has contributed to the development of effective educational strategies that promote holistic student growth and well-being.

CHAPTER THREE: METHODS

Overview

The purpose of this quantitative, quasi-experimental study was to examine how project-based learning affects sixth-grade students' self-concept in all school subjects, specifically reading and mathematics. This chapter begins by introducing the study's design, including complete definitions of all variables. The research questions and null hypothesis follow. Finally, the participants, setting, instrumentation, procedures, and data analysis plans are presented.

Design

A quasi-experimental, nonequivalent control group design was used to determine if project-based learning influences sixth graders' self-concept. Quasi-experimental research has lacked the random assignment characteristic of experimental designs, but it has been valuable when true experiments are impractical (Zajić, & Maksimović, 2022). Nonequivalent control groups, a key feature in quasi-experimental studies, have involved selecting a comparison group that was not randomly assigned but was comparable to the experimental group in relevant characteristics (Maciejewski, 2020). This approach provided valuable insights into cause-and-effect relationships when randomization was challenging or unfeasible. This approach was chosen because it allowed the examination of interventions, while maintaining the capacity to manipulate variables, all without the requirement of using random participant selection (Gall et al., 2007). Thus, the adoption of a quasi-experimental, nonequivalent design was driven by the feasibility of manipulating variables and the impracticality of randomly assigning individual participants to treatment and control groups. Quasi-experimental designs have frequently been used when randomized control was unattainable or ethically challenging (Gopalan et al., 2020).

Given their common use in the educational field (Gall et al., 2007), a quasi-experimental design was deemed the most suitable choice for the current research endeavor.

The independent variable was the presence of project-based learning, which was titled present and not present. The dependent variables were mean self-concept scores for three different subscales—reading, mathematics, and all school subjects—from the modified SDQ-I (Niehaus & Adelson, 2013; Pollack et al., 2005) that were provided from the populations of one middle school from the state of Virginia. A non-experimental, quasi-experimental design allowed the comparison of groups in terms of a cause (Creswell & Creswell, 2017). The most appropriate instrument for the study to assess the level of self-concept among sixth graders before and after the implementation of project-based learning was the modified Self Description Questionnaire-I (SDQ-I; Niehaus & Adelson, 2013; Pollack et al., 2005).

While the quasi-experimental, nonequivalent control group design adopted in this study allowed for a nuanced exploration of the impact of project-based learning on sixth graders' self-concept, it was important to acknowledge certain limitations inherent in this approach. The absence of random assignment, a characteristic of experimental designs, posed a limitation, as it could have introduced potential biases in group composition. The reliance on nonequivalent control groups, though designed to be comparable to the experimental group in relevant characteristics, could not entirely eliminate the risk of confounding variables influencing the observed outcomes (May & Collier, 2023). Additionally, the quasi-experimental design inherently lacked the same level of control as true experiments (Hübner et al., 2023), making it challenging to establish a definitive causal relationship between project-based learning and changes in self-concept. These limitations were considered when interpreting the findings related

to the research questions, particularly in assessing differences in reading, mathematics, and all school subjects' self-concept scores while controlling for preexisting self-concept levels.

Research Questions

RQ1: Is there a difference in reading self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of reading self-concept?

RQ2: Is there a difference in mathematics self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of mathematics self-concept?

RQ3: Is there a difference in all school subjects self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of all school subjects self-concept?

Hypotheses

$H_0$1: There is no significant difference in reading self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of reading self-concept.

$H_0$2: There is no significant difference in mathematics self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not when controlling for the preexisting level of mathematics self-concept.

$H_0$2: There is no significant difference in all school subjects' self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not when controlling for the preexisting level of all school subjects' self-concept.

Participants and Setting

This study examined sixth graders' self-concept related to the implementation of project-based learning. The study participants included sixth-grade students from N Middle School (NMS) and examined if there was a significant difference in student self-concept between sixth-grade students who participated in project-based learning and those who did not participate in project-based learning. This section describes the population, participants, sampling technique, and setting.

Population

The study's target population consisted of sixth-grade public school students enrolled in NMS in the Southeastern United States. The selection of this middle school was based on its convenience and the substantial enrollment of sixth graders. Data collection occurred during the 2023–2024 school year in eastern Virginia. The school district, characterized as a lower-to-middle-income rural setting, comprised three elementary schools, one middle school, and one high school. The middle school hosted 822 students from sixth through eighth grade with a student-teacher ratio of 15:1, providing a suitable context for the study (National Center for Education Statistics, n.d.). Each sixth grader in the middle school had 82 minutes daily dedicated to both English Language Arts (ELA) and mathematics. The research spanned 3 weeks, during which the treatment group engaged in 150 minutes of project-based learning weekly during both their mathematics and ELA instruction times. The study focused on sixth-grade students, who were in a crucial developmental period marked by evolving self-concept. As children mature and acquire new experiences, their self-concept undergoes intricate growth, necessitating additional interventions to enhance their evolving self-perception (Marsh & Shavelson, 1985).

Participants

The total number of participants sampled was 164 students for mathematics, 168 students for reading, and 168 students for all school subjects. According to Gall et al. (2007), 100 students was the required minimum for a one-way ANCOVA when assuming a medium effect size with a statistical power of .7 at the .05 alpha level. The researcher first met with the principal and lead sixth-grade teacher of the middle school face-to-face and received permission to conduct the study in the school. The researcher then met with the mathematics and reading teachers in the middle school. Within the selected middle school, all 22 sixth-grade classrooms, 13 mathematics classes, and nine reading classes were invited to participate in the study. The 13 mathematics classes and the nine reading classes agreed to participate in the study, which consisted of all sixth-grade classrooms, besides the researcher's reading classroom, in both subjects. Both the three reading teachers and four mathematics teachers each taught three classes, along with an additional mathematics teacher teaching one class a day, resulting in a total of 22 classes that participated in the study. The total number of students in the 13 mathematics classes and nine reading classes provided the necessary minimum of 100 participants for each of the samples.

Both convenience sampling and voluntary sampling were utilized in the study. Many empirical studies have utilized convenience sampling methods (Scholtz, 2021) to assess student self-concept and voluntary sampling (Alrajeh, 2020) to measure project-based learning internally. Convenience sampling was beneficial, in that it was inexpensive, efficient, and easy to execute (Winton & Sabol, 2022). The selection of participants was based on location, and voluntary response sampling was utilized due to its simplicity (Creswell & Creswell, 2017). Convenience sampling was utilized, as the researcher lived and worked in the county where the middle school was located. Voluntary sampling was utilized, due to the willingness of the

teachers to volunteer their classrooms to participate in the proposed study. The benefits of voluntary response were utilized within each group after the schools were chosen as either the treatment or the control groups. The benefits of voluntary sampling included access to specific populations and the assurance that there were equal representations.

Reading and All School Subjects Participants

The participants' demographic information was collected through PowerSchool, the platform that NMS used. The samples were comparable between the control and treatment group participants. The students' ages ranged from 10–12 years old, with a total sample size for reading and all school subjects including 168 individuals, with 84 students from three classes assigned to the control group, and 84 students from three classes to the treatment group. In terms of gender distribution across the entire sample for reading and all school subjects, 47% were female, and 53% were male. Analysis of students' ethnicity at NMS indicated a predominant Caucasian majority. Table 1 delineates the sample breakdown based on lunch price and provides a detailed presentation of students' gender, race, ethnicity, and socioeconomic status, organized by ethnic group.

Table 1

Breakdown by Gender, Race, Ethnicity, and Socioeconomic Status for Reading and All School Subjects

Characteristic	Entire Sample	Control Group	Treatment Group
Gender			
Female	79	32	47
Male	89	52	37
Race/Ethnicity			
American Indian/Alaskan Native	2	1	1
Asian	2	2	0
Black or African American	9	5	4
Native Hawaiian/Other Pacific Islander	1	0	1
Hispanic/Latino	5	3	2
Two or More Race Categories	4	2	2
Caucasian	145	71	74
Lunch Price			
Free or Reduced Lunch	35	15	20
Paid Lunch	133	69	64

The majority of students in the study spoke English as their first language, with data indicating that 98.1% spoke English as their first language, while 1.9% used English as a second language. Table 2 illustrates a detailed distribution based on students' native languages. Additionally, a substantial majority of the students did not receive special education services. Table 2 summarizes the sample based on whether students received special education services,

indicating that all participants in the treatment group did not receive such services, whereas 12.6% of the control group did, with the remaining 87.4% not receiving special education services.

Table 2

Breakdown by Students' Native Language and Special Education Services for ELA and All School Subjects

Characteristic	Entire Sample	Control Group	Treatment Group
Native Language			
English	165	82	83
English as a Second Language	3	2	1
Special Education Services			
Receives services	10	10	0
Does not receive services	158	74	84

Mathematics Participants

The participants' demographic information was collected through PowerSchool. The samples were comparable between the control and treatment group participants. The students' ages ranged from 10–12 years old, with a total sample size for mathematics that included 164 individuals: 82 students from six classes were assigned to the control group, and 82 students from seven classes were assigned to the treatment group. In terms of gender distribution across the entire sample for reading and all school subjects, 50.6% were female, and 49.4% were male. See Table 3 for a breakdown by gender race/ethnicity, and lunch price.

Table 3

Breakdown by Gender, Race, Ethnicity, and Socioeconomic Status for Mathematics

Characteristic	Entire Sample	Control Group	Treatment Group
Gender			
Female	83	47	36
Male	81	35	46
Race/Ethnicity			
American Indian/Alaskan Native	4	3	1
Asian	2	1	1
Black or African American	9	7	2
Native Hawaiian/Other Pacific Islander	1	1	0
Hispanic/Latino	9	4	5
Two or More Race Categories	8	3	5
Caucasian	131	63	68
Lunch Price			
Free or Reduced Lunch	42	17	25
Paid Lunch	122	65	57

The majority of students in the study spoke English as their first language, with data indicating that 98.1% spoke English as their first language, while 1.9% used English as a second language. Table 4 illustrates a detailed distribution based on students' native languages. Additionally, a substantial majority of the students did not receive special education services. Table 4 summarizes the sample based on students' receipt of special education services. It shows

that 4% of participants in the treatment group received these services, compared to 2.4% in the control group.

Table 4

Breakdown by Students' Native Language and Special Education Services for Mathematics

Characteristic	Entire Sample	Control Group	Treatment Group
Native Language			
English	163	82	81
English as a Second Language	2	1	1
Special Education Services			
Receives services	11	4	7
Does not receive services	153	78	75

Setting

This study took place in one brick-and-mortar middle school setting, which was a closed campus. The respective classroom teachers administered the pretests and posttests using school-issued computers. Students accessed the laptops comfortably by sitting in child-sized chairs at child-sized desks placed within easy reach. Although efforts were made to minimize distractions during the tests, it was not possible to eliminate all of them entirely. All treatment activities and project-based learning interventions were conducted by the teachers within the classroom.

The research study took place in a small school district in eastern Virginia. The school district experienced tremendous growth in the 3 years prior to the study taking place. At the time of the study, there were five schools, one brand new, serving a total of 3,538 students in grades PK–12. The schools and the communities in which the students lived were similar. There were three elementary schools, one middle school, and one high school in the 2023–2024 school year.

The state accredited all five schools during the proposed study (Virginia Department of Education, n.d.). The district also surpassed the state average by 4% in reading scores, 11% in math scores, 9% in history scores, and 9% in science scores during the 2022–2023 school year (Virginia Department of Education, n.d.). The middle school had one head principal, two assistant principals, and two administrative interns at the time of the study. The teacher-student ratio averaged 1:24 in mathematics and 1:27 in ELA classes in sixth grade.

Instrumentation

The purpose of the modified SDQ-I instrument was to measure student self-concept among sixth-grade students before and after project-based learning implementation (Niehaus & Adelson, 2013; Pollack et al., 2005). The modified SDQ-I questionnaire was created and validated to evaluate self-concept in younger students. The modified SDQ-I was a well-established instrument designed to measure self-concept among young students (Pollack et al., 2005). The instrument has been used in numerous studies (Alkhateeb et al., 2022; Marsh & Holmes, 1990).

Email communication was sent to the primary author of this instrument on February 16, 2023, describing the present study and asking for permission to use the instrument. Dr. Herbert Marsh provided permission via email (see Appendix B) to use the modified SDQ-I questionnaire (see Appendix C) for research purposes. The modified SDQ-I questionnaire was derived from the SDQ-I and developed to best measure self-concept in younger children (Niehaus & Adelson, 2013; Pollack et al., 2005). The modified SDQ-I questionnaire was adapted to capture self-concept in both academic and non-academic domains, which provided a comprehensive view of students' perceptions of themselves as younger students (Niehaus & Adelson; Pollack et al.). The choice of this assessment tool was underpinned by its demonstrated high reliability, validity, and

suitability for examining dependent variables. A track record of effectiveness was evident, as the instrument had been used in multiple studies (e.g., Niehaus & Adelson, 2013; Pollack et al., 2005). This showed how well it could be used to understand different aspects of self-concept in various groups of students.

The construct validity of the modified SDQ-I used in the proposed study was established through factor analysis and internal consistency assessments, drawing from previous research by Kaminski et al. (2005). Building on this foundation, Kaminski et al. (2005) investigated the SDQ-I's construct validity among Mexican American girls and boys, affirming its reliability and cultural applicability in assessing self-concept. Niehaus and Adelson (2013) further examined the SDQ-I's validity by assessing its measurement invariance and cross-group comparisons, revealing its consistency across diverse language groups. In this study, the modified SDQ-I exhibited robust psychometrics, maintaining the credibility of Dr. Marsh's original instrument (Shahrivar et al., 2009). The modified version, which tied the focus on fourth- to sixth-grade students' self-concept, ensured internal consistency and content validity, aligning with established theoretical frameworks.

Niehaus and Adelson (2013) established benchmarks for their "Multiple-Group Confirmatory Factor Analysis" (p. 233). Due to the substantial sample size and a desire to avoid misinterpretation of minor chi-square changes as indicative of measurement non-invariance across groups in Multiple-Group Confirmatory Factor Analysis analyses, Niehaus and Adelson turned to alternative goodness-of-fit indices. Specifically, they evaluated the root-mean-square error of approximation and the comparative fit index (Niehaus & Adelson). They considered a root-mean-square error of approximation values below .05 (Browne & Cudeck, 1993) and comparative fit index values exceeding .90 (Marsh et al., 2004) as indicative of relatively good

model-to-data fit. Research by Chen (2007) supported the utility of the comparative fit index and root-mean-square error of approximation values, especially in the context of invariance testing. Moving on to their findings, the Confirmatory Factor Analysis model encompassed six correlated latent constructs, representing the six SDQ-I scales and 42 indicators corresponding to the 42 SDQ-I items, along with error terms. The Confirmatory Factor Analysis model demonstrated an acceptable model fit for the entire sample of 12,843 students, with a root-mean-square error of approximation at .038 and a comparative fit index at .935 (Niehaus & Adelson, 2013).

The reliability of the modified SDQ-I was assessed through the calculation of Cronbach's α coefficients for each of its subscales, factors, dimensions, and constructs. Cronbach's α provided an indication of the internal consistency and stability of the measurement tool, offering insights into the extent to which items within each subscale measured a common underlying construct. Reliability was estimated with a median Cronbach's α of .85. The individual Cronbach's α for each self-concept subscale, reading, mathematics, all school subjects, peer relations, externalizing problems, and internalizing problems are shown in Table 5, as described by Marsh (1990).

Table 5

Cronbach's α for the Subscales of the Modified SDQ-I

Subscale	Cronbach's α Coefficient
Reading Self-Concept	.89
Mathematics Self-Concept	.89
All School Subjects Self-Concept	.86
Median Score of SDQ-I	.85

The Cronbach's α coefficients observed across all subscales and constructs for the modified SDQ-I consistently demonstrated high levels of internal consistency reliability, with coefficients ranging from 0.82 to 0.91 (Marsh, 1990). This confirmed the instrument's robustness in efficiently evaluating various dimensions of social competence among sixth-grade students, demonstrating strong interconnectedness and coherence within the measured variables. These coefficients substantiated the instrument's effectiveness in consistently measuring participants' self-perceptions, thus underpinning its utility in evaluating the targeted dependent variables within the context of the proposed study.

The instrument comprised a series of 42 self-descriptive statements related to various domains, including academic skills, social interactions, and personal attributes. Participants were asked to indicate the extent to which each statement applied to them on a Likert scale. The reading section consisted of eight questions, mirroring the mathematics section, which also comprised eight questions, while the school subjects section comprised six questions. Since the students in this study only completed the reading, mathematics, and all school subjects subscale questions, it resulted in a total of 22 questions per student.

The design of this instrument was intended for children in grades four through six, due to the variety of necessary academic skills that are required to complete the questionnaire. The instrument included scoring students' self-concept in the areas of reading, mathematics, all school subjects, peer relations, externalizing problems, and internalizing problems. How a student viewed themself had the potential to affect their self-concept. In addition, the context of the questions included questions about how the student saw themself in school situations, as well as outside of school, making this an ideal tool for use with elementary students. Because dishonest actions are frequently interpreted as having differing levels of severity, the responses

were presented in a 4-point Likert-Scale, allowing responders the opportunity to rank their level of agreement/disagreement with the scenario being how they view themself.

Scoring the adapted SDQ-I involved evaluating distinct subscales related to reading, mathematics, and all school subjects, individually assessing students' self-concept within specific educational domains. Participants responded using a Likert scale, with higher scores reflecting a more positive self-perception. For instance, prompt responses to questions like "I get good grades in reading" ranged from 1 = Not at all true to 4 = Very true. The researcher calculated and determined the mean for each subscale, both pretest and posttest. This meticulous approach allowed for a nuanced analysis of students' self-concept across these academic domains. Ultimately, individuals received three separate scores—averages for reading, mathematics, and all school subjects' subscales—enabling a comprehensive assessment of the impact of project-based learning on diverse aspects of academic self-perception. Analyzing scores across subscales offered insights into an individual's multifaceted self-perception within various academic facets.

The administration of the modified SDQ-I involved the classroom teacher telling the students to log on to their Chromebooks and log in to Schoology to fill out the survey with clear instructions about honest responses (see Appendix D for instructions). The teacher guided the process, ensuring that students understood the importance of sincerity in their responses. Following completion, the instrument was collected via Google Forms, and the researcher conducted the scoring.

The instrument was designed and tested as a self-reported questionnaire to assess various dimensions of self-concept among individuals. The specific software program used for the development of the SDQ-I questionnaire was not mentioned in the research or psychometric documentation. A high-ranking score was indicative of high self-concept. The scores were a

result of summing the scores for each of the subscales. The highest possible score for this instrument was 32, which indicated the perception of a very high student self-concept, and the lowest possible score was eight, which indicated that the individual had a severely low self-concept. The overall process was designed to be efficient and seamlessly integrated into the classroom setting, taking no more than 20 minutes, with the researcher taking responsibility for the subsequent scoring and analysis.

Procedures

Human participants were utilized for this study, so the institutional review board (IRB) needed to provide permission for continuance (see Appendix E). A mandatory IRB online training certificate also needed to be secured prior to beginning the study. Once the IRB approved the study, the researcher received permission from the principal at NMS. Opt-out forms (see Appendix F) were provided, distributed, signed, returned, and collected. Before collecting data or gaining participants, the IRB approval was obtained.

The participants for the study were drawn from a mixture of methods of sampling that included convenience sampling and voluntary convenience sampling from NMS in the form of teachers volunteering their classrooms to participate in disseminating the questionnaire and forming treatment and control groups. Within each group, there was a treatment group (i.e., implementation of project-based learning) and a control group (i.e., no project-based learning implemented) for each of the subscales: ELA, mathematics, and all school subjects. The independent variable was the presence of project-based learning in the classroom. Thus, there was a total of two groups that included sixth-grade students who participated in project-based learning and those who did not participate in project-based learning for both ELA and

mathematics. Control groups were added, as this strengthened the internal validity of experiments (Gall et al., 2007).

The researcher met with the NMS principal to describe the study and explain the potential risks and benefits to subjects and to gain permission to solicit teachers during a grade-level meeting for participation in the study. After obtaining permission from the principal (see Appendix G), all NMS sixth-grade classrooms were invited to participate in the study to ensure unbiased representation. The study was introduced to the teachers through a clear and comprehensive communication process. The objectives, methods, and potential benefits were explained to the teachers. The teachers were then given the opportunity to volunteer their classrooms for participation or to opt-out, contributing to the study's voluntary nature. In anticipation of potential fluctuations in student participation and consent, the outlined research thoughtfully considered a scenario in which a teacher overseeing a class of 20 students agreed to participate, yet 10 students' parent(s) signed an opt-out form. Thus, the number of students that the researcher invited to participate in the study significantly exceeded the required number needed to conduct the study in the case that students' parent(s)/guardian(s) signed the opt-out form. Despite returning the opt-out form, two students still engaged in project-based learning alongside their peers. However, 50 students did not complete one of the reading and all school subjects SDQ-I questionnaires, and 75 students did not complete one of the questionnaires (either the pretest or posttest) in mathematics, unlike the other students who did not return the opt-out form but completed it.

The researcher sent an email via PowerSchool, the school's preferred method of communication, to all eligible sixth-grade students' parent(s)/guardian(s). The email included the opt-out form (see Appendix F) and any other important information that was necessary for the

study. Letters in English and Spanish were also sent via email through PowerSchool. The letter was translated into Spanish by the English as a second language (ESL) teacher. The opt-out forms, if returned, were returned to the students' ELA teacher, which was then handed to the researcher. The researcher gave the parent(s)/guardian(s) a full week to return the opt-out forms before the study began.

When consent was obtained to conduct the study, the researcher began by training the teacher(s) on the SDQ-I so that they were able to administer the pretest effectively. After the training of the SDQ-I, the researcher then trained educators in the control group on project-based learning.

Training on Project-Based Learning

The educators leading the experimental groups in administering the treatment underwent comprehensive training in proficiently implementing project-based learning. The training process consisted of a 30-minute virtual session facilitated by the researcher, during which educators were instructed on the intricacies of the treatment. This training session was recorded and then sent to the participating teachers in the treatment group via email. To ensure comprehensive engagement, the email included a link to the Nearpod platform, which was employed by the researcher to guide the training process. Within the Nearpod presentation, a series of step-by-step instructional videos demonstrated the seamless integration of project-based learning into the classroom environment, augmented by interactive questions and discussion boards to foster active participation. Notably, this training initiative was streamlined to efficiently encompass a 30-minute duration, a detail that was communicated to the principal of the school participating in the treatment group. It was worth emphasizing that the training included a practical demonstration of a project-based learning lesson, utilizing a module sourced from

PBLworks.org, thus providing the educators with a tangible model to reference during the study.

Control Group

The researcher also sent the control group a brief training session to discuss project-based learning and fidelity. Gall et al. (2007) emphasized the importance of considering treatment fidelity, defining it as the degree to which the treatment conditions, as implemented, aligned with the researcher's specified guidelines for the treatment. The educators in the control group observed the researcher modeling a project-based learning lesson to document procedures during project-based learning instruction to ensure that experimental treatment diffusion did not threaten internal validity. An arrangement was established with the control group (see Appendix H) to ensure their exclusive engagement with the traditional teaching method, refraining from participating in any project-based learning activities. This agreement was implemented to guarantee adherence to the prescribed project-based learning criteria for the treatment, ultimately bolstering the study's dependability. The control group maintained fidelity throughout the process by not receiving any lessons or projects that the treatment group implemented. The researcher also looked at the team lesson plans to ensure that no project-based learning was being implemented in the control groups' classrooms. Once both groups, the treatment and control groups, received their training, the teachers gave the pretest to all of the participants.

Administering the SDQ-I Pre-Test

Administering the SDQ-I questionnaire pretest involved a series of steps to ensure a smooth and confidential process. The first step included telling the students to log on to their Chromebooks to access the SDQ-I questionnaire. With clear instructions about the importance of honest responses, the teacher then explained to the students that they would have 20 minutes to complete their pretests. The students who did not participate in the study did not receive access

to complete the questionnaire. The teacher gave the students who returned the opt-out form another activity to work on based on the teacher's choice. To maintain privacy and confidentiality, the students first received the Google form. The researcher received the students' email addresses that were attached to the completed questionnaire so that the researcher could match the student's pretest to their posttest. Once the posttest was collected and the questionnaire responses were received, the student's email address was deleted and changed to a number to ensure privacy. This coding system ensured that responses remained anonymous and individual names were not associated with the questionnaire.

After providing clear instructions (see Appendix D), the data collection process began. Completed questionnaires were submitted, and the classroom teacher addressed any unanswered questions, encouraging students to fill in any gaps. The students' email addresses were utilized to match responses from the pretest and posttest stages, enabling the researcher to analyze changes in students' self-concept over time.

The SDQ-I scores obtained from different subscales of the SDQ-I were kept separate to reflect their self-concept in the three subcategories: reading, mathematics, and all school subjects. The researcher made two identical Google forms of the questionnaire so that the data would automatically be organized by the control group and the treatment group. The researcher generated separate Google forms for the mathematics subscale and the combined reading self-concept and all school subjects self-concept subscales. Students in ELA were assessed on both the ELA self-concept and the all school subjects self-concept because the sixth-grade ELA curriculum offered greater flexibility compared to the mathematics curriculum, enabling the allocation of additional time for the inclusion of six extra questions from the all school subjects self-concept subscale. Once the researcher received all the completed questionnaires, the

researcher exported the data into a spreadsheet. The first column included the students' email, and the other columns included the responses per question. However, after each subcategory on the questionnaire, the researcher inserted a column to include the mean for the specific subscale. For example, if the student responded to the first question in the reading section, "I am good at reading," with a Very True statement, a "4" was input into the spreadsheet for the first question. However, if the student's answers were Not at all True, a "1" was input into the spreadsheet for the first question. All of the questions for each subsection received a score between 1–4. At the end of each subscale, a mean score was calculated using Statistical Package for Social Sciences (SPSS) for both the pretest and the posttest. These calculations gave a straightforward view of the data, which allowed the researcher to notice any trends or patterns in how students saw themselves. The mean of each subscale was then used to run the analysis of covariance (ANCOVA) in SPSS for each of the three research questions to determine if project-based learning affected student self-concept. Once the data was input into the spreadsheet for both the control and the treatment groups, the data was stored securely, and only the researcher had access to the records. Data was stored on a password-protected external drive. When not being utilized, the external drive was stored in a locked drawer. The data will be retained for a period of 5 years after the completion of the research study, after which it will be destroyed properly.

Following the completion of the pretest questionnaire for the SDQ-I, the study proceeded by initiating a 3-week treatment period. During this time, participants in the treatment group engaged in the designated intervention activities aimed at influencing their self-concept perceptions. This intervention period allowed for the exploration of potential changes in self-perceptions over the specified duration.

Treatment Period

After the researcher collected the initial data, the experimental group received treatment for 3 weeks. The researcher chose the 30–40-minute daily timeframe for project-based learning, due to findings from Chen and Yang's (2019) research. The results of post-hoc comparisons from their study demonstrated a significantly stronger effect when utilizing project-based learning for more than 2 hours per week in contrast to conventional instructional methods. Furthermore, adopting a 30–40-minute duration each day was also found to be more feasible for teachers when incorporating project-based learning into their subject instruction. Instruction was supported by the classroom teacher using projects aligned with the sixth-grade Virginia Department of Education state standards in reading and mathematics.

Students collaborated in pairs or groups as determined by teacher discretion. This entailed the teacher selecting the optimal arrangement—pairs or groups—based on the students' proficiency levels and what the teacher deemed most effective. After gathering the initial data for the entire 3-week period, the researcher provided the treatment group teachers with the project plans. The teachers implemented project-based learning in their classrooms for the entire 3 weeks to focus on the specific state standard that they were teaching at the time. Students in the experimental group participated in 30–45 minutes of project-based learning instruction during each school day.

ELA

Throughout a 3-week (15-day) period of project-based learning for ELA, NMS students participated in a series of activities that integrated reading comprehension, creative expression, and critical thinking (see Appendix I). The 3-week lesson plan was designed to incorporate project-based learning while adhering to Gold Standard Project-Based Learning. The first and

last days were devoted to evaluating students' self-concept via the SDQ-I pretest and SDQ-I posttest, and the remaining days comprised a series of activities that promoted collaboration, revision, and reflection, with a focus on developing essential skills.

During the first week, students honed their ability to understand a short story's plot, characters, and themes. In the second week, they were involved in developing research skills, with students working in teams to research and present information on a topic related to the story. In the third week, students focused on communication skills, crafting and delivering a persuasive argument related to a real-world issue.

Throughout the lesson plan, students engaged in activities aligned with the Gold Standard Project-Based Learning while following the learning standards set by the Virginia Department of Education. The projects promoted authenticity by empowering students to express themselves authentically, granting them autonomy and collaboration opportunities. Students could showcase their work and receive constructive feedback from peers and teachers, facilitating reflection on their learning journey. By the end of the 3-week period, students had developed a range of skills related to reading comprehension, research, and communication, while also refining their ability to work effectively in teams.

Mathematics

During the same period of time, the students in the mathematics treatment group participated in project-based learning for 3 weeks (see Appendix J). The process began with the completion of the mathematics portion of the SDQ-I questionnaire on the first day. The NMS teacher was provided with the necessary materials and instructions. At the beginning of the week, the teacher informed the students that the projects for the week would center around the mathematics standards that they were learning at the time. For the remainder of the first week,

the students participated in an inequalities project. The project required students to survey six different groups of people, including themselves, and gather the data to create an inequality. The students then created a poster that represented a section for each question and inequality from the chart. Students had to write the question, define a variable, write an inequality, graph the inequality, and write a complete sentence answering the question. The project allowed students to apply one-variable inequality concepts to real-world situations and develop key vocabulary.

During the second week of the mathematics treatment group, the focus was on real-world problems that involved circles. Over the course of 5 days, students worked on four different tasks. These tasks included creating a circular track, designing a circular decking for a pool, and calculating the area of a circular pizza. Throughout the project, the students learned how to apply mathematical concepts to real-world situations. The students gained a deeper understanding of circles and their properties, while also developing important 21st-century skills.

In the final week, the students applied their understanding of area and perimeter in a real-world context. The driving question challenged students to design the most efficient garden layout for a local community center. They had the autonomy to make decisions regarding park design elements. Throughout the week, students studied the concepts of area and perimeter. They investigated practical applications of the measurements and engaged in hands-on activities to deepen their understanding. They collaborated in small teams, provided constructive feedback on each other's designs, and refined their own designs. The last day consisted of the students completing the posttest for the SDQ-I.

Administering the SDQ-I Posttest

Following the 30-day treatment period, the participating students underwent the mathematics posttest for the SDQ-I, administered by the mathematics teachers. Simultaneously,

the ELA teachers conducted the posttest for the SDQ-I on ELA and all school subjects for the participating students. The questionnaires were distributed to the students using the same instructions as the pretest. Following the posttest data collection, the researcher employed the same systematic process of transporting the gathered data into the Microsoft spreadsheet using the Google Forms tools. The students' responses were matched with the pretest by their email address. This process allowed the data to be easily compared and contrasted with the pretest scores. Once the researcher matched the pretests and posttests together, the email addresses were changed to numbers starting with one and going in numerical order. The combined data from both the pretest and posttest was entered into SPSS. This platform facilitated the necessary statistical analyses, aiding in the identification of potential changes in self-concept because of the implemented treatment. The data was then analyzed as described in the following section.

Data Analysis

To examine the null hypothesis concerning the variation in self-concept scores as measured by the modified SDQ-I among sixth-grade students engaged in project-based learning, an ANCOVA was employed. The ANCOVA was used to determine if there were statistically significant differences in the dependent variable, self-concept scores in all three subscales of the modified SDQ-I questionnaire, while controlling for a covariate, which in this case was a pretest score (Gall et al., 2007). The research context featured a single categorical independent variable, project-based learning, representing the different learning methods, and a continuous dependent variable, which was the mean self-concept score for each of the three subscales obtained through the modified SDQ-I questionnaire.

Given the presence of two groups from a categorical independent variable, three continuous dependent variables in the subscales—reading, mathematics, and all subject areas—

and a continuous covariate, the ANCOVA was chosen as the fitting analytical tool to assess the null hypothesis (Gall et al., 2007). The continuous dependent variables in the study were the mean scores of the subscales, with a possible range from 6–24 in the subsections of all school subjects. The reading and mathematics subscales ranged from 8–32. Data collection involved calculating the mean scores for each subscale using a Likert scale. A one-way ANCOVA was utilized to analyze the impact of the treatment while adjusting for pretest scores (Hsin & Wu, 2023). This approach effectively evaluated the differences among the various group combinations, emphasizing any statistically significant changes in outcomes while controlling for potential Type I errors inherent in multiple t-tests (Gall et al., 2007). Including a covariate was essential to minimize interaction effects linked to initial differences among groups (Schneider et al., 2015).

To utilize a one-way ANCOVA, nine assumptions had to be met (Laerd Statistics, n.d.). The first four were evaluated before data collection. These included the requirement for consistency of the dependent variable across all levels of the independent variable and subscale scores for the SDQ-I aggregated from Likert data and demonstrated continuity in a defined range. The second assumption necessitated that the independent variable comprised two or more categorical, independent groups—a condition that was met by the study's treatment and control group design. The third assumption was that a covariate was assessed at a continuous level. In the study, each ANCOVA incorporated one covariate, the mean subscale score of reading self-concept, mathematics self-concept, or all school subjects' self-concept. The measurement included computing scores that compared the pretest scores to the posttest scores in an Excel spreadsheet file, which was imported into SPSS (IBM, 2021). The fourth assumption stipulated distinct participants in each group, with each participant assigned solely to either a treatment or

control group for reading as well for mathematics.

After the data collection, the researcher tested the remaining five assumptions: the absence of extreme outliers, normal distribution, homogeneity of variances, linear relationships, and homogeneity of regression slopes. The fifth assumption was the assumption of no significant outliers. This involved screening for outliers, checking for normality using the Kolmogorov-Smirnov test, and evaluating the equality of variance using Levene's Test of Equality of Error Variance. Detection of extreme outliers was achieved through the application of box-and-whisker plots, while the Kolmogorov-Smirnov test was applied to assess the distribution of the data, considering the sample size. Any extreme outliers were examined to understand if the data generated should be removed. If the outliers were coding errors, the researcher fixed them. The sixth assumption was the assumption of normal distribution (Gall et al., 2007). The Kolmogorov-Smirnov test was used to test the assumption of normality. A series of scatterplots between the pretest and posttest variables and self-concept scores for the control and experimental groups were used to test the assumption of bivariate normal distribution. In bivariate normal distribution, the researcher looked for a cigar shape. The seventh assumption was the assumption of the homogeneity of variances (Gall et al.). To test the assumption of homogeneity of slopes, the researcher looked for the interactions within the data. Levene's Test of Equality of Error Variance tested the equality of variance assumption. Internal and external validity measures remained consistent with the use of ANCOVA and a pretest (Gall et al.). If the means of the control and experimental groups were too different, then the treatment could not be said to have an effect (Campbell & Stanley, 1963). The eighth assumption was the assumption of linear relationships between the covariate and the dependent variable with each independent variable group (Gall et al., 2007). Scatterplots were used between the pretest, the covariate, and posttest

scores, the dependent variance for each group to assess the assumption of linear relationships. The researcher looked for a straight-line pattern, suggesting a linear relationship between the covariate and the dependent variable for the treatment and control groups. The final assumption, homogeneity of regression slopes, aimed to determine whether there was any interaction between the covariate and the independent variable. This assessment involved examining the regression lines in the scatterplots within the box-and-whisker plots. It was ensured that all lines were parallel during the data analysis.

The null hypothesis rejection threshold was set at the 95% confidence level. All statistical analyses and assumption tests were conducted using SPSS Statistics 28.0, with partial eta squared serving as an indicator of effect size, aligned with significance levels corresponding to varying effect magnitudes. A significance level of .05 was adopted for statistical significance. This meant that the significance level of $\alpha = .05$ was adopted for statistical significance (IBM, 2021).

CHAPTER FOUR: FINDINGS

Overview

The purpose of this quantitative, quasi-experimental study was to examine how project-based learning affects sixth-grade students' self-concept in all school subjects, specifically reading and mathematics, at a rural middle school in southeast Virginia. Chapter Four presents the results of this study. It states the research questions, hypotheses, and descriptive statistics. A one-way analysis of covariance (ANCOVA) was used to test each of the three hypotheses, which the researcher failed to reject. The results of the assumption tests and data analyses are outlined.

Research Questions

RQ1: Is there a difference in reading self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of reading self-concept?

RQ2: Is there a difference in mathematics self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of mathematics self-concept?

RQ3: Is there a difference in all school subjects self-concept scores, as measured by the modified SDQ-I between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of all school subjects self-concept?

Null Hypotheses

$H_0$1: There is no significant difference in reading self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of reading self-concept.

$H_0$2: There is no significant difference in mathematics self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not when controlling for the preexisting level of mathematics self-concept.

$H_0$3: There is no significant difference in all school subjects self-concept scores, as measured by the modified SDQ-I between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of all school subjects self-concept.

Descriptive Statistics

Descriptive statistics were gathered for both the covariate, initial self-concept scores, and the dependent variable, final self-concept scores, across all groups in reading, mathematics, and all school subjects. The sample comprised 168 sixth-grade students for reading and all school subjects across three teachers and nine classes and 164 sixth-grade students for mathematics across five teachers and 13 classes, all from a single middle school. Scores on the modified SDQ-I questionnaire ranged from 1–4, where a score of 24 across all school subjects and a score of 32 in reading and mathematics indicated a significantly high self-concept in those areas. In contrast, a score of 6 across all school subjects and 8 in reading and mathematics indicated a low self-concept.

In this study, sixth-grade students' self-concept scores were assessed through a pretest administered by participating classroom teachers on March 18, 2024. The intervention, employing project-based learning, commenced in the treatment groups on March 19, 2024 and continued until March 26, 2024. However, the study experienced a brief hiatus from March 29–April 3, 2024, coinciding with the school's spring break. Upon students' return to school on April 8, 2024, the intervention resumed, culminating in the administration of the posttest on

April 12, 2024. Throughout the intervention period, which lasted approximately 30–40 minutes daily, excluding spring break and test days, teachers in the treatment group received weekly lessons and necessary supplies. Finally, on April 12, 2024, participants completed the posttest, marking the conclusion of the study's intervention phase.

Reading Self-Concept Descriptive Statistics

For the reading groups, the mean self-concept pretest score in the control group was 21.53, with a standard deviation of 5.38. In the treatment group, the mean self-concept was 19.54, with a standard deviation of 5.64. The median for the reading control group was 22 (n = 8), and the mode was 24 (n =9), while the treatment group median was 19 (n = 4), and the mode was 15 (n = 11). Descriptive statistics for the covariate are presented in Table 6, with Figures 1 and 2 depicting the data distribution for reading.

Table 6

Descriptive Statistics for Covariate for Reading Self-Concept (Pretest Score)

Group	*N*	*Range*	*Min*	*Max*	*M*	*SD*
Control Group (Traditional Learning)	84	22	10	32	21.53	5.38
Treatment Group (Project-Based Learning	84	24	8	32	19.54	5.64

Figure 1

Distribution of Covariate for Reading Self-Concept (Control Group Pretest Score)

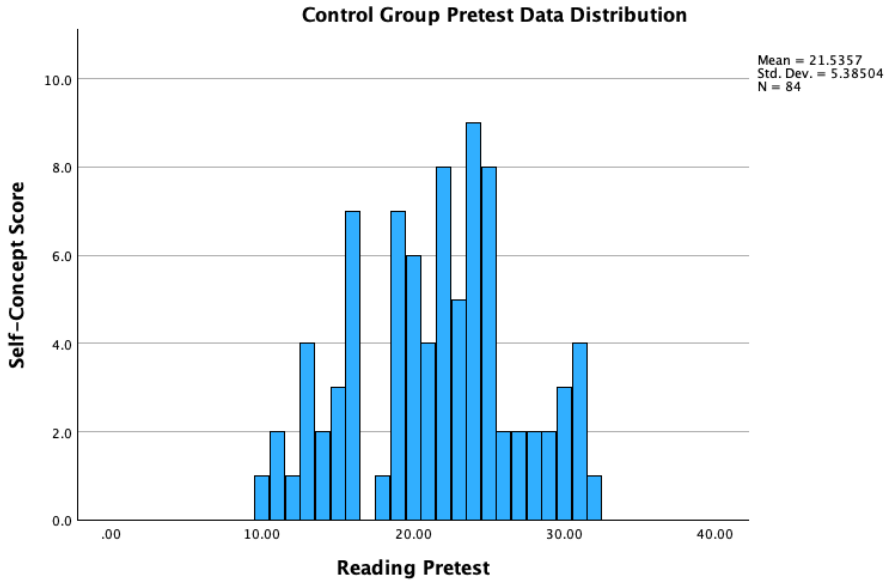
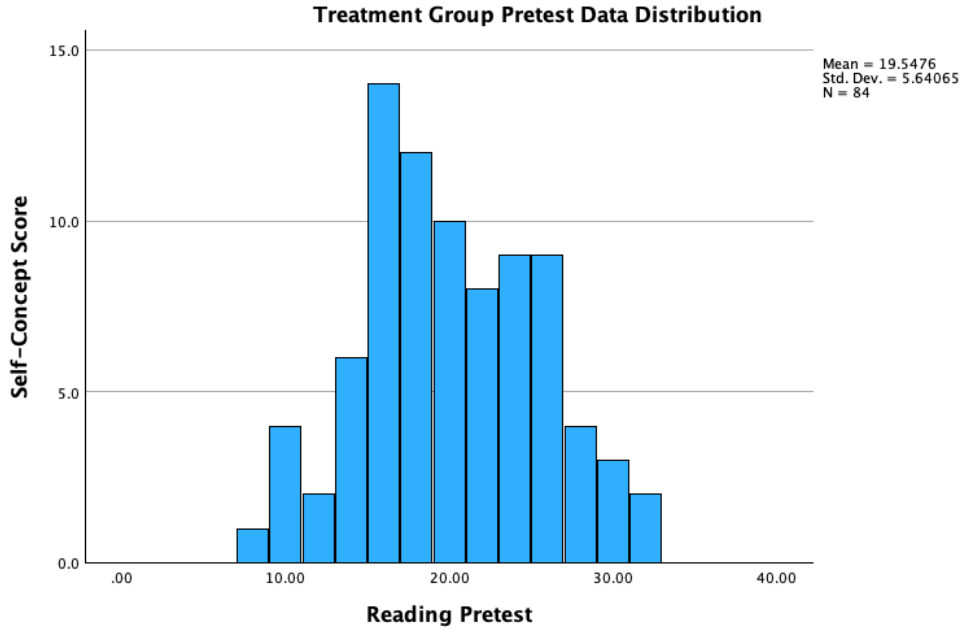


Figure 2

Distribution of Covariate for Reading Self-Concept (Treatment Group Pretest Score)



Overall, the mean self-concept pretest score for the control group was 21.53, while the treatment group's mean score was 19.54. On the posttest, the control group's mean self-concept score was 22, compared to 20.63 for the treatment group. After adjusting for pretest self-concept levels, the mean difference for the control group was 0.47, whereas the treatment group's mean difference was 1.09. Descriptive statistics for the dependent variable can be found in Table 7. See Figures 3–5 for graphs of the data distribution of the dependent variable.

Table 7

Descriptive Statistics for Covariate for Reading Self-Concept (Posttest Score)

Group	*N*	*Range*	*Min*	*Max*	*M*	*SD*
Control Group (Traditional Learning)	84	21	11	32	22	5.30
Treatment Group (Project-Based Learning	84	22	10	32	20.63	5.29

Figure 3

Distribution of Covariate for Reading Self-Concept (Control Group Posttest Score)

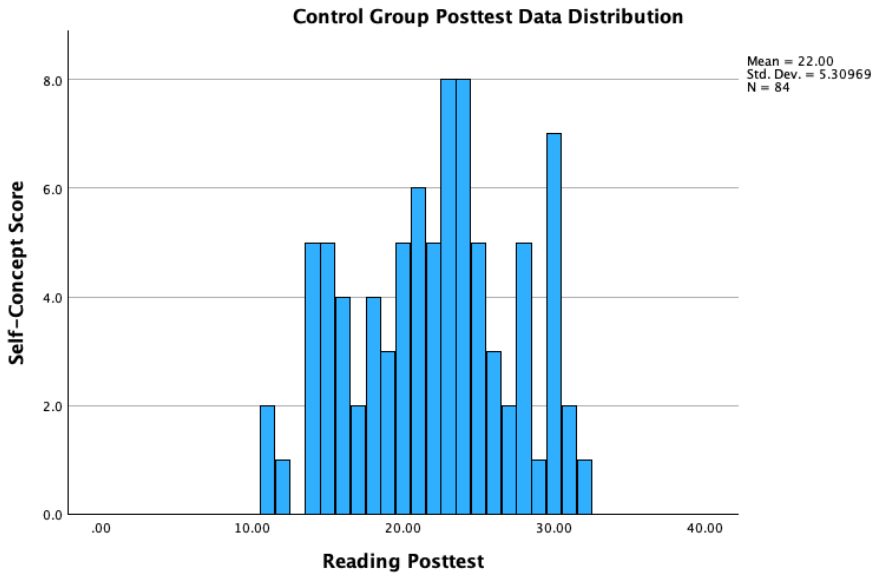


Figure 4

Distribution of Covariate for Reading Self-Concept (Treatment Group Posttest Score)

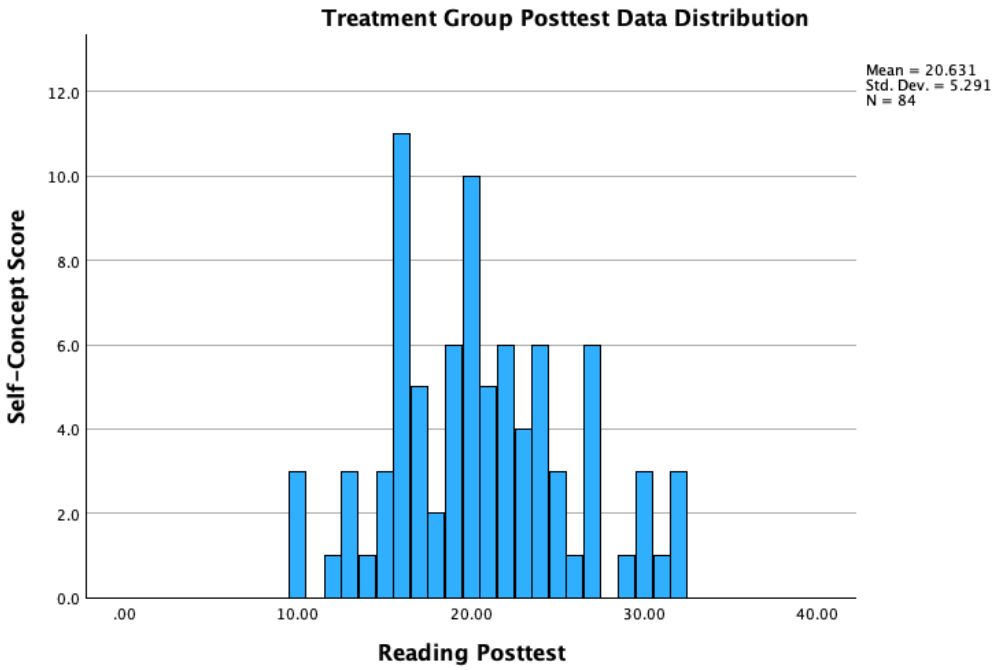
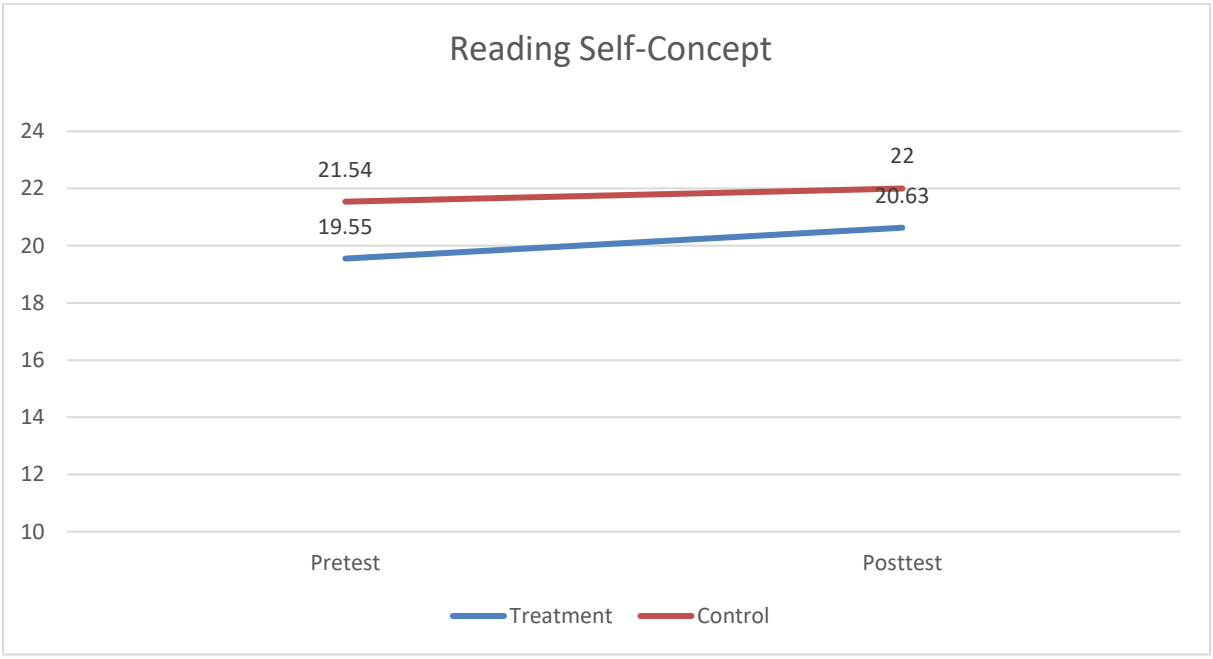


Figure 5

Reading Self-Concept Pretest to Posttest Score Treatment and Control Group



Mathematics Self-Concept Descriptive Statistics

The initial self-concept scores, utilized as the covariate, spanned from 8–32 for mathematics. In the mathematics control group, the mean self-concept pretest score was 18.68 with a standard deviation of 6.30, while in the mathematics treatment group, the mean self-concept was 20.87 with a standard deviation of 5.97. The median self-concept score for the mathematics control group was 18 (n = 5), and the mode was 19 (n = 7), while for the treatment group, the median self-concept score was 21 (n = 5), and the mode was 16 (n = 9). Descriptive statistics for the covariate are provided in Table 8, and Figures 7 and 7 illustrate the data distribution for mathematics.

Table 8

Descriptive Statistics for Covariate for Mathematics Self-Concept (Pretest Score)

Group	*N*	*Range*	*Min*	*Max*	*M*	*SD*
Control Group (Traditional Learning)	82	24	8	32	18.68	6.30
Treatment Group (Project-Based Learning	82	24	8	32	20.87	5.97

Figure 6

Distribution of Covariate for Mathematics Self-Concept (Control Group Pretest Score)

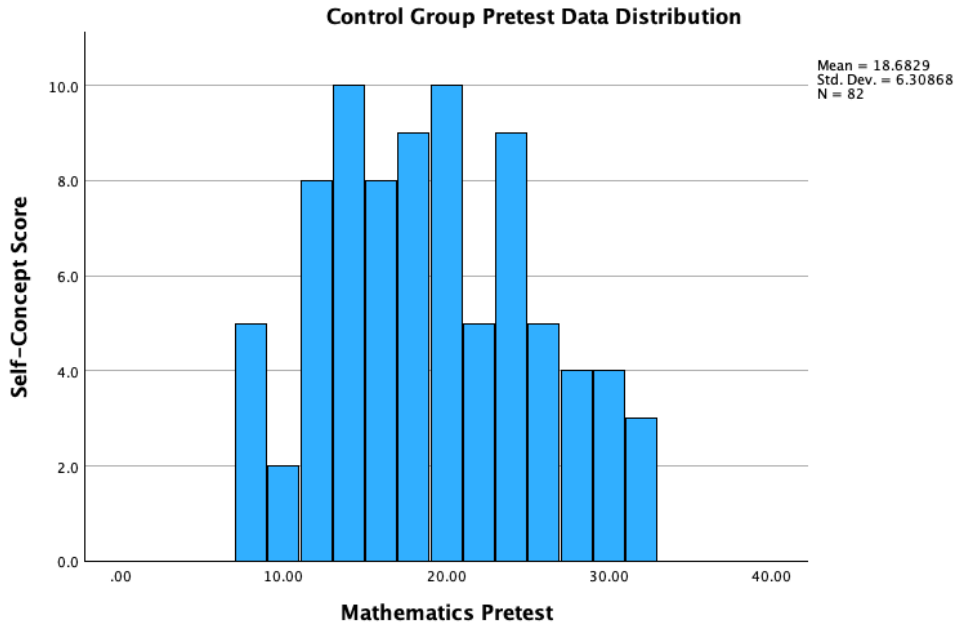
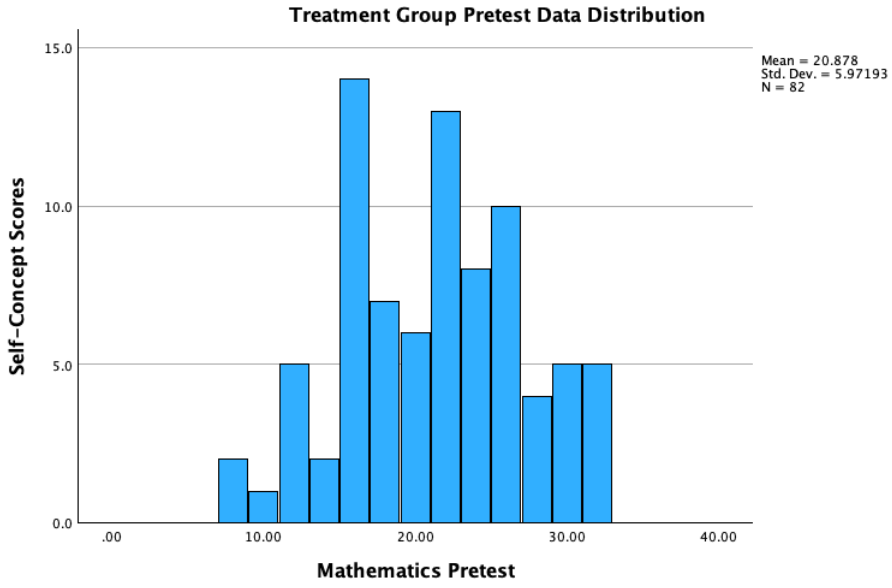


Figure 7

Distribution of Covariate for Mathematics Self-Concept (Treatment Group Pretest Score)



Overall, the mean for the control group's self-concept pretest was 18.68, whereas the treatment group's self-concept was 20.87. The posttest control group's self-concept was 18.45, whereas the treatment group's self-concept was 22.65. Therefore, after controlling for the mathematics self-concept pretest, the control group's mean difference went down 0.23, and the treatment group's mean difference was 1.78 from the pretest to the posttest. Descriptive statistics for the dependent variable can be found in Table 9. See Figures 8–10 for graphs of the data distribution of the dependent variable.

Table 9

Descriptive Statistics for Covariate for Mathematics Self-Concept (Posttest Score)

Group	*N*	*Range*	*Min*	*Max*	*M*	*SD*
Control Group (Traditional Learning)	82	24	8	32	18.45	6.01
Treatment Group (Project-Based Learning	82	21	11	32	22.65	5.29

Figure 8

Distribution of Covariate for Mathematics Self-Concept (Control Group Posttest Score)

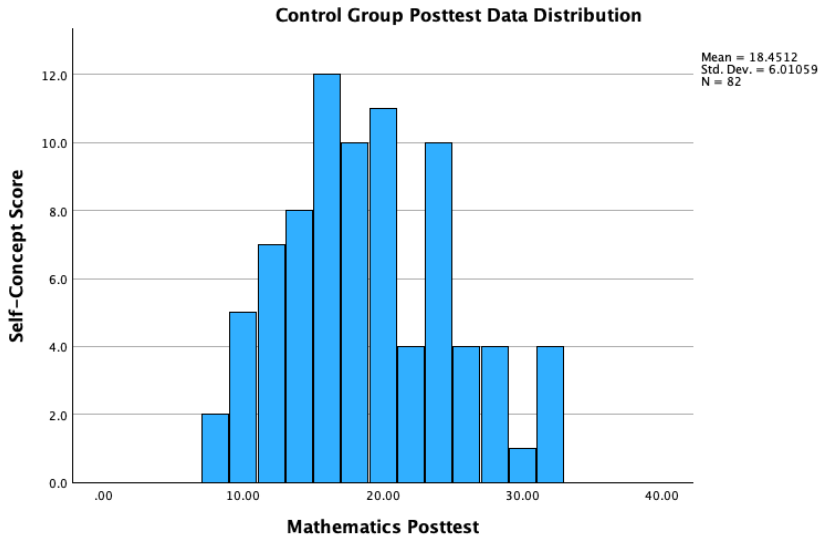


Figure 9

Distribution of Covariate for Mathematics Self-Concept (Treatment Group Posttest Score)

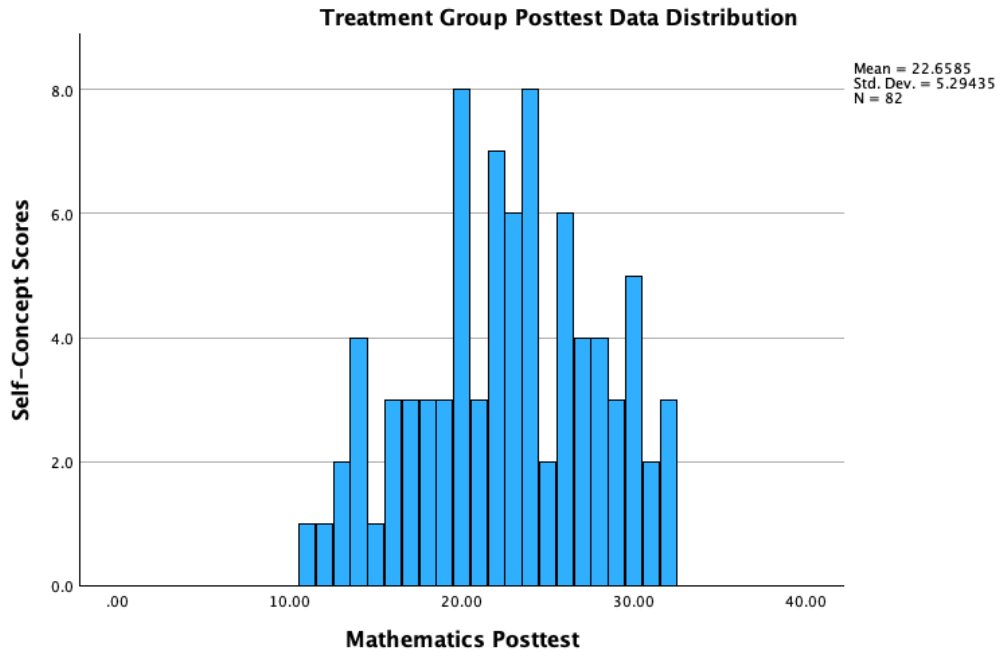
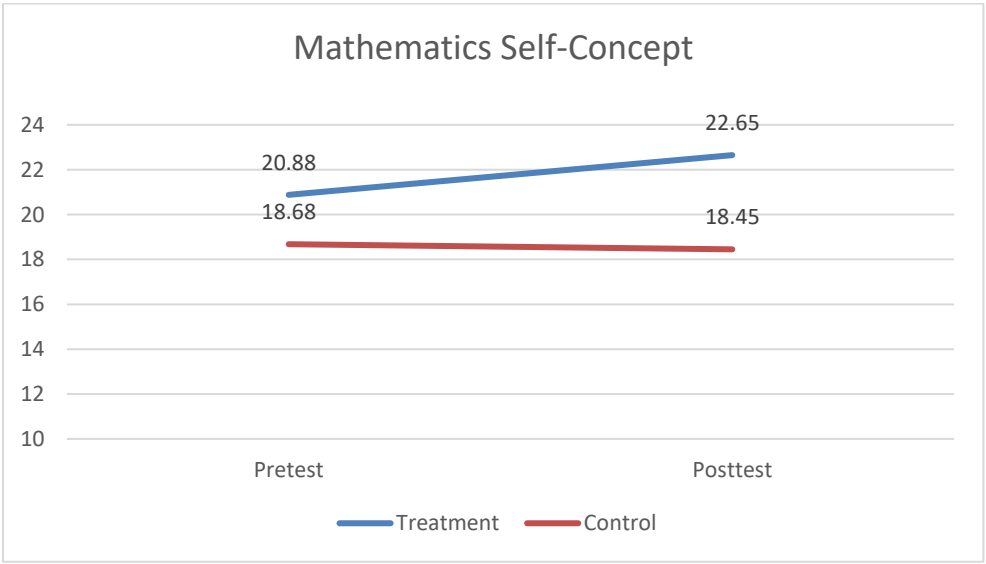


Figure 10

Mathematics Self-Concept Pretest to Posttest Score for Treatment and Control Group



All School Subjects Self-Concept Descriptive Statistics

In all school subjects, the mean self-concept pretest score in the control group was 13.74 with a standard deviation of 3.27; in the treatment group, the mean self-concept pretest score was 13.81 with a standard deviation of 3.37. The median self-concept was 13 (n = 12), and the mode was 13 (n = 12) for the control group, while the treatment group had a median self-concept of 14 (n = 6) and a mode of 15 (n = 16). Descriptive statistics for the covariate are included in Table 10, while Figures 11 and 12 offer visual representations of the data distribution for all school subjects.

Table 10

Descriptive Statistics for Covariate for All School Subjects Self-Concept (Pretest Score)

Group	*N*	*Range*	*Min*	*Max*	*M*	*SD*
Control Group (Traditional Learning)	79	13	8	21	13.74	3.27
Treatment Group (Project-Based Learning	80	15	6	21	13.81	3.37

Figure 11

Distribution of Covariate for All School Subjects Self-Concept (Control Group Pretest Score)

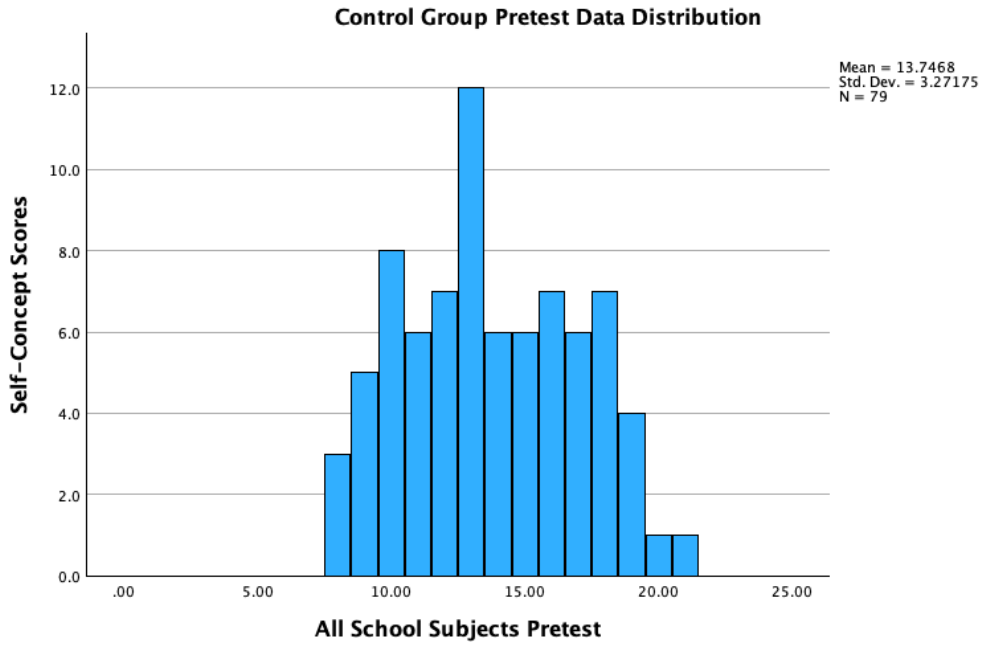
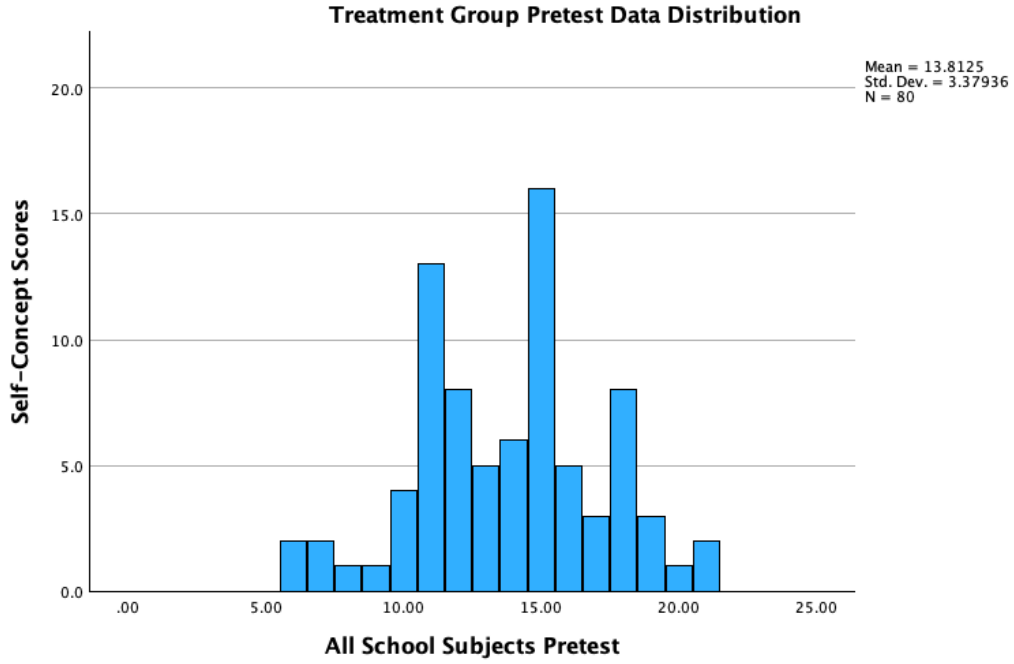


Figure 12

Distribution of Covariate for All School Subjects Self-Concept (Treatment Group Pretest Score)



Overall, the mean self-concept pretest score for the control group was 13.74, while the treatment group scored 13.81. On the posttest, the control group's mean self-concept score was 14.44, compared to 14.82 for the treatment group. After adjusting for the all school subject's self-concept pretest, the control group's mean difference from pretest to posttest was 0.7, whereas the treatment group's mean difference was 1.01. Table 11 and Figures 13–15 visually represent the posttest data distribution for all school subjects.

Table 11

Descriptive Statistics for Covariate for All School Subjects Self-Concept (Posttest Score)

Group	*N*	*Range*	*Min*	*Max*	*M*	*SD*
Control Group (Traditional Learning)	79	15	6	21	14.44	3.48
Treatment Group (Project-Based Learning	80	16	6	22	14.82	3.69

Figure 13

Distribution of Covariate for All School Subjects Self-Concept (Control Group Posttest Score)

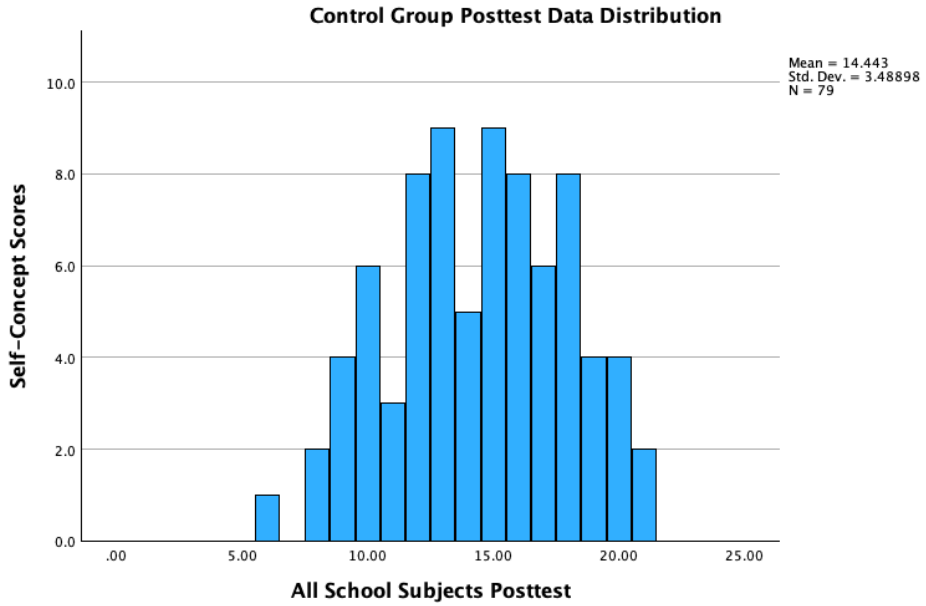


Figure 14

Distribution of Covariate for All School Subjects Self-Concept (Treatment Group Posttest Score)

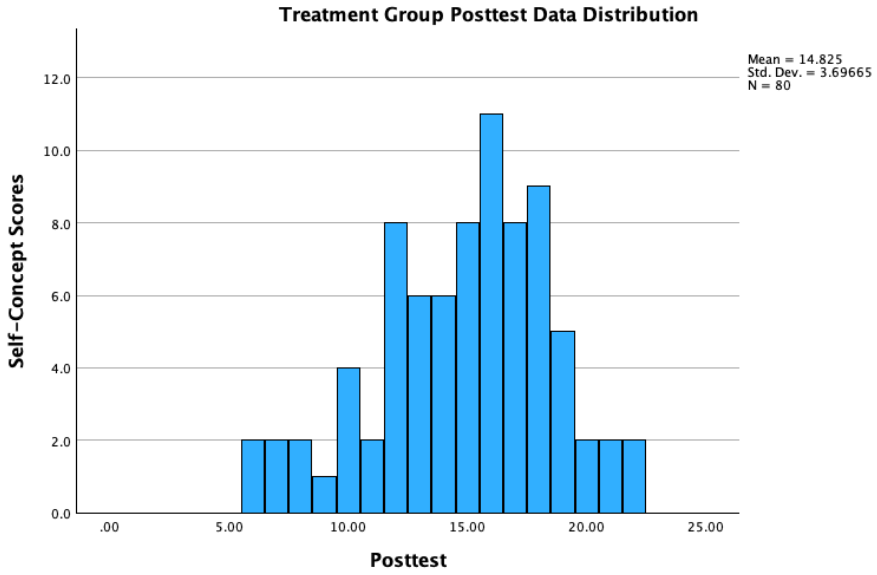
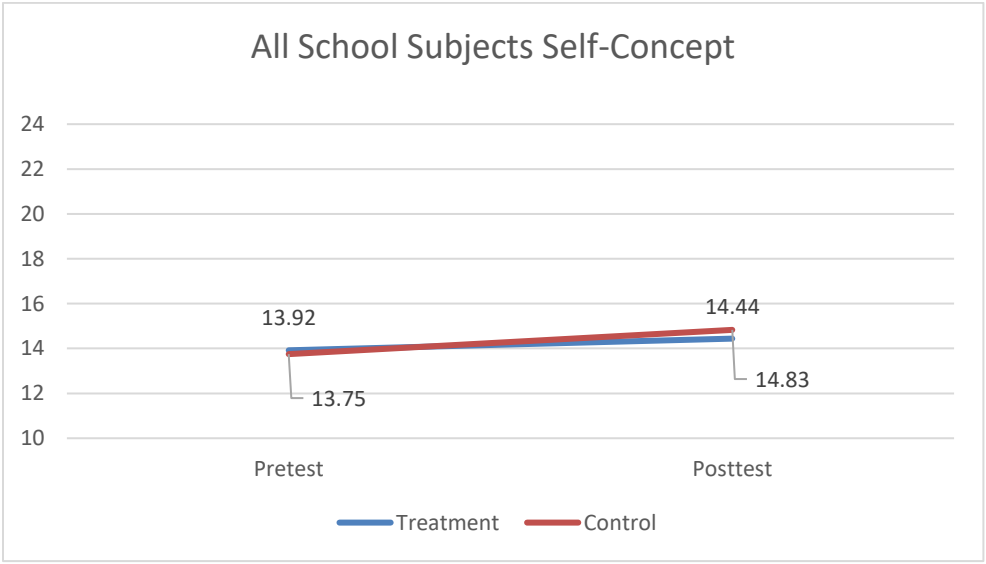


Figure 15

All School Subjects Self-Concept Pretest to Posttest score for Treatment and Control Group



Both the treatment and the control groups showed an increase in self-concept scores across reading, mathematics, and all school subjects. When controlling for the preexisting self-concept levels in all school subjects, the data showed that sixth-grade students who participated in project-based learning exhibited the greatest improvement in their self-concept scores across the subscales of reading, mathematics, and all school subjects.

Results

Hypotheses

This study tested three null hypotheses, each corresponding to one of the research questions. An ANCOVA was conducted for each hypothesis to determine whether project-based learning influenced students' self-concept in reading, mathematics, and all school subjects. The independent variable was whether the students participated in project-based learning or traditional learning strategies, and the dependent variable was the students' self-concept score.

Table 15 (reading self-concept), Table 19 (mathematics self-concept), and Table 24 (all school subjects self-concept) exhibited the mean and standard deviation for each dependent variable among two distinct groups: project-based learning and traditional learning. The analysis revealed that the treatment group demonstrated the greatest improvement in their self-concept in reading, indicating a favorable impact of project-based learning on the student's self-concept. Similarly, in mathematics, the treatment group exhibited the most significant emphasis on the beneficial effect of project-based learning on their self-concept. Statistical significance was used to evaluate the results using an alpha of .05.

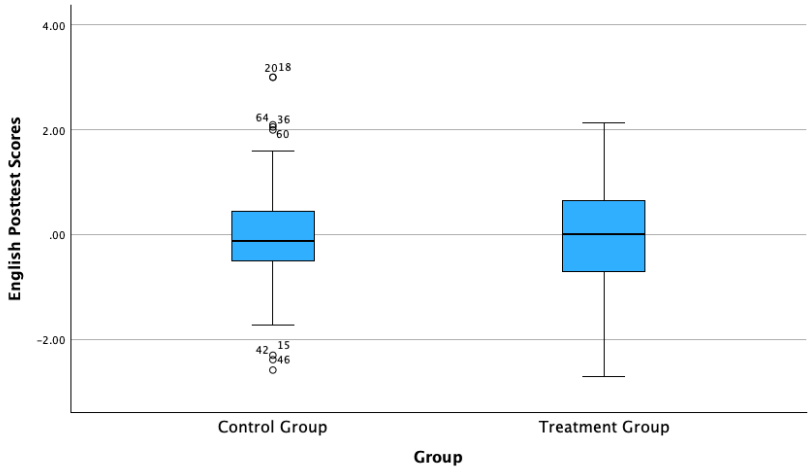
Null Hypothesis $H_0 1$

$H_0 1$: There is no significant difference in reading self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of reading self-concept.

The data underwent a thorough screening to identify any possible inconsistencies or significant outliers. Furthermore, visual data screening was conducted to identify missing data points or inconsistencies in the self-concept scores. The data screening process did not reveal any issues within the dataset. To ensure that participants were only included in one group, independent observations were made by matching each student's pretest and posttest scores and assigning a unique identification code. Additionally, the Google form was set to accept only one response per student to prevent participants from submitting multiple pretest or posttest attempts. Box-and-whisker plots (see Figure 16) were used to determine whether extreme outliers would affect the groups' mean scores, and the outliers were not excluded from the data based on the possibility of extreme self-concept.

Figure 16

Covariate and Dependent Variable Box-and-Whisker Plot for Reading Self-Concept



The data screening met the assumptions supporting the use of ANCOVA, and the following assumptions were tested before running ANCOVA. To meet the first assumption, one dependent variable had to be measured on a continuous scale. The criterion for the dependent variable, which involved being on a continuous scale, was fulfilled by summarizing the scores from the modified SDQ-I reading self-concept assessment.

The second assumption was to have one independent variable consisting of two or more categorical, independent groups. This requirement was met by having an independent variable consisting of two different groups. The two independent categorical groups were students who received project-based learning and students who received traditional learning in reading. The groups were determined by the teacher randomly assigned to implement traditional learning in their classroom as the control group or project-based learning in their classroom as the treatment group. Students could not be a part of both groups simultaneously.

The third assumption was that the covariate was measured at a continuous level. The continuous variable covariate was the sum of scores from eight items measured on a 4-point Likert scale. These pretest scores for the reading self-concept were imported from an Excel file into SPSS. Subsequently, the scores were computed by comparing the pretest and posttest scores. In the ANCOVA model (see Table 15), one covariate, pretest scores, was incorporated, thus satisfying the assumption.

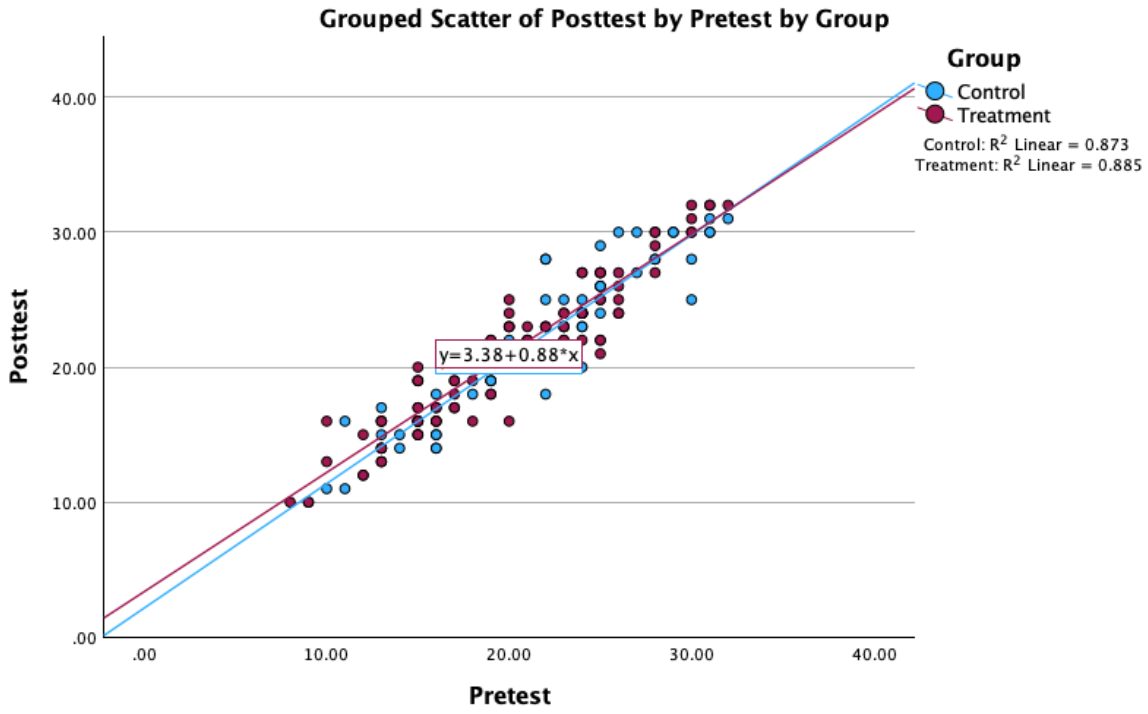
The fourth assumption of independence of observations was satisfied by ensuring that there were no relationships among the groups themselves in the research. This was accomplished by ensuring that each participant was assigned solely to either a treatment or control group for reading, with distinct participants in each group. This assumption was met since each teacher was assigned to a specific group, and each student could only have one reading teacher. To

confirm that each group had different participants, a unique identifier was assigned to each participant, and each participant was limited to only one response per Google form.

The fifth assumption stated that the covariate had to exhibit a linear relationship with the dependent variable at every level of the independent variable. To assess this assumption, a grouped scatterplot was constructed, plotting the dependent variable (i.e., posttest scores) against the covariate (i.e., pretest scores) for each level of the independent variable (i.e., project-based learning and traditional learning). Visual inspection of the scatterplot revealed a linear relationship between the pre- and post-intervention self-concept scores for each type of intervention (see Figure 17). Thus, it was concluded that the fifth assumption was satisfied.

Figure 17

Grouped Scatterplot of Posttest by Pretest by Group for Reading Self-Concept



The sixth assumption concerned the homogeneity of regression slopes, ensuring that there was no interaction between the covariate and the independent variable. To verify this assumption, it was essential for the regression lines to be parallel (see Figure 12) to evaluate the significance of the interaction. This assumption was tested using ANCOVA with an interaction term (see Table 15). In this analysis, the homogeneity of regression slopes was confirmed as the interaction term was found to be statistically nonsignificant, with $F(1,164) = .54$ and $p = .463$. Since the $p > .05$, indicating no significance, the interaction term demonstrated homogeneity of regression slopes (see Table 15).

Table 12

Tests of Between-Subjects Effects With Interaction for Reading Self-Concept

Source	Type III Sum of Squares	*df*	*Mean Square*	*F*	*Sig*
Corrected Model	4178.30	3	1392.77	405.01	<.001
Intercept	84.97	1	84.98	24.71	<.001
Group	4.08	1	4.08	1.19	.278
Reading Self-Concept Pretest	4097.01	1	4097.01	1191.38	<.001
Group* Reading Self-Concept Pretest	1.86	1	1.86	.54	.463
Error	563.98	164	3.44		
Total	81073.00	168			
Corrected Total	4742.28	167			

Note. R Squared = .881 (Adjusted R Squared = .879)

The seventh assumption pertained to the approximate normal distribution of the dependent variable within each group of the independent variable. This was assessed using the Kolmogorov-Smirnov test, considering that the population of each group exceeded 50. Results of the Kolmogorov-Smirnov test indicated a p-value of .044 for the control group and .200 for the treatment group (see Table 13). While the p-value for the control group fell short of meeting the assumption of normal distribution, given the large participant numbers (n = 84), Laerd Statistics (n.d.) noted that this might not necessarily pose a concern. According to Laerd Statistics (n.d.), non-normality has minimal impact on the Type I error rate, rendering the one-way ANCOVA to be robust. Additionally, visual inspection of Q-Q plots supported the conclusion that the

distributions for both the control and treatment groups were normal, as detailed in Table 13 and Figures 18 and 19.

Table 13

Tests of Normality by Group for Reading Self-Concept

Group		Kolmogorov-Smirnov		
		Statistic	*df*	*Sig*
Control Group (Traditional Learning)	Posttest Score	.10	84	.044
Treatment Group (Project-Based Learning	Posttest Score	.05	84	.200

Figure 18

Normal Q-Q Plot of Reading Self-Concept Posttest for Control Group

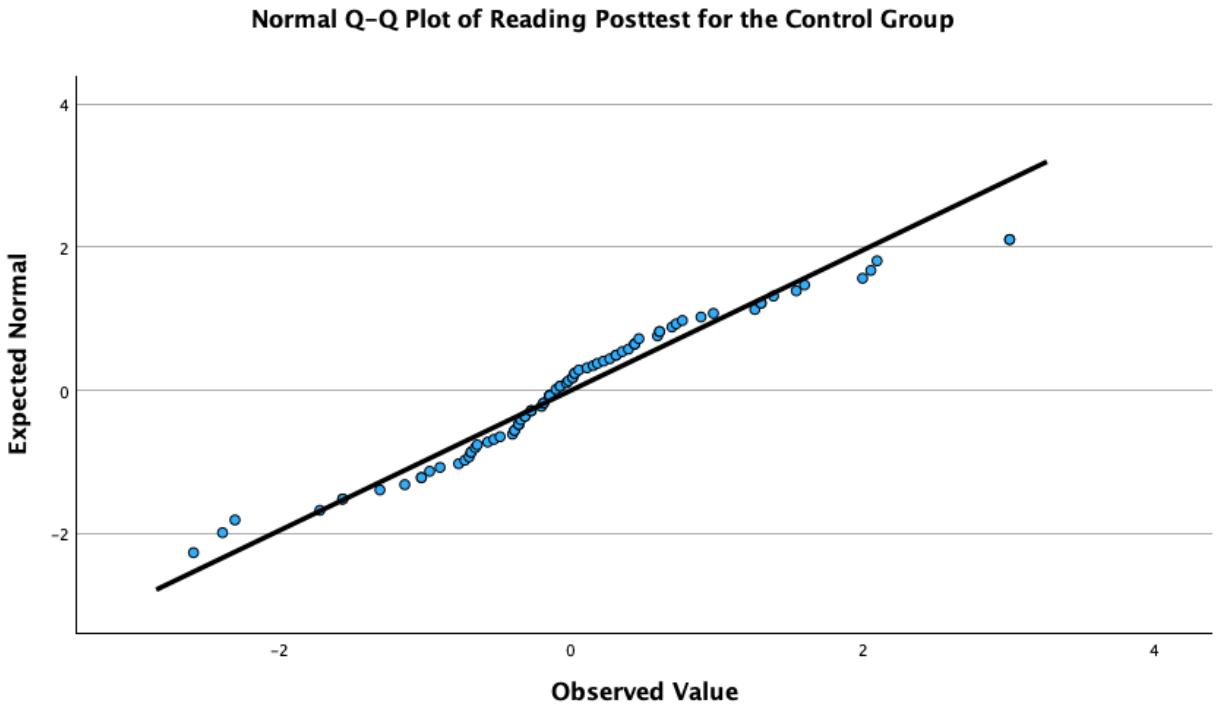
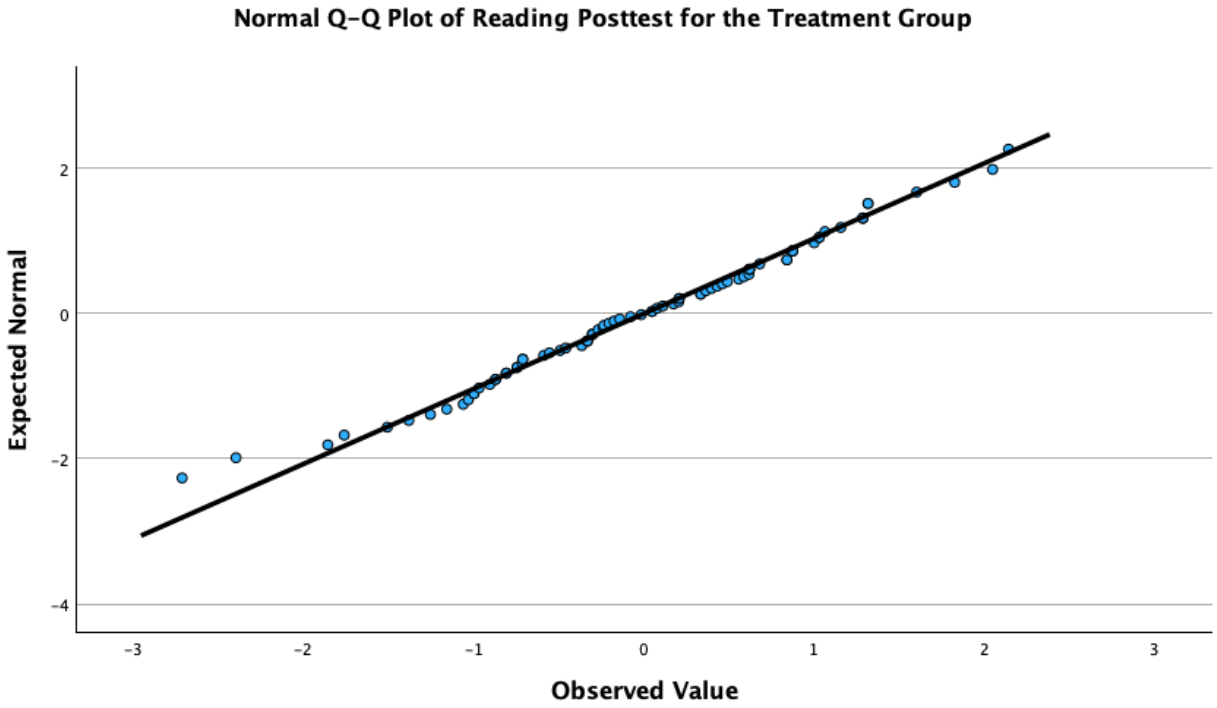


Figure 19

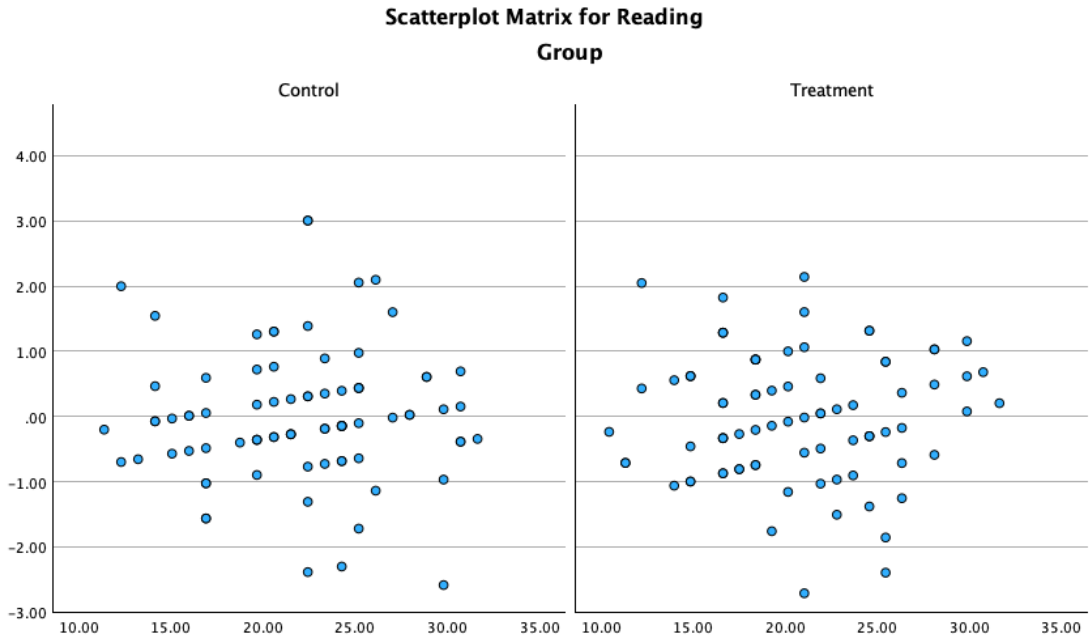
Normal Q-Q Plot of Reading Self-Concept Posttest for Treatment Group



The eighth assumption concerned homoscedasticity, which evaluated the consistency of variance across the predicted values categorized by the independent variables (i.e., the control group and the treatment group). Scatterplots were employed to evaluate the linearity of the ANCOVA model (see Figure 20). Visual inspection of the standardized residuals plotted against the predicted values indicated homoscedasticity.

Figure 20

Scatterplot Matrix for Reading Self-Concept



The ninth assumption pertained to the homogeneity of variances. Homogeneity of variance was evaluated using Levene's Test of Equality of Error Variance. This assumption was satisfied with a p-value of .611. Since Levene's Test yielded a non-significant result ($p > .05$), indicating equal variances, the assumption of homogeneity of variances was upheld. Thus, variances were deemed equal, meeting the requirement of homogeneity of variances. This finding was further confirmed by Levene's test results ($p = .611$), as presented in Table 14.

Table 14

Levene's Test of Equality of Error Variances for Reading Self-Concept

Dependent Variable: Posttest Score			
F	*df1*	*df2*	*Sig*
.26	1	166	.611

The 10th assumption pertained to the absence of significant outliers. This assumption, concerning the reading self-concept scores, was confirmed in both the control and treatment groups. An extreme outlier was defined as a score significantly higher or lower than the average scores within the dataset. Such outliers, whether high or low, could distort the results of the one-way ANCOVA (Laerd Statistics, n.d.). Scores exceeding ±3 standard deviations from the mean warranted investigation for potential removal (Laerd Statistics, n.d.). Upon inspection of the dataset, no standardized residuals exceeded ±3, with 3 being the largest deviation observed. Consequently, no outliers were identified in the data, ensuring compliance with the assumption of no significant outliers.

Results of Null Hypothesis $H_0$1

An ANCOVA was run to determine the differences between sixth-grade students' reading self-concept scores who participated in project-based learning (i.e., treatment group) and those who participated in traditional learning (i.e., control group). After adjustment for pre-intervention self-concept scores, there was not a significant difference in post-intervention reading self-concept scores between the interventions, F (1,165) = 2.11, p = .148, partial η^2 = .01. The self-concept scores in the pretest explained 87.9% of the variance in the posttest self-concept score (η^2 = .88; see Table 15; Richardson, 2011). Therefore, the null hypothesis failed to be rejected.

Table 15

Tests of Between-Subjects Effects Without Interaction Term for Reading Self-Concept

Source	Type III Sum of Squares	*df*	Mean Square	*F*	*Sig*	Partial ETA Squared
Corrected Model	4176.44	2	2088.22	608.93	<.001	.88
Intercept	88.02	1	88.02	25.67	<.001	.14
Group	7.25	1	7.25	2.11	.148	.01
Reading Self-Concept Pretest	4097.72	1	4097.72	1194.91	<.001	.88
Error	565.84	165	3.43			
Total	81073.00	168				
Corrected Total	4742.28	167				

Note. R Squared = .881 (Adjusted R Squared = .879)

Null Hypothesis $H_0$2

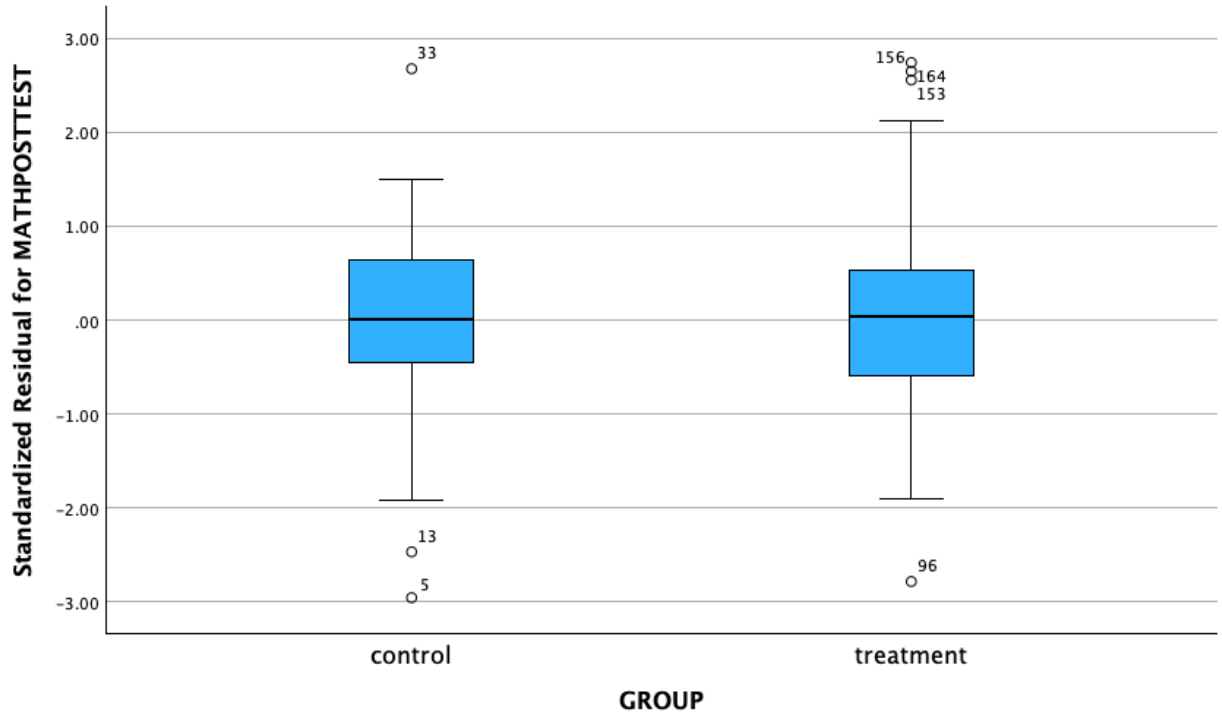
$H_0$2: There is no significant difference in mathematics self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not when controlling for the preexisting level of mathematics self-concept.

The data was thoroughly screened to identify any inconsistencies or significant outliers. In addition, visual data screening was carried out to identify any missing data points or inconsistencies in the self-concept scores. The data screening process did not reveal any issues within the dataset. To ensure that each participant was included in only one group, independent observations were made by matching each student's pretest and posttest scores, followed by

assigning a unique identification code. Furthermore, the Google form was set to accept only one response per student to prevent participants from submitting multiple pretest or posttest attempts. Box-and-whisker plots were used to determine whether extreme outliers would affect the groups' mean scores, and the outliers were not excluded from the data based on the possibility of extreme self-concept (see Figure 21). The data screening met the assumptions supporting the use of ANCOVA, and the following assumptions were tested before running ANCOVA.

Figure 21

Covariate and Dependent Variable Box-and-Whisker Plot for Mathematics Self-Concept



In order to satisfy the first requirement, one dependent variable had to be on a continuous scale. This requirement was met by using the modified SDQ-I mathematics subscale. The condition for the dependent variable, which required a continuous scale, was satisfied by summing the scores from the modified SDQ-I mathematics self-concept assessment.

The second assumption was that one independent variable consisted of two or more categorical, independent groups. This requirement was fulfilled by having an independent variable of two different groups. The two independent categorical groups were made up of students who received project-based learning and students who received traditional learning in mathematics. The groups were determined by randomly assigning teachers to implement either traditional learning in their classroom as the control group or project-based learning in their classroom as the treatment group. Students were not allowed to be a part of both groups at the same time.

The third assumption in the study was that the covariate should be measured at a continuous level. To meet this requirement, the covariate was defined as the sum of scores from eight items measured on a 4-point Likert scale. The pretest scores for mathematics self-concept were imported from an Excel file into SPSS for analysis. These scores were then used to compute the difference between pretest and posttest scores. To satisfy this assumption, the ANCOVA model (see Table 16) included one covariate: the pretest scores.

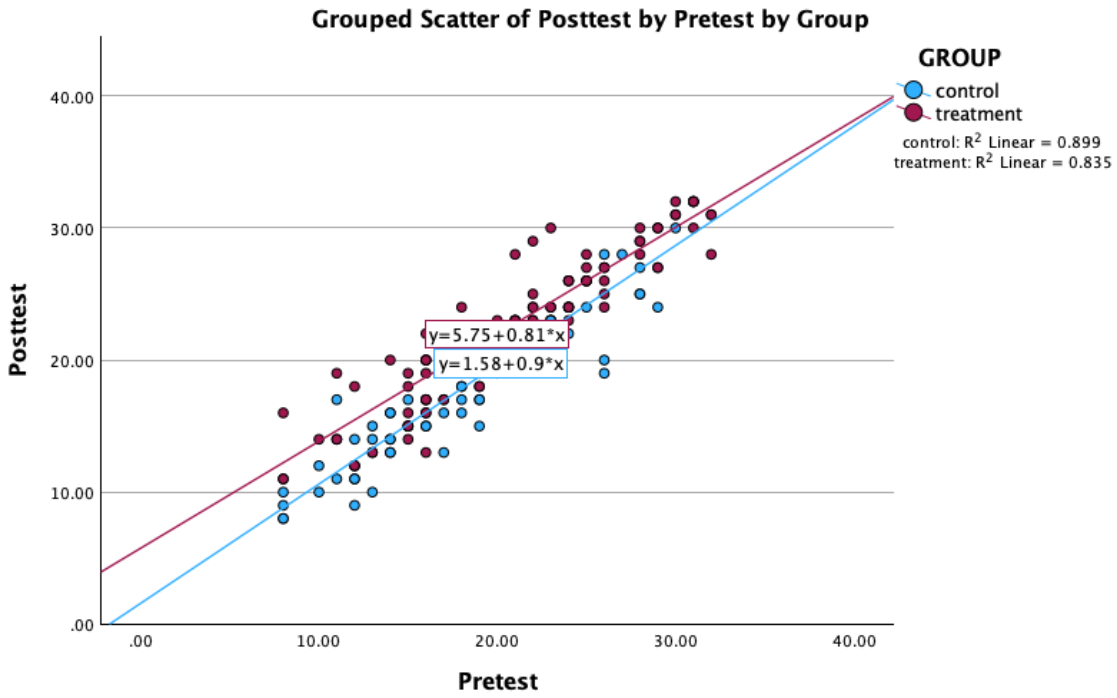
The fourth assumption of independence of observations in the research was met by ensuring that there were no relationships among the groups. This was achieved by assigning each participant solely to either the treatment or control group for mathematics, with distinct participants in each group. As each teacher was assigned to a specific group, and each student could only have one reading teacher, this assumption was satisfied. To verify that each group had different participants, a unique identifier was assigned to each participant, and each participant was restricted to only one response per Google form.

The fifth assumption asserted that the covariate had to demonstrate a linear association with the dependent variable across all levels of the independent variable. To evaluate this, a

grouped scatterplot was generated, depicting the dependent variable (i.e., posttest scores) against the covariate (i.e., pretest scores) for each category of the independent variable (i.e., project-based learning and traditional learning). Visual examination of the scatterplot unveiled a linear relationship between the pre- and post-intervention self-concept scores for both the control and treatment groups (see Figure 22). Therefore, the assumption that the covariate had to be linearly related to the dependent variable at each level of the independent variable had been met.

Figure 22

Grouped Scatterplot of Posttest by Pretest by Group for Mathematics Self-Concept



The sixth assumption of the analysis focused on the homogeneity of regression slopes, which meant ensuring no interaction between the covariate and independent variable. To confirm this, it was crucial to check if the regression lines were parallel to assess the significance of the interaction. This analysis validated the homogeneity of regression slopes as the interaction term was statistically significant, with F (1,160) = 3.16 and p = .077. Since p >.05, indicating that the

slopes are not statistically significant different, it suggested that the interaction term exhibited homogeneity of regression slopes (see Table 16).

Table 16

Tests of Between-Subjects Effects With Interaction Term for Mathematics Self-Concept

Source	Type III Sum of Squares	*df*	*Mean Square*	*F*	*Sig*	Partial ETA Squared
Corrected Model	5250.47	3	1750.16	416.68	<.001	.89
Intercept	189.29	1	189.29	45.07	<.001	.22
Group	61.42	1	61.42	14.62	<.001	.08
Mathematics Self-Concept Pretest	4471.15	1	4471.15	1064.50	<.001	.87
Group* Mathematics Self-Concept Pretest	13.27	1	13.27	3.16	0.077	.02
Error	672.04	160	4.20			
Total	75213.00	164				
Corrected Total	5922.51	163				

Note. R Squared = .887 (Adjusted R Squared = .884)

The seventh assumption concerned the approximate normality of the dependent variable within each category of the independent variable. This was evaluated using the Kolmogorov-Smirnov test, considering that each group's population exceeded 50. Results from this test revealed a p-value of .200 for the control group and .088 for the treatment group (see Table 17). Standard residuals for the interventions were normally distributed, as assessed by Kolmogorov-Smirnov ($p > .05$). Therefore, the normality assumption was met.

Table 17

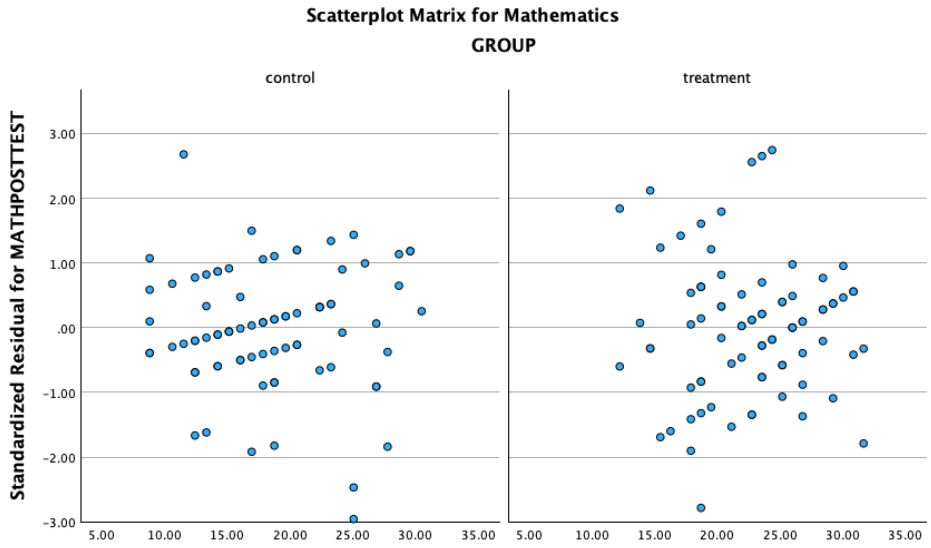
Tests of Normality by Group for Mathematics Self-Concept

Group		Kolmogorov-Smirnov		
		Statistic	*df*	*Sig*
Control Group (Traditional Learning)	Posttest Score	.08	82	.200
Treatment Group (Project-Based Learning	Posttest Score	.09	82	.088

The eighth assumption pertained to homoscedasticity, which assessed the uniformity of variance across predicted values, segregated by the independent variables (i.e., the control group and the treatment group). Scatterplots were utilized to determine the linearity of the ANCOVA model (see Figure 23). Visual examination of the standard residuals plotted against the predicted values suggested homoscedasticity.

Figure 23

Scatterplot Matrix for Mathematics Self-Concept



The ninth assumption focused on the homogeneity of variances, which was assessed using Levene's Test of Equality of Error Variance. This assumption was validated with a p-value

of .524. Since the result of Levene's Test was not statistically significant ($p > .05$), indicating equal variances, the assumption of homogeneity of variances was supported. Therefore, variances were considered equal, fulfilling the criteria of homogeneity of variances. This result was corroborated by Levene's test outcome ($p = .524$), as displayed in Table 18.

Table 18

Levene's Test of Equality of Error Variances for Mathematics Self-Concept

Dependent Variable: Posttest Score			
F	*df1*	*df2*	*Sig*
.41	1	162	.524

The 10th assumption concerned the absence of significant outliers, a condition verified in the control and treatment groups regarding reading self-concept scores. An extreme outlier was a score markedly higher or lower than the average within the dataset. These outliers, whether high or low, can potentially distort the results of the one-way ANCOVA (Laerd Statistics, n.d.). Scores surpassing ±3 standard deviations from the mean required scrutiny for potential removal. Upon examination of the dataset, no standardized residuals exceeded ±3, with -2.96 representing the most significant deviation observed. Consequently, no outliers were detected in the data, ensuring adherence to the assumption of no significant outliers.

Results of Null Hypothesis $H_0 2$

Two ANCOVAs were conducted for mathematics self-concept: one with interaction effects (see Table 16) and one without (see Table 19). The results indicated a statistically significant difference in post-intervention self-concept between the interventions, suggesting that the interventions had a notable impact on participants' self-concept in mathematics. Specifically,

an ANCOVA was performed to assess the effect of project-based learning on students' mathematics self-concept, controlling for pre-intervention self-concept scores. After this adjustment, there was a statistically significant difference in post-intervention mathematics self-concept scores between the interventions, F (1,161) = 50.29, $p < .001$, partial $\eta^2 = .24$. After controlling for initial levels, the treatment group's posttest scores showed a 12% improvement, with an average increase of 2.32 points in self-concept. Consequently, the treatment group (i.e., project-based learning) demonstrated significantly higher self-concept scores than the control group (i.e., traditional learning), affirming that project-based learning significantly positively affects students' mathematics self-concept. The self-concept scores in the pretest explained 83.3% of the variance in the posttest self-concept score ($\eta^2 = .84$; Richardson, 2011). See also Table 20. Therefore, the null hypothesis was rejected.

Table 19

Tests of Between-Subjects Effects Without Interaction Term for Mathematics Self-Concept

Source	Type III Sum of Squares	*df*	Mean Square	*F*	*Sig.*	Partial ETA Squared
Corrected Model	5237.20[a]	2	2618.60	615.19	<.001	.88
Intercept	180.91	1	180.91	42.50	<.001	.21
Group	214.04	1	214.04	50.29	<.001	.24
Mathematics Self-Concept Pretest	4511.44	1	4511.44	1059.88	<.001	.87
Error	685.31	161	4.26			
Total	75213.00	164				
Corrected Total	5922.51	163				

[a] R Squared = .884 (Adjusted R Squared = .883)

Table 20

Estimated Marginal Means for Mathematics Self-Concept

Group	*Mean*	*Std. Error*
Control	19.39	.23
Treatment	21.72	.23

Null Hypothesis $H_0$3

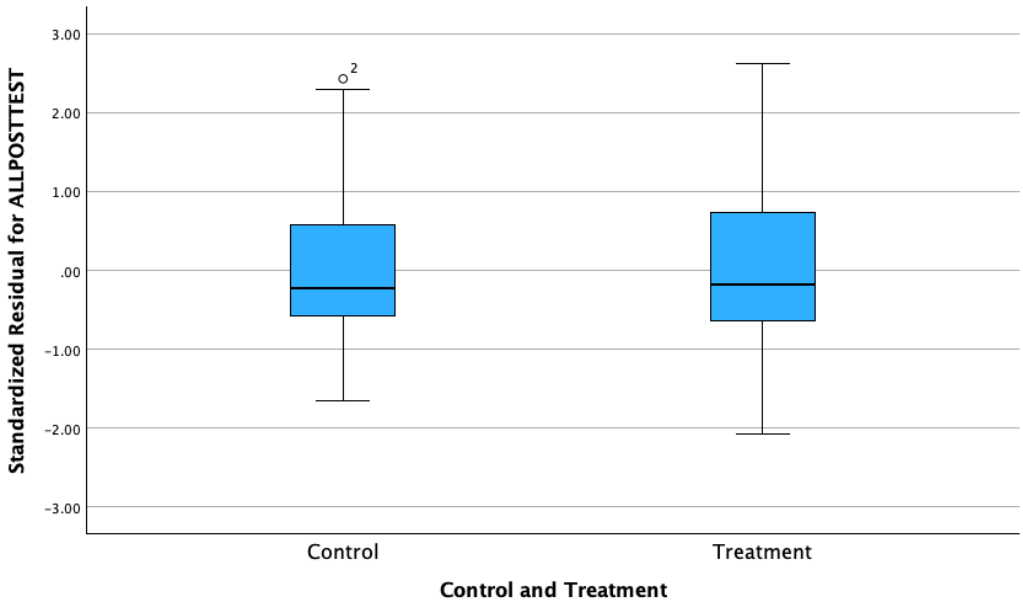
$H_0$3: There is no significant difference in all school subjects self-concept scores, as measured by the modified SDQ-I between sixth-grade students who participated in project-based

learning and those who did not, when controlling for the preexisting level of all school subjects self-concept.

The dataset was thoroughly checked to identify any inconsistencies or significant outliers. In addition, visual data screening was carried out to detect any missing data points or inconsistencies in the self-concept scores. The data screening process did not reveal any issues within the dataset. To ensure that each participant was included in only one group, independent observations were made by matching each participant's pretest and posttest scores and assigning a unique identification code. Furthermore, the Google form was set to accept only one response per participant to prevent participants from submitting multiple pretest or posttest attempts. Box-and-whisker plots (see Figure 24) were used to determine whether any extreme outliers would affect the groups' mean scores, and the outliers were not excluded from the data based on the possibility of extreme self-concept. The data screening met the assumptions supporting the use of ANCOVA, and the following assumptions were tested before running ANCOVA.

Figure 24

Covariate and Dependent Variable Box-and-Whisker Plot for All School Subjects Self-Concept



A dependent variable had to be measured on a continuous scale to satisfy the initial requirement. This criterion was satisfied using the modified all-school subscale of the SDQ-I. The requirement for the dependent variable, which necessitated a continuous scale, was met by totaling the scores from the modified SDQ-I all school subjects' self-concept assessment.

The second assumption of the study was to have one independent variable that consisted of two or more categorical, independent groups. This requirement was fulfilled by having an independent variable with two different groups. The two independent categorical groups were comprised of students who received project-based learning and students who received traditional learning. These groups were determined by randomly assigning the teacher to implement traditional learning as the control group or project-based learning in their classroom as the treatment group. Notably, students could not be a part of both groups simultaneously.

The ANCOVA model assumed that the covariate was measured at a continuous level. To satisfy this assumption, the continuous variable covariate comprised the scores from six items measured on a 4-point Likert Scale. The pretest scores for all school subjects' self-concept were imported from an Excel file into SPSS. The scores were computed by comparing pretest and posttest scores. One covariate, pretest scores, was incorporated into the ANCOVA model, as shown in Table 18.

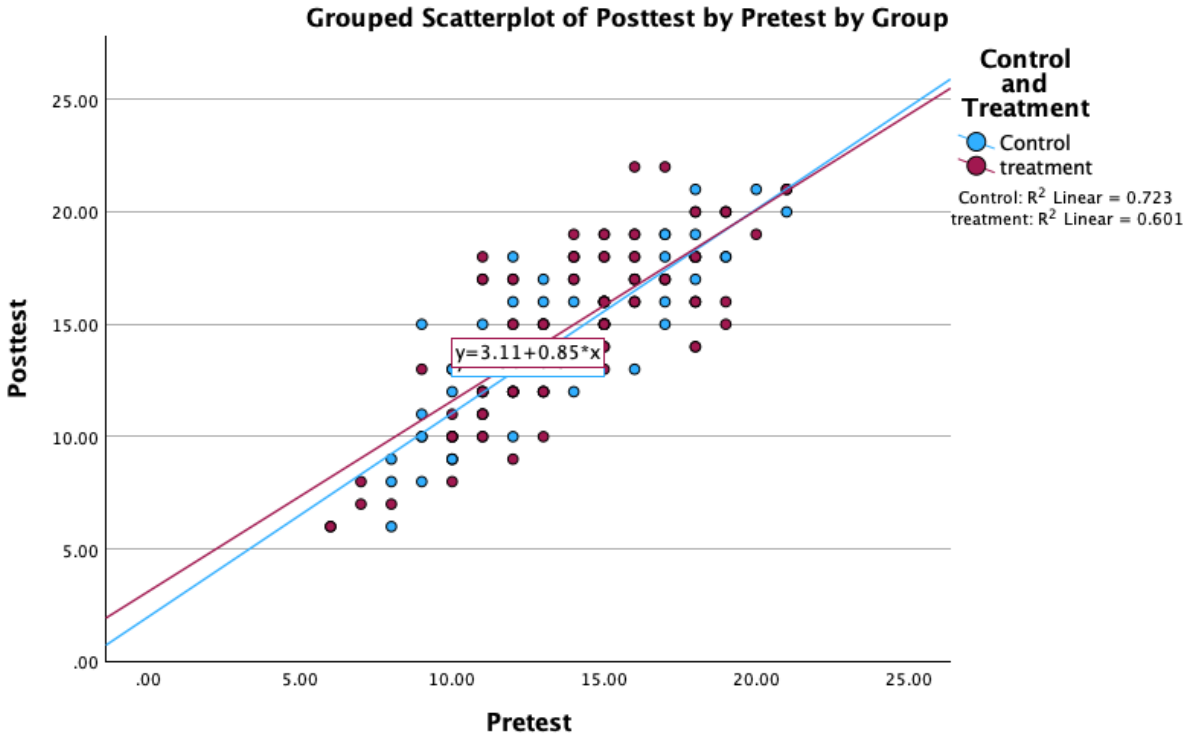
The fourth assumption of independence of observations was met by ensuring that there were no relationships between the groups in the study. This was done by ensuring that each participant was assigned exclusively to either a treatment or a control group for all school subjects, with no overlap between the participants in each group. This assumption was satisfied as each teacher was assigned to a specific group, and each student could have only one teacher.

To ensure that each group had distinct participants, a unique identifier was assigned to each participant, and each participant was limited to submitting only one response per Google form.

The fifth assumption in statistical analysis required that the covariate display a linear relationship with the dependent variable at every independent variable level. To verify this, a grouped scatterplot was created by plotting the dependent variable (i.e., posttest scores) against the covariate (i.e., pretest scores) for each level of the independent variable (i.e., project-based learning and traditional learning). Upon visual analysis of the scatterplot, it was found that there was a linear relationship between the pre-and post-intervention self-concept scores for each type of intervention (see Figure 25). Therefore, the fifth assumption was met.

Figure 25

Grouped Scatterplot of Posttest by Pretest by Group for All School Subjects Self-Concept



The sixth assumption in regression analysis was the homogeneity of regression slopes. It ensured no interaction between the covariate and the independent variable. To confirm this assumption, it was necessary to check that the regression lines were parallel, as shown in Figure 22, and evaluate the significance of the interaction. In this analysis, the homogeneity of regression slopes was confirmed as the interaction term was statistically insignificant, with $F(1,155) = .33$ and $p = .568$. The $p > .05$ indicated that the interaction term demonstrated homogeneity of regression slopes, as shown in Table 21.

Table 21

Tests of Between-Subjects Effects With Interaction Term for All School Subjects Self-Concept

Source	Type III Sum of Squares	*df*	Mean Square	*F*	*Sig*	Partial ETA Squared
Corrected Model	1341.19	3	447.07	99.90	<.001	.66
Intercept	55.94	1	55.94	12.50	<.001	.08
Group	2.74	1	2.74	.611	.435	.004
All School Subjects Self-Concept Pretest	1335.35	1	1335.35	298.39	<.001	.66
Group* All School Subjects Self-Concept Pretest	1.47	1	1.47	.327	.568	.002
Error	693.65	155	4.48			
Total	36091.00	159				
Corrected Total	2034.84	158				

Note. R Squared = .659 (Adjusted R Squared = .653)

The seventh assumption stated that the dependent variable should follow an approximately normal distribution within each independent variable group. The Kolmogorov-Smirnov test was used to assess this assumption, considering that each group had more than 50 participants. The results showed a p-value of .018 for the control group and .005 for the treatment group (see Table 22). Although both the control and treatment groups did not satisfy the normality assumption, with many participants (n = 79 and n = 80), it may not be a significant concern, as noted by Laerd statistics (n.d.) According to Laerd Statistics (n.d.), non-normality has a minimal impact on the Type I error rate, which made the one-way ANCOVA robust. Furthermore, visual inspection of Q-Q- plots supported the conclusion that the distributions of both the control and treatment groups were normal, as presented in Table 22 and Figures 26 and 27.

Table 22

Tests of Normality by Group for All School Subjects Self-Concept

Group		Kolmogorov-Smirnov		
		Statistic	*df*	*Sig*
Control Group (Traditional Learning)	Posttest Score	.11	79	.018
Treatment Group (Project-Based Learning	Posttest Score	.12	80	.005

Figure 26

Normal Q-Q Plot of Standardized Residual for All School Subjects Self-Concept Posttest for Control Group

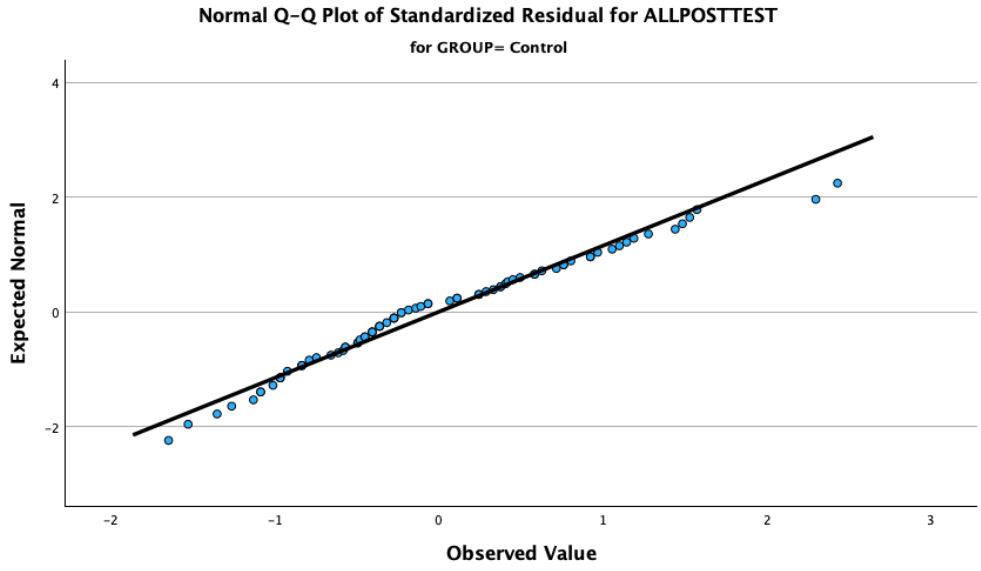
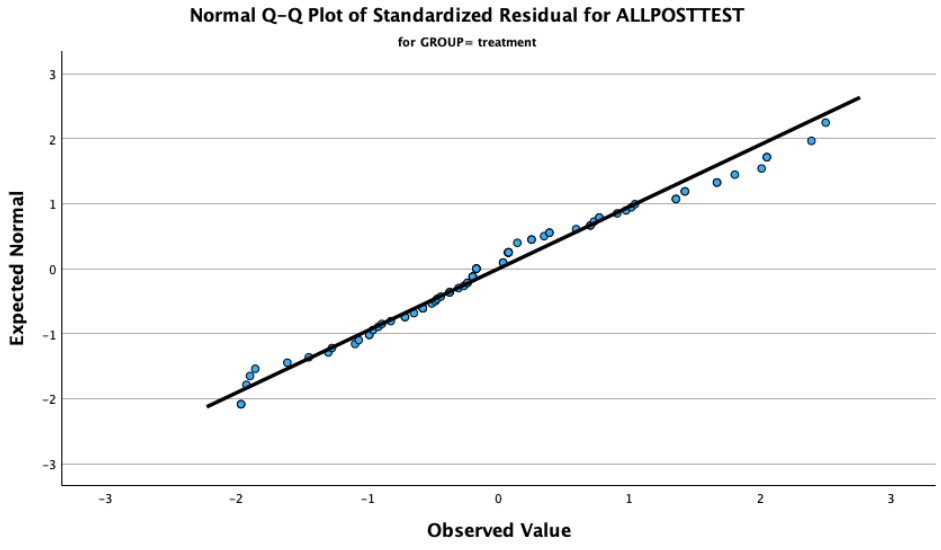


Figure 27

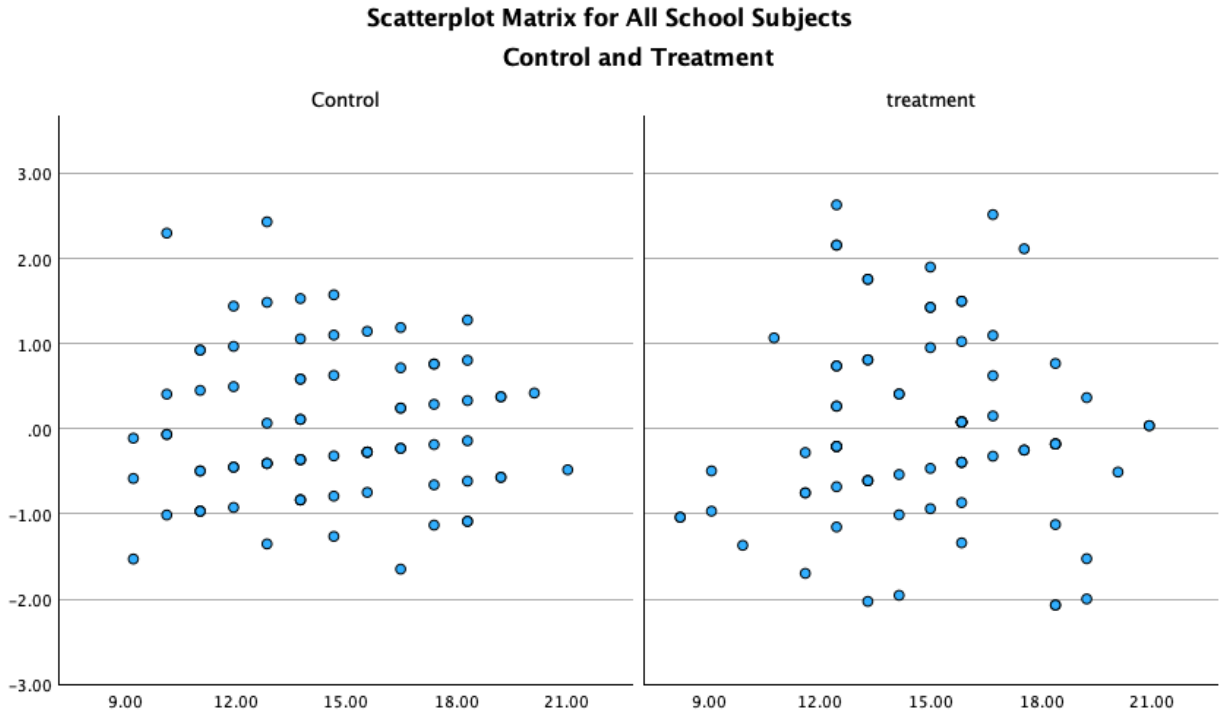
Normal Q-Q Plot of Standardized Residual for All School Subjects Self-Concept Posttest for Treatment Group



The eighth assumption in statistical analysis involved homoscedasticity, which assessed the consistency of variance in predicted values across independent variables, such as the control group and the treatment group. Scatterplots were used to evaluate the linearity of the ANCOVA model (see Figure 28). Visual inspection of the standardized residuals plotted against the predicted values indicated that homoscedasticity was present. Therefore, the eighth assumption was met.

Figure 28

Scatterplot Matrix for All School Subjects Self-Concept



The ninth assumption dealt with homogeneity of variances, which was tested using Levene's Test of Equality of Error Variance. The test produced a p-value of .147, indicating that the assumption of homogeneity of variances was upheld since the result was non-significant ($p > .05$), meaning that the variances were equal. This requirement of homogeneity of variances was met, as confirmed by the results of Levene's test ($p = .147$), which is presented in Table 23.

Table 23

Levene's Test of Equality of Error Variances for All School Subjects Self-Concept

Dependent Variable: Posttest Score			
F	*df1*	*df2*	*Sig*
2.12	1	157	.147

The 10th assumption dealt with the presence of any noticeable outliers. The assumption regarding all school subjects' self-concepts was met in both the control and treatment groups. An extreme outlier was a score significantly higher or lower than the average scores within the dataset. These outliers, whether high or low, can potentially distort the results of the one-way ANCOVA (Laerd Statistics, n.d.). Scores that exceed ±3 standard deviations from the mean required further investigation for potential removal. After reviewing the dataset, no standard residual exceeded ±3, with 2.63 being the most significant deviation observed. Therefore, no outliers were identified in the data, and the assumption of no significant outliers was met.

Results of Null Hypothesis $H_0$3

An ANCOVA was run to determine the effect of the differences between sixth-grade students' all school subjects self-concept scores that participated in project-based learning (i.e., treatment group) and those who participated in traditional learning (i.e., control group). After adjustment for pre-intervention all school subjects' self-concept scores, there was no significant

difference in post-intervention reading self-concept scores between the interventions, F (1,156) = .94, p = .334, partial η^2 = .01 (see Table 24). The self-concept scores in the pretest explained 65.4% of the variance in the posttest self-concept score (η^2 = .65; Richardson, 2011). Therefore, the null hypothesis was rejected.

Table 24

Tests of Between-Subjects Effects Without Interaction Term for All School Subjects Self-Concept

Source	Type III Sum of Squares	*df*	Mean Square	*F*	*Sig*	Partial Eta Squared
Corrected Model	1339.73	2	669.86	150.33	<.001	.66
Intercept	56.65	1	56.65	12.71	<.001	.08
Group	4.18	1	4.18	.94	.334	.01
All School Subjects Self-Concept Pretest	1333.93	1	1333.93	299.36	<.001	.66
Error	695.11	156	4.46			
Total	36091.00	159				
Corrected Total	2034.84	158				

Note. R Squared = .658 (Adjusted R Squared = .654)

Summary

The purpose of this quantitative, quasi-experimental study was to examine how project-based learning affects sixth-grade students' self-concept in all school subjects, specifically reading and mathematics, at a rural middle school in southeast Virginia. An ANCOVA was conducted to compare the posttest self-concept scores of students who participated in project-

based learning versus those who received traditional education. The independent variable was the type of learning, and the dependent variable was posttest self-concept scores in reading, mathematics, and all school subjects. The analysis was performed using SPSS 28.0, and the pretest self-concept scores were used as a covariate. The results of the analysis failed to reject the null hypothesis for two of the research questions, which meant that there was no significant difference in the treatment and control groups regarding reading self-concept and all school subjects' self-concept. The ANCOVA findings showed a statistically significant difference in the posttest mathematics self-concept score between students who experienced project-based learning and those who experienced traditional learning, resulting in a rejection of the null hypothesis. Thus, project-based learning exerted a beneficial influence on students' mathematics self-concept.

CHAPTER FIVE: CONCLUSIONS

Overview

This study investigated how project-based learning affects sixth-grade students' self-concept in all school subjects, specifically reading and mathematics. The self-concept scores were analyzed when controlling for the preexisting level of self-concept. This chapter includes a discussion of the results, implications, limitations, and recommendations for further research.

Discussion

This quantitative, quasi-experimental study examined whether project-based learning affects sixth-grade students' self-concept across all school subjects, with a particular focus on reading and mathematics, at a rural middle school in southeastern Virginia. The research included a 3-week intervention period. During this time, students in the treatment group engaged in daily project-based learning activities. The study aimed to determine whether this educational approach could enhance students' perceptions of their abilities in these core subjects.

The results of the study did not provide conclusive evidence that project-based learning can change self-concept. Several factors could have contributed to this outcome. It is possible that treatment fidelity was not adequately maintained, meaning that the project-based learning implementation varied significantly across different classrooms. Additionally, the involvement of first-year teachers, who may have lacked the experience and confidence to effectively execute project-based learning strategies, could have impacted the results. Another consideration is that project-based learning, despite its benefits in other areas, might inherently lack the ability to influence self-concept. Finally, the curriculum itself may not have been designed in a way that supports changes in self-concept through project-based learning. Therefore, the inconclusive nature of the study leaves the specific reasons behind the findings uncertain.

Marsh et al. (2019) found that enhanced self-concept can lead to better academic performance, positive social interactions, higher motivation, and improved emotional well-being and mental health. Chen and Yang (2019) found that project-based learning improves students' academic scores and self-efficacy. Project-based learning has been known to significantly impact self-efficacy, mainly because it is hands-on and experiential. Individuals develop a sense of mastery and accomplishment by engaging in real-world projects as they tackle challenges and solve problems (Chen & Yang, 2019; Marsh et al., 2019). This process boosts their belief in their ability to succeed, known as self-efficacy. However, it may not necessarily affect self-concept in the same way. Self-concept referred to a broader, more stable perception of oneself, encompassing beliefs about one's overall worth and identity (Marsh et al., 2019). While project-based learning can enhance specific skills and confidence in completing tasks, it may not inherently alter one's fundamental self-concept. Self-concept is influenced by factors beyond skill mastery, including social comparisons, cultural norms, and personal experiences, making it less susceptible to change through a single learning approach like project-based learning (Shavelson et al., 1976).

Research has shown that self-concept, self-efficacy, and project-based learning are interconnected, each supporting and enhancing the others in education. Positive self-concept and high self-efficacy significantly boost students' involvement and achievements in project-based learning. Conversely, the theory supported the conjecture that engaging in project-based learning can cultivate positive self-concept and self-efficacy (Al-Abyadh & Abdel Azeem, 2022).

However, there has not been significant research that investigated how project-based learning affects students' self-concept. This lack of exploration highlighted a significant oversight in educational research, as understanding the relationship between these two variables

has been crucial for informing effective teaching practices and promoting student well-being (Marsh et al., 2019). By bridging this gap, researchers can uncover valuable insights into how project-based learning impacts students' perceptions of themselves and their abilities. This emphasis has underscored the importance of addressing this gap in the literature to advance our understanding of educational methodologies and their influence on student outcomes. Thus, the foundation for the present study was formed by integrating these concepts with the researcher's professional and personal experiences in education.

The study was also driven by recognizing that project-based learning can be vital to student self-concept. By engaging in project-based learning, students can take ownership of their learning, which fosters a sense of competence and autonomy. This learning method encourages students to collaborate, solve real-world problems, and think critically, enhancing their self-efficacy and intrinsic motivation (Chen & Yang, 2019; Marsh et al., 2019; Shin, 2018). Through these meaningful and hands-on experiences, students can see the tangible results of their efforts, which positively influences their self-perception and academic identity. The interactive nature of project-based learning helps to build a supportive learning community, further reinforcing students' confidence in their abilities (Chen & Yang, 2019). Ultimately, the study investigated the potential of project-based learning to transform educational experiences and bolster students' belief in their capabilities.

Research Question 1

RQ1: Is there a difference in reading self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not when controlling for the preexisting level of reading self-concept?

Null Hypothesis

$H_0$1: There is no significant difference in reading self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of reading self-concept.

Project-based learning did not lead to higher reading self-concept in the group receiving project-based learning versus the traditional learning method. Overall, the control group had a mean self-concept pretest score of 21.53, while the treatment group scored 19.54. On the posttest, the control group's mean self-concept score was 22, compared to 20.63 for the treatment group. After adjusting for pretest self-concept levels, the mean difference was 0.47 for the control group and 1.09 for the treatment group. The null hypothesis, which assumed so significant difference in reading self-concept scores between students who engaged in project-based learning and those who did not, after controlling for pre-existing levels of reading self-concept was not rejected ($F(1,165) = 2.11$, $p = .148$, partial $\eta^2 = .01$). After adjustment for pre-intervention self-concept scores, there was not a significant difference in post-intervention reading self-concept scores between the interventions. This indicated that project-based learning did not significantly impact the reading self-concept of the participating sixth-grade students.

Despite extensive research on project-based learning's impact on academic achievement, self-efficacy, motivation, and attitude in various subjects, there was a gap in understanding its effects on reading self-concept, particularly among sixth-grade students. Existing literature emphasized the importance of reading self-concept in shaping students' academic outcomes, particularly in reading comprehension (Katzir et al., 2009). Studies have demonstrated that students with a positive reading self-concept tend to perform better in reading-related tasks (Locher et al., 2021). Additionally, Shin (2018), Duke et al. (2021), and Baş and Gezegin (2015)

suggested that there is a positive correlation between project-based learning experiences and reading self-efficacy, motivation, and attitudes. However, the absence of specific investigations into reading self-concept within these studies left uncertainty regarding the direct positive influence of project-based learning on students' beliefs about their reading abilities. The results of this study contradicted the broader research, suggesting that project-based learning promotes positive self-efficacy, which in turn enhances self-concept. Instead, the results suggested that project-based learning may not necessarily create positive self-efficacy or self-concept, which aligned with research by Choi et al. (2019).

The study on the effect of project-based learning on sixth-grade students' self-concept aligned with research by Shin (2018), which explored project-based learning's impact on students' motivation and self-efficacy in an ELA teaching context. Shin's research found that project-based learning significantly enhanced students' motivation and self-efficacy. In the current study, lesson plans from PBLworks.org were used for reading, and while the treatment group showed higher self-concept scores after adjusting for initial levels, the difference was not statistically significant. Despite the lack of significant findings in reading, both studies highlighted the positive influence of project-based learning on student outcomes, underscoring the importance of using such approaches to boost self-concept and motivation across different academic areas.

The present study found no significant relationship between project-based learning and students' reading self-concept. Several factors could have contributed to this lack of significant findings. First, the duration of the intervention may have limited the extent to which the effects of project-based learning could have fully materialized. A more extended intervention period might have afforded students greater opportunities to engage deeply with the curriculum,

potentially yielding more pronounced outcomes. Additionally, implementing project-based learning by novice teachers might have introduced instructional quality and consistency variability. These educators may have still been acquainting themselves with classroom dynamics and instructional strategies, which could have impacted the effectiveness of the intervention. Conversely, more experienced instructors might have been better equipped to navigate the challenges associated with project-based learning, possibly leading to more robust outcomes. Moreover, the timing of the intervention within the school year could have influenced students' responsiveness and engagement. Implementing project-based learning toward the end of the academic year, when students might be tired or distracted by state assessments or grade transitions, could have diminished its impact. Alternatively, introducing the intervention at the beginning of the year might have facilitated a smoother integration into the curriculum and provided ample time for students to adapt to the instructional approach. The complexity of reading self-concept underscored the necessity for further investigation to unravel its intricate relationship with project-based learning. Factors, such as prior experiences and motivation, play pivotal roles in shaping reading self-concept, highlighting the multifaceted nature of this construct (Haas & vanDellen, 2020).

Research Question 2

RQ2: Is there a difference in mathematics self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of mathematics self-concept?

Null Hypothesis 2

$H_0$2: There is no significant difference in mathematics self-concept scores, as measured by the modified SDQ-I, between sixth-grade students who participated in project-based learning and those who did not when controlling for the preexisting level of mathematics self-concept.

Project-based learning led to higher mathematics self-concept in the group receiving project-based learning compared to the traditional learning method. The control group had a mean self-concept pretest score of 18.68, while the treatment group scored 20.87. On the posttest, the control group's mean self-concept score was 18.45, compared to 22.65 for the treatment group. After adjusting for pretest self-concept levels, the mean difference was -0.23 for the control group and 1.78 for the treatment group. The null hypothesis, which assumed no significant difference in mathematics self-concept scores between students who engaged in project-based learning and those who did not, was rejected after controlling for preexisting levels of self-concept.

An ANCOVA was performed to assess the effect of project-based learning on students' mathematical self-concept, controlling for pre-intervention self-concept scores. After this adjustment, there was a statistically significant difference in post-intervention mathematics self-concept scores between the interventions, F (1,161) = 50.29, $p < .001$, partial $\eta^2 = .24$. After controlling for initial levels, the treatment group's posttest scores showed a 12% improvement, with an average increase of 2.32 points in self-concept. Consequently, the treatment group (i.e., project-based learning) demonstrated significantly higher self-concept scores than the control group (i.e., traditional learning), affirming that project-based learning significantly positively affects students' mathematics self-concept. The self-concept scores in the pretest explained 83.3% of the variance in the posttest self-concept score ($\eta^2 = .83$). Therefore, the null hypothesis

was rejected, indicating that project-based learning significantly impacts the mathematics self-concept of the participating sixth-grade students.

This study investigated the impact of project-based learning on the mathematics self-concept of sixth-grade students. Although direct research on the impact of project-based learning on mathematics self-concept was nonexistent, this study's findings provided compelling evidence of the positive effect of project-based learning on students' mathematics self-concept. Despite the lack of prior evidence, the results suggested that project-based learning positively affects mathematics self-concept in sixth-grade students, highlighting the importance of exploring innovative teaching methodologies in educational research.

While project-based learning has been researched, the findings of this study demonstrated its positive influence on students' mathematics self-concept. Studies, such as those by Xion (2021), Holmes and Hwang (2016), and Suciati et al. (2020), have shown that project-based learning activities lead to a higher level of self-efficacy, motivation, attitude, and academic achievement in mathematics. By experiencing success and mastery in project-based tasks, students believe in their ability to succeed in mathematical endeavors (Nurbavliyev et al., 2020), aligning with the story of self-concept, where perceptions of capability significantly impact educational outcomes. Furthermore, the collaborative and engaging nature of project-based learning fosters positive attitudes toward mathematics (Shin, 2018), as demonstrated by Johnson (2021), who found higher levels of motivation and favorable attitudes among students engaged in such activities compared to traditional settings, which resulted in a higher self-concept (Marsh et al., 2019). On the other hand, studies like Bong et al. (1999) and Zimmerman (2000) found that higher self-efficacy does not relate to higher self-concept, which this study contradicted.

In conclusion, while direct evidence linking project-based learning to positive mathematics self-concept has not been studied, this study provided valuable insights into its potential benefits. Drawing from existing research on self-efficacy and instructional methodologies, the findings suggested that project-based learning can be crucial in shaping students' perceptions of mathematical abilities. Exploring innovative teaching approaches, such as project-based learning, was essential for enhancing students' self-concept and fostering a positive learning environment.

Research Question 3

RQ3: Is there a difference in all school subjects self-concept scores, as measured by the modified SDQ-I between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of all school subjects self-concept?

Null Hypothesis 3

$H_0$3: There is no significant difference in all school subjects self-concept scores, as measured by the modified SDQ-I between sixth-grade students who participated in project-based learning and those who did not, when controlling for the preexisting level of all school subjects self-concept.

Project-based learning did not lead to higher self-concept in all school subjects for the group receiving project-based learning compared to the traditional learning method after controlling for the preexisting level of self-concept. Overall, the control group had a mean self-concept pretest score of 13.74, while the treatment group scored 13.81. On the posttest, the control group's mean self-concept score was 14.44, compared to 14.82 for the treatment group. After adjusting for pretest self-concept levels, the mean difference was 0.7 for the control group and 1.01 for the treatment group. The null hypothesis, which assumed no significant difference

in self-concept scores for all school subjects between students who engaged in project-based learning and those who did not, was tested after controlling for preexisting levels of self-concept. After adjustment, there was no significant difference in post-intervention self-concept scores between the groups, F (1,156) = .94, p = .334, partial η^2 = .01. The pretest self-concept scores explained 65.4% of the variance in the posttest self-concept scores (η^2 = .65). Therefore, the null hypothesis failed to be rejected, indicating that project-based learning did not significantly impact the self-concept of participating sixth-grade students in all school subjects after controlling for the preexisting level of self-concept.

Despite promising findings (Al-Balushi & Al-Aamri, 2014; Beier et al., 2019; Chen & Yang, 2018) about the benefits of project-based learning on self-efficacy, motivation, attitude, and academic achievement across various subjects, there still remained a notable research gap concerning its impact on students' self-concept. Studies, including Astawa et al. (2018), Coelho et al. (2015), and Ozkan (2023), have shown that project-based learning fosters positive attitudes and enthusiasm towards learning, particularly in middle school students. However, there has been a lack of empirical evidence regarding its influence on self-concept across all school subjects (Al-Balushi & Al-Aamri, 2014; Beier et al., 2019; Bravo et al., 2021; Chen et al., 2021; Condliffe et al., 2017; Geier et al., 2008; İlter, 2014). The disconnect between the observed benefits of project-based learning on self-efficacy, motivation, attitude, and academic achievement and its perceived impact on students' overall self-concept underscored the need for more comprehensive research. Although this study did not find a significant connection between project-based learning and students’ all-school subjects self-concept, further research still needs to be done to deepen the understanding of the complex dynamics in shaping students’ beliefs about themselves in educational settings.

Implications

The study's implications were significant because they added to the existing knowledge and theory about how project-based learning affects sixth graders' self-concept in various academic areas, especially in reading and mathematics. This study found a high level of mathematics self-concept among students who experienced project-based learning. However, the self-concept scores for reading and all school subjects did not show significant improvement, though they did indicate a noteworthy trend in the treatment group’s posttest results. Despite this, there was a noteworthy trend in the treatment group’s posttest results.

The findings offered valuable insights into the effectiveness of project-based learning, especially for new first-year teachers. Although there was no significant increase in posttest scores for reading self-concept after controlling for preexisting levels, this study emphasized the importance of considering individual student needs and preferences in project-based learning. The limited choice of reading material and standardized projects could have contributed to the need for significant improvement in self-concept scores. Additionally, reading-aloud accommodations underscored the need for tailored support to address diverse learning styles and abilities. The fact that the teachers implementing project-based learning in reading were first-year teachers could also have influenced the students' self-concept in reading, as these teachers might still have been refining their instructional methods and classroom management skills. This highlighted the need for ongoing support and professional development for new teachers to enhance their effectiveness in implementing innovative teaching strategies. These results emphasized the significance of personalized and varied approaches in project-based learning to address the unique needs of students and help close the gap in self-concept development.

The study revealed a notable increase in posttest self-concept scores in mathematics when experienced teachers with effective classroom management implemented project-based learning. This improvement in self-concept could have been attributed to the more engaging and hands-on nature of the mathematics lessons, which directly targeted specific self-concept questions from the questionnaire. For instance, integrating questions like "I like math" into the lessons increased student engagement and excitement, reflecting positively in the self-concept scores.

The results from the study, particularly the statistically significant difference in post-intervention self-concept between the project-based learning and traditional learning groups, underscored the impactful influence of the interventions on students' mathematics self-concept. The analysis revealed a substantial 12% enhancement in self-concept scores for the treatment group, with an average increase of 2.32 points after accounting for initial self-concept levels. Moreover, the pretest self-concept scores explained a remarkable 83.3% variance in the posttest self-concept score, emphasizing the strong influence of preexisting self-concept on post-intervention outcomes. These findings contributed to advancing knowledge in the field and highlighted the potential of project-based learning to elevate students' self-concept in mathematics significantly.

While the results did not show a significant increase in post-intervention reading self-concept scores, the study's findings had far-reaching implications for improving the conditions, lives, and work environments of others. Furthermore, the study's findings had practical implications for improving the classroom environment and fostering a positive learning atmosphere. Educators can create engaging and relevant learning experiences that enhance students' academic knowledge and bolster their self-concept by implementing project-based learning strategies. The collaborative nature of project-based learning encourages students to

work together, communicate effectively, and take ownership of their education, promoting a sense of competence and confidence in their abilities.

In conclusion, while the study found that project-based learning only had a statistically significant positive impact on mathematics self-concept, it provided valuable insights into the potential benefits of project-based learning for reading and all school subjects. By adding to the existing knowledge and theory, the study highlighted the importance of innovative teaching methodologies in improving sixth graders' self-concept and overall academic experiences. The findings aligned with self-concept theory, which posited that individuals' perceptions of their abilities significantly affect their motivation and performance. Furthermore, the study supported constructivist learning theory, which emphasized the role of active, student-centered learning experiences in fostering deeper understanding and personal growth. Further research and implementation of project-based learning approaches can enhance the classroom environment and promote positive self-concept among students across various educational domains. By integrating the principles of self-concept theory and constructivist learning theory, educators can develop strategies that not only improve academic performance but also foster positive self-concept, ultimately leading to more motivated, resilient, and successful learners.

Limitations

The study faced several limitations that could have influenced the results and interpretation. First, the lack of randomization of students posed a significant challenge to drawing causal conclusions about the effects of project-based learning on sixth-grade students' self-concept. Without random assignment, there was a risk of systematic differences between the treatment and control groups, potentially biasing the observed outcomes. Inconsistencies in implementing project-based learning across different subjects due to scheduling differences

added complexity to the situation. Some students may have experienced project-based learning in one subject but not in others. This had to be clarified when separating the treatment group from the control group. For instance, a student may have been exposed to project-based learning in a reading class but not in a mathematics class. It was challenging to establish distinct treatment and control groups in different subjects simultaneously, as students were not consistently grouped throughout the day.

The reading lesson plans from PBLWorks.org aimed to engage students with short stories through various collaborative and individual tasks, such as podcast creation, diorama building, and project presentations. The activities encouraged students to delve into the story's plot, characters, and themes, fostering a more profound understanding while promoting critical thinking and creativity. However, upon closer examination, it became apparent that the reading lesson plans closely resembled traditional teaching pedagogy rather than strictly adhering to the principles of project-based learning. Activities like individual reading, group discussions, and project presentations aligned more with traditional teaching methods, focusing on comprehension, analysis, and presentation skills.

The lesson plans were designed to improve self-concept by emphasizing authenticity, student voice, and reflection within project-based learning. These plans were sourced from an external company, PBLWorks.org, focusing on improving students' self-concept. The mathematics lesson plans introduced new types of work and assignments. In Week 1, the project involved a research phase where students surveyed six groups to gather numerical data and create inequalities. They then presented their findings using poster boards, incorporating specific vocabulary and colorful decorations. Week 2 involved exploring the history and significance of pi, with students estimating its value and applying their findings to real-world problems

involving circles. Additionally, they designed a circular tank for an aquatic animal, showcasing their calculations to the class. Week 3 focused on area and perimeter, challenging students to create an efficient garden layout for a local community center. This task allowed students to apply their understanding of area and perimeter to real-world contexts, emphasizing collaboration, interdisciplinary connections, and problem-solving skills. The assessment included rubrics, presentations, and peer reviews, promoting a comprehensive evaluation of students' work. The lesson plans were specifically designed to enhance students' self-concept. In the mathematics lesson plans, innovative approaches included real-world problem-solving activities, such as estimating the value of pi and developing practical applications like circular tanks for aquatic animals. These tasks were aligned with the gold standard for project-based learning and tailored to match the modified SDQ-I, ensuring that the activities directly addressed aspects of self-concept in a meaningful and engaging way.

Moreover, the involvement of brand-new first-year teachers in the reading treatment group added variability to the fidelity of project-based learning implementation. Inexperienced teachers may need help to effectively facilitate project-based learning activities, leading to inconsistencies in the delivery of the intervention across classrooms (Beringer et al., 2007). This variability in implementation could result in differences in the quality and intensity of the project-based learning experiences received by students, which may influence their self-concept outcomes.

Furthermore, the duration of the intervention, compounded by the interruption of spring break, may not have been sufficient to capture the full effects of project-based learning on students' self-concept. The interruption caused by spring break may have further fragmented students' experiences and diluted the potential impact of the intervention, making it challenging

to detect significant differences between the treatment and control groups. The study identified limitations about sampling, anonymity, and data collection. Nonetheless, precautions were implemented to mitigate the impact of these limitations on the overall research.

Recommendations for Future Research

Recommendations for further research to advance the knowledge of the effect project-based learning has on sixth-grade students' self-concept included:

1. Investigating alternative methods of assigning students to treatment and control groups is crucial for achieving a more balanced distribution across classes and class sizes, thereby enhancing the validity of the study's findings. Random sampling or matching techniques based on relevant student characteristics could create more comparable groups. Participants could include sixth-grade students from various classes, with random sampling or matching ensuring equitable representation. The research design could likely be quasi-experimental, with pretest and posttest measures of self-concept administered to both groups. Statistical analyses could compare changes in self-concept between treatment and control groups while controlling for potential confounding variables. Additionally, qualitative methods could be used to explore students' experiences with project-based learning. This approach could aim to improve the study's methodological rigor and provide deeper insights into the effects of project-based learning on sixth-grade students' self-concept.
2. Longitudinal studies are imperative to understanding the sustained effects of project-based learning on sixth-grade students' self-concept over time. By tracking changes in self-concept at multiple points in time, researchers can assess the durability and stability of these effects. Participants in such studies could include sixth-grade

students engaged in project-based learning interventions over an extended period of time. Data collection could occur at various intervals, allowing for the examination of trajectories of self-concept development. Statistical techniques like growth curve modeling could aid in analyzing these longitudinal data.

3. Qualitative research offers valuable insights into students' experiences with project-based learning and their perceptions of its effects on self-concept. Participants could include sixth-grade students involved in project-based learning interventions, their teachers, and potentially parents. This research design could utilize qualitative methods, such as interviews, focus groups, and observations, to explore students' attitudes, beliefs, and experiences related to project-based learning. Thematic analysis could help identify patterns and themes in the qualitative data, enriching the understanding of the phenomenon.
4. Expanding the study to encompass project-based learning across all classes throughout the school day holds immense promise for a comprehensive understanding of its impact on students' self-concept. Researchers could explore how project-based learning influences self-concept in various academic domains by extending the intervention beyond mathematics and reading to include other subjects. This approach could provide valuable insights into the holistic effects of project-based learning on students' overall perception of their abilities and academic performance. To complete such a study, careful planning and coordination would be essential. Collaboration among teachers, administrators, and researchers would be necessary to ensure consistent implementation of project-based learning across all classes. Additionally, data collection would need to include assessments of self-concept in each subject

area, allowing for comparisons between treatment and control groups across multiple domains. While challenging, conducting such a study could yield invaluable insights into the potential benefits of integrating project-based learning throughout the entire school day.

5. Investigating the impact of teacher training and support on project-based learning effectiveness is crucial for optimizing implementation fidelity and student outcomes. Participants could include sixth-grade teachers receiving training and support in project-based learning pedagogy and their students engaging in project-based learning activities. Employing mixed-methods research, quantitative assessments of student outcomes could be combined with qualitative data on teacher experiences and perceptions. Surveys, interviews, and classroom observations could provide insights into teacher training, implementation fidelity, and student outcomes.

Summary

This quantitative, quasi-experimental study examined how project-based learning affects sixth-grade students' self-concept in all school subjects, specifically reading and mathematics, at a rural middle school in southeastern Virginia. The outcomes of the one-way ANCOVA revealed no statistical significance for reading and all school subjects. However, mathematics yielded a statistically significant result. These findings represented another step towards bridging the divide between student self-concept and project-based learning. While this study did not conclusively impact self-concept in all school subjects, it served as a call to action for further investigation into the effects of project-based learning and other educational strategies on student self-concept, especially in reading and mathematics.

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Appendix A

Gold Standard Project-Based Learning

The term Gold Standard Project-Based Learning was coined by the Buck Institute for Education, an organization renowned for its expertise in project-based learning (Sayuti et al., 2020). This approach is considered the highest quality and most effective method for implementing project-based learning in educational settings (Sayuti et al., 2020). Created by the Buck Institute for Education, the Gold Standard Project-Based Learning is a comprehensive set of criteria and guidelines to implement rigorous and meaningful project-based learning. Educators are provided with a clear framework to develop and assess project-based learning projects that engage students in deep learning, critical thinking, and problem-solving while addressing real-world issues.

The Gold Standard Project-Based Learning emphasizes essential elements such as incorporating authentic, real-world problems, student engagement in inquiry and investigation, collaboration among students, and opportunities for them to present their findings to authentic audiences. These criteria aid educators in designing high-quality projects that align with academic standards, foster 21st-century skills, and create positive and meaningful learning experiences for students (Sayuti et al., 2020). While the specific date of the Gold Standard Project-Based Learning's creation has yet to be mentioned, the Buck Institute for Education has actively promoted and refined the framework over many years to support educators in implementing compelling project-based learning experiences (Sayuti et al., 2020).

Incorporating Gold Standard Project-Based Learning principles in a research design is rooted in its robust framework, which harmonizes seamlessly with the principles of Bloom's Taxonomy (Junisbayeva, 2020). This strategic integration underscores a deliberate endeavor to establish a research methodology that facilitates active and profound learning experiences and encourages students' engagement in higher-order cognitive processes, particularly in evaluation and creation. By aligning with the Gold Standard, Project-Based Learning establishes a research approach that facilitates knowledge acquisition and promotes its application and analysis within authentic contexts (Junisbayeva, 2020). This alignment with Bloom's Taxonomy fosters critical thinking abilities and cultivates a deep comprehension, wherein students are not just recipients of knowledge but evaluators and creators of innovative solutions. Junisbayeva (2020) explained that several instructional and student engagement components are implemented throughout the Gold Standard Project-Based Learning process. Junisbayeva (2020) explained that there are seven specific components and three learning goals for project-based learning, also known as the Gold Standards Pro, as shown in Figure 29.

Figure 29

New Model for Gold Standard Project-Based Learning

The learning goal components show that teachers and students must learn while mastering knowledge and concepts within the standards provided (Larmer et al., 2015). Larmer et al. (2015) continued by stating that critical success is meant for the students to use their background knowledge and understanding of the topic while doing the Gold Standard Project-Based Learning for the future. The remaining Gold Standard Project-Based Learning elements are for the project's structure. The first element, challenging a problem or question, is essential in giving the students the purpose of the project or lesson (Larmer et al. 2015). When the students know the project's purpose, they will learn how to apply their knowledge of the content material, leading to mastery of the topic (Larmer et al., 2015). If the students master the project, they will know when to use and apply the content material daily.

The subsequent aspect of the Gold Standard Project-Based Learning framework involves sustained inquiry, where students engage in continuous exploration through challenging questions or problems, ensuring a thorough investigation of their chosen subject. This element is closely intertwined with Bloom's Taxonomy, which prompts higher-order cognitive processes across its levels. The demanding questions promote knowledge acquisition and encourage critical analysis, synthesis, and evaluation. Additionally, integrating real-life contexts aligns with Bloom's Taxonomy by fostering the application and synthesis of knowledge and skills in meaningful scenarios.

The subsequent element within the Gold Standard Project-Based Learning framework involves granting students autonomy and decision-making opportunities. Larmer et al. (2015) emphasize the importance of creating an environment where students can freely express their perspectives, enhancing the meaningfulness and personalization of the learning experience. This aspect aligns with Bloom's Taxonomy by promoting higher-order cognitive skills such as analysis, evaluation, and creation. Moreover, encouraging students to collaboratively address project-related challenges independently fosters skills in application and synthesis, further connecting with Bloom's Taxonomy levels.

Embedded within the Gold Standard Project-Based Learning framework is the element of

reflection, signifying a pivotal skill in mastering a subject. Larmer et al. (2015) underscore the significance of students engaging in ongoing introspection regarding their objectives, inquiry process, and project effectiveness. This reflective practice correlates with Bloom's Taxonomy by promoting higher-order cognitive skills like analysis and evaluation. As students scrutinize their progress and method effectiveness, they engage in critical thinking, aligning with Bloom's Taxonomy's emphasis on intellectual engagement and comprehension, ultimately enhancing their academic achievement (Larmer et al., 2015).

The succeeding elements of the Gold Standard Project-Based Learning framework encompass critique and revision, a process that aligns with Bloom's Taxonomy by fostering critical analysis and evaluation skills. Larmer et al. (2015) emphasize students' active participation in offering and receiving constructive feedback, a core practice woven throughout Gold Standard Project-Based Learning projects. Collaborative project work often brings together students with varying background knowledge, mirroring Bloom's Taxonomy emphasis on understanding and applying diverse perspectives. As students engage in attentive listening and thoughtful critique, they deepen their grasp of the subject matter, exemplifying the integration of higher-order cognitive skills by Bloom's Taxonomy (Larmer et al., 2015).

The final component of Gold Standard Project-Based Learning pertains to public products, aligning with Bloom's Taxonomy by encouraging students to synthesize and present their knowledge. According to Larmer et al. (2015), students sharing the products they create based on the content material exemplifies this concept. This approach enhances engagement and authenticity, mirroring Bloom's Taxonomy emphasis on application and communication of knowledge. From an academic achievement perspective, sharing ideas allows for practical application and potential learning transfer among students, reinforcing Bloom's higher cognitive processes (Larmer et al., 2015).

The attributes outlined above serve as the fundamental and indispensable elements of the project-based learning process. As students navigate this process, they become active participants in their learning journey, employing higher-order cognitive skills. Examining Bloom's taxonomy, it becomes evident that project-based learning encompasses all seven cognitive categories, thus encompassing a comprehensive spectrum of learning experiences intertwined with elevated cognitive processing, a factor acknowledged for its positive impact on student achievement. The amalgamation of enhanced SC and a profound grasp of subject matter fostered through the Gold Standard Project-Based Learning approach is expected to yield improvements in student SC and academic accomplishment (Larmer et al., 2015).

Appendix B

Permission to Use the Instrument

Dear Miranda:

Thank you for your interest in my research. My SDQ instruments, are in the public domain and freely available from my website
https://ippe.acu.edu.au/research/research-instruments/ **Also, because they are in the public domain, you do not need me permission to use them. All the information available for each of the instruments is on the website**

Also, attached is a monograph that provides an overview of my research and also a bloated CV file so you can see the things that I have been doing more recently. The monograph is open source, so please feel free to distribute it to your colleagues.

HERB

Appendix C

Modified SDQ-I Questionnaire Instrument

Self-Description Questionnaire--I--ECLS-K Version

Items

Scales	Items
Reading	I get good grades in reading.
	I like reading.
	Work in reading is easy for me.
	I am interested in reading.
	I cannot wait to read each day.
	I am good at reading.
	I like reading long chapter books.
	I enjoy doing work in reading.
Mathematics	Work in math is easy for me.
	I cannot wait to do math each day.
	I get good grades in math.
	I am interested in math.
	I can do very difficult problems in math.
	I like math.
	I enjoy doing work in math.
	I am good at math.
All School Subjects	I am good at all school subjects.
	I enjoy work in all school subjects.
	Work in all school subjects is easy for me.
	I like all school subjects.
	I look forward to all school subjects.
	I get good grades in all school subjects.

Appendix D

SDQ-1 Questionnaire Administration Script

Script for teachers to follow during the administration of the SDQ-I questionnaire:

Introduction:
"Hello, students! Today, we will participate in a questionnaire to help us learn more about how you perceive yourselves in different areas. This survey is part of a bigger study to understand how students like you feel about different things. Your honest and thoughtful responses will greatly contribute to our understanding. Let's begin!"

Step 1: Explanation of the Survey:
"I'm going to provide you with a set of statements. Each statement is about you and how you might feel about different things. Please read each statement carefully and consider how much it describes you. There are no right or wrong answers – just what you honestly believe about yourself."

Step 2: Instructions for Responding:
"For each statement, you'll see some options. These options show how much you agree or disagree with the statement. Please listen carefully as I explain the options:
- The first option, 'Not At All True,' means you don't feel that way about yourself.
- The second option, 'A Little True,' means you sometimes feel that way.
- The third option, More True,' means you feel that way quite a bit.
- The fourth option, 'Very True,' means you often feel that way."

Step 3: Example:
"Let's try an example together. If you agree with the statement 'I am good at reading' and believe you are good at reading, you might choose 'Very True.' But if you don't believe you are good at reading, you might choose 'Not At All True.' Now, let's practice together."

Step 4: Distribution and Completion:
"I will now distribute the survey booklets and pencils. Please read each statement carefully and choose the option that best describes your feelings. You'll have enough time to complete the survey, so take your time. Raise your hand if you have any questions."
“When you get your survey, please put the name of the school, the first initial of my last name, and your number in the classroom.” (The teacher will write an example on the board for the students to follow)

Step 5: Monitoring and Clarification:
"While you're completing the survey, I'll be here to answer any questions. If you're unsure about a statement, don't worry –choose the option closest to how you feel. Remember, honest answers are important, and there's no right or wrong response."

Step 6: Collecting Surveys:
"Once you've finished, please raise your hand, and I'll come around to collect your survey booklet. Ensure you've completed all the statements before handing them to me."

Closing:
"Thank you all for participating and sharing your thoughts with us. Your responses will help us learn more about how students like you perceive themselves. Your contribution is valuable, and we appreciate your time and effort. Have a great day!"

Appendix E

IRB Approval

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

March 7, 2024

[redacted]

Re: IRB Exemption - IRB-FY23-24-1033 A QUASI-EXPERIMENTAL STUDY LOOKING AT THE EFFECT OF PROJECT BASED LEARNING ON SIXTH-GRADE STUDENTS' SELF-CONCEPT

Dear Miranda Carter, [redacted]

The Liberty University Institutional Review Board (IRB) has reviewed your application per the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data-safeguarding methods described in your IRB application, and no further IRB oversight is required.

Your study falls under the following exemption category, which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:104(d):

Category 1. Research, conducted in established or commonly accepted educational settings, that specifically involves normal educational practices that are not likely to adversely impact students' opportunity to learn required educational content or the assessment of educators who provide instruction. This includes most research on regular and special education instructional strategies, and research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

For a PDF of your exemption letter, click on your study number in the My Studies card on your Cayuse dashboard. Next, click the Submissions bar beside the Study Details bar on the Study Details page. Finally, click Initial under Submission Type and choose the Letters tab toward the bottom of the Submission Details page. Your information sheet and final versions of your study documents, **which you must use to conduct your study,** can also be found on the same page under the Attachments tab.

This exemption only applies to your current research application, and any modifications to your protocol must be reported to the Liberty University IRB for verification of continued exemption status. You may report these changes by completing a modification submission through your Cayuse IRB account.

If you have any questions about this exemption or need assistance in determining whether possible modifications to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,

[redacted]

Appendix F

Parental Opt-Out

Parental Opt-Out

Title of the Project: A Quasi-Experimental Study Looking at the Effect of Project-Based Learning on Sixth-Grade Students' Self-Concept
Principal Researcher: Miranda Carter, Ph.D. candidate, School of Education, Liberty University

Invitation to be Part of a Research Study

Your student is invited to participate in a research study. To participate, he/she must be a student in sixth-grade English and Mathematics classes during the 2023-2024 school year at [redacted] Middle School. Taking part in this research project is voluntary.

Please take time to read this entire form and ask questions before deciding whether to allow your student to take part in this research project.

What is the study about and why are we doing it?

The purpose of the study is to determine what impact Project-Based Learning has on sixth-grade students' self-concept. Over the course of 3 weeks, some participating students will be taught with a project-based learning lessons designed to improve their confidence in mastering the subjects. Students in the treatment group, participating in project-based learning, could potentially benefit from increased engagement, deeper understanding of the subject matter, and a boost in their self-confidence as they actively participate in hands-on, real-world projects tailored to their learning needs.

What will participants be asked to do in this study?

If you agree to allow your student to be in this study, I will ask him/her to do the following:

1. Take a short 22-question modified Self-Description Questionnaire-I (SDQ-I) to check their self-concept before any Project-Based Learning takes place. The questionnaire will be given to each student on a computer and will take approximately 20 minutes to complete.
2. Then, participants will be assigned to either the treatment group, which receive Project-Based Learning throughout the day, or the control group, which does not receive Project-Based Learning throughout the day. Participants may or may not receive the intervention as part of their participation.
3. Throughout the three weeks, during your students' English/Language Arts class, your student will participate in their assigned activities for 30-40 minutes a day. If your student is in the treatment group, your student will participate in a project that is Virginia standards aligned and will be centered around the instructional unit that your students' teacher is teaching.
4. Throughout the three weeks, during your students' Mathematics class, your student will participate in their assigned activities for 30-40 minutes a day. If your student is in the treatment group, your student will participate in a project that is Virginia standards aligned and will be centered around the instructional unit that your students' teacher is teaching.

5. After the three weeks, students will again take the modified SDQ-I questionnaire (approximately 20 minutes) to check to see if there is a change in their self-concept.

These procedures will be administered by your student's teacher. Should you choose to opt out, your student will still receive the same instruction throughout the three week period.

How could participants or others benefit from this study?

The direct benefits participants should expect to receive from taking part in this study is a chance to participate in Project Based Learning in Math and Reading, which has potential to improve their confidence in mastering these subject areas.

Benefits to society include advancing the understanding of students' self-concept and promoting further exploration of interventions to enhance it, ultimately fostering a more successful learning environment.

What risks might participants experience from being in this study?

The expected risks from participating in this study are minimal, which means they are equal to the risks your student would encounter in everyday life.

How will personal information be protected?

The records of this study will be kept private. Published reports will not include any information that will make it possible to identify a subject. Research records will be stored securely, and only the researcher will have access to the records. Data collected from your student as part of this study may be shared for use in future research studies or with other researchers. If data collected from your studentis reused or shared, any information that could identify your student, if applicable, will be removed beforehand.

Participant responses will be kept confidential by replacing names with pseudonyms. Data will be stored on a password-protected external hard drive that will be kept in a locked safe when not in use. After five years, all electronic records will be deleted.

Is study participation voluntary?

Participation in this study is voluntary. Your decision whether to allow your student to participate will not affect your or his/her current or future relations with Liberty University. If you decide to allow your student to participate, he/she is free to not answer any question or withdraw at any time without affecting those relationships.

What should be done if a participant wishes to withdraw from the study?

If you choose to withdraw your student from the study, please contact the researcher at the email address/phone number included in the next paragraph. Should you choose to withdraw him/her=, data collected from your student will be destroyed immediately and will not be included in this study. Students withdrawn from the study will not be expected to complete the SDQ-I surveys. However, they will still receive instruction from the same curriculum as the rest of their group throughout the three week period.

Whom do you contact if you have questions or concerns about the study?

The researcher conducting this study is Miranda Carter. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact her at mlcarter7@liberty.edu.

Appendix G

Site Approval

[redacted]

March 5, 2024

[redacted]

Dear Miranda Carter:

After careful review of your research proposal entitled A Quasi-Experimental Study Looking at the Effect of Project-Based Learning on Sixth-Grade Students' Self-Concept, I have decided to grant you permission to access our membership list/contact our faculty/staff/other and invite them to participate in your study.

☑ Check the following boxes, as applicable:

I grant permission for Miranda Carter to contact sixth-grade Mathematics and English teachers to invite them to collaborate in her research study and enable their students to participate.

Sincerely,

[redacted]

Appendix H

Control Group Agreement

Month, Date, Year

Dear Teacher(s),

I sincerely appreciate your interest in participating as part of the control group in our research study titled "A quasi-experimental study looking at the effect of project-based learning on sixth-grade students' self-concept." This agreement outlines the terms and conditions for your involvement in the research and clarifies that you will not be utilizing Project-Based Learning during the research period.

As a member of the control group, you will not be exposed to Project-Based Learning during the research period. Instead, your participation will involve following the standard curriculum and instructional methods as directed by your school and teachers. Throughout the research, we will collect data on various aspects of students' self-concept using established assessment tools and surveys. Your active participation in these assessments is vital to the success of the research.

By being a teacher and having your students participate in this research, you acknowledge that you have read and understood the terms of this agreement and agree to adhere to the conditions stated herein.

Thank you for your willingness to contribute to this significant research study. Your support is invaluable to the pursuit of knowledge and enhancing educational practices.

Sincerely,

Miranda Carter
Doctoral Candidate

I, _____, hereby agree to participate as a control group member in the research study titled " A quasi-experimental study looking at the effect of project-based learning on sixth-grade students' self-concept" and confirm that I will not be using Project-Based Learning during the research time.

Signature: _____ Date: _____

Appendix I

ELA Lesson Plan

Week 1: Lesson Plan: "Home" by Hena Khan

Duration: 4 Days

Day 1: Introduction and Reading

Objective: Students will be able to understand the plot, characters, and themes of the short story "Home" by Hena Khan.

Gold Standard for Project-Based Learning:
- Authenticity: The students will engage with a real-world text and analyze its elements to deepen their understanding of the story.
- Student Voice and Choice: Students can share their thoughts and interpretations of the story during the class discussion.

1. Begin the lesson by introducing the short story "Home" by Hena Khan. Provide a brief overview of the author and the story's background.
2. Distribute copies of the short story to each student or divide them into small groups and provide each group with a copy of the story.
3. Instruct the students to read the story silently or take turns reading aloud within their groups.
4. After reading, facilitate a class discussion to ensure comprehension. Ask questions about the plot, characters, and themes of the story.
5. Encourage students to share their thoughts and interpretations of the story.

Day 2: Podcast Creation (Part 1)

Objective: Students will work collaboratively to create a podcast episode discussing the themes, characters, and relevance of "Home" to real-world issues.

Gold Standard for Project-Based Learning:
- Collaboration: Students will work in small groups to brainstorm ideas and create an outline for their podcast episode.
- Public Product: The podcast episode will be shared with the class, allowing students to showcase their understanding of the story and its relevance to real-world issues.

1. Review the concept of a podcast and its purpose. Explain that students will create a podcast episode related to the short story "Home."
2. Divide the students into small groups and assign each group a specific topic related to the story (e.g., themes, characters, real-world connections).

3. Instruct the groups to brainstorm ideas and create an outline for their podcast episode. They should consider the key points they want to discuss and the order in which they will present them.
4. Provide resources such as laptops or tablets for the students to research and gather information to support their podcast episodes.
5. Encourage the groups to script their discussions, ensuring each member has a role in the podcast.
6. Allow time for the groups to practice and refine their scripts.

Day 3: Podcast Creation (Part 2) or Diorama Creation

Objective: Students will continue working on their podcast episode or begin creating a diorama representing critical elements of the story.

Gold Standard for Project-Based Learning:
- Revision and Reflection: Students will receive feedback and guidance on improving their podcast scripts or diorama designs.
Authenticity: Students will create a podcast episode or diorama representing their understanding of the story.

Option 1: Podcast Creation (Part 2)
1. Review the progress made by each group in creating their podcast episode.
2. Provide feedback and guidance to help the groups improve their scripts and ensure they address the required topics.
3. Instruct the groups to record podcast episodes using recording devices or software. Alternatively, they can perform their podcast live in front of the class.
4. Allow the groups to edit and finalize their podcast episodes.

Option 2: Diorama Creation
1. Explain the concept of a diorama and its purpose. Show examples of dioramas to inspire the students.
2. Provide the necessary materials for the students to create their dioramas, such as cardboard, craft supplies, and figurines.
3. Instruct the students to plan and design their dioramas based on the critical elements of the story, including the characters, character traits, setting, and character development.
4. Allow the students to work on their dioramas, providing guidance and support as needed.

Day 4: Project Presentation

Objective: Students will present their podcast episodes or dioramas to the class, demonstrating their understanding of the story and its elements.

Gold Standard for Project-Based Learning:
- Critique and Revision: The audience will actively listen to the presentations and provide constructive feedback.

- Public Product: Students will showcase their podcast episodes or dioramas to the class.

1. Begin the lesson by reviewing the purpose of the project presentations and the criteria for evaluation.
2. Divide the class into two groups: one for podcast presentations and one for diorama presentations.
3. Each group will take turns presenting their projects to the class. Encourage the audience to listen and actively provide constructive feedback.
4. After each presentation, facilitate a brief discussion to allow the audience to share their thoughts and ask questions.
5. Provide feedback and evaluation based on the criteria discussed earlier.
6. Conclude the lesson by summarizing the key points discussed during the presentations and highlighting the students' achievements.

Extension Activities:
1. Writing Reflection: Ask students to write a reflection on their experience creating the podcast episode or diorama. They should discuss what they learned, their challenges, and how their understanding of the story deepened through the project.
2. Group Discussion: Facilitate a class discussion on the different interpretations and perspectives presented in the podcast episodes or dioramas. Please encourage students to compare and contrast their findings and engage in respectful dialogue.
3. Real-World Connections: Assign a follow-up activity in which students research and present real-world issues related to the theme of "Home." They can explore topics such as immigration, cultural identity, or the importance of community.

Week 2: Lesson Plan: "After 20 Years" - Exploring Themes and Creating a Comic Strip

Duration: 40 minutes per day (5 days)

Day 1: Introduction and Reading

Learning Objectives:
- Students will be able to identify the main characters and setting of the story.
- Students will engage in active reading and comprehension.

Instructional Activities:
1. Begin the lesson by introducing the short story "After Twenty Years" by O. Henry. Explain that the novel explores themes of honesty, trust, and friendship.
2. Discuss the elements of a short story, including setting and characters. Provide examples from other stories to reinforce understanding.
3. Divide the students into pairs or small groups. Assign each group a section of the story to read aloud together.
4. As the students read, encourage them to take notes on the setting and main characters.

Assessment:
- Monitor student engagement during the reading activity.
- Collect and review the students' notes on the setting and main characters.

Day 2: Analyzing Themes and Characters

Learning Objectives:
- Students will be able to identify the story's central theme and support their claim with evidence.
- Students will analyze the story's honesty, trust, and morality significance.
- Students will practice critical thinking and reflection.

Instructional Activities:
1. Begin the lesson by reviewing the main characters and setting of the story.
2. Provide the students with the following questions and ask them to answer them individually or in small groups:
   - Recall: Describe the setting and main characters of the story using evidence from the text.
   - Understand: What is the central theme of the story? Use evidence to support your claim.
   - Apply: Explain the significance of honesty, trust, and morality in the short story. If you were in Jimmy’s situation, would you do the same thing? Why or why not?
   - Analyze: We know that Bob did something in his past to get arrested. What do you think the cause for his arrest might have been and why?
   - Evaluate: In your opinion, is it possible or realistic to have “life-long” friends? Would you make a pact similar to Bob and Jimmy’s? Why or why not?

3. Allow students to discuss their answers and provide evidence from the text to support their claims.
4. Facilitate a class discussion to share and compare different perspectives.

Assessment:

- Review the students' answers to the questions and provide feedback.
- Observe and assess their participation in the class discussion.

Days 3 and 4: Creating a Comic Strip

Learning Objectives:

- Students will be able to demonstrate their understanding of the story by creating a comic strip.
- Students will practice creativity and visual storytelling.
- Students will apply knowledge of plot structure.

Instructional Activities:

1. Explain to the students that they will create a comic strip that accurately portrays the short story “After Twenty Years.”
2. Provide the following guidelines for their comic strip:
   - Use at least ten frames on a poster board.
   - Create a “Character Key” that identifies each character by drawing the person and labeling it.
   - Use colorful illustrations to bring the story to life.
   - Include all aspects of the plot structure (exposition, rising action, climax, falling action, resolution).
   - Fill the entire poster board without any blank spaces.
   - Ensure that the comic strip tells the entire story in detail.
   - Encourage students to put forth time, effort, and creativity.
3. Allow students to work individually or in pairs to plan and create their comic strips.
4. Circulate the classroom to provide guidance and support as needed.

Assessment:

- Evaluate the students' comic strips based on their adherence to the guidelines and ability to portray the story and its plot structure accurately.
- Provide feedback and suggestions for improvement.

Day 5: Sharing Presentations

Learning Objectives:

- Students will be able to present their comic strips to their peers.
- Students will practice public speaking and active listening.

Instructional Activities:

1. Divide the students into small groups or pairs.
2. Instruct each student to present their comic strip to their peers, explaining the plot and the choices in their illustrations.

3. Encourage active listening by asking each group to provide feedback and ask questions about the comic strips.
4. Allow time for discussion and reflection on the students' different interpretations and creative choices.

Assessment:

Observe and assess the students' presentations, focusing on their ability to communicate their ideas effectively and engage their peers.
- Encourage peer feedback and reflection on the presentations.

Extension Activities:

- Have students write a short reflection on the process of creating the comic strip and how it helped deepen their understanding of the story.
- Encourage students to explore other short stories by O. Henry and compare them to "After Twenty Years" in terms of themes and writing style.
- Discuss the "life-long" friends concept and have students share personal experiences or opinions.

Week 3 Lesson Plan:

This week, the students will choose which project they want to do.

Option 1: Literary Playlist from PBLWorks.org

Literary Playlist

How can we use music to communicate about characters and themes in a novel/story?

Grades
6-12

Subjects
ELA

Estimated Duration
12-17 instructional hours

Key Content
literary analysis, character development, theme

Taking on the role of curators for a streaming music service that is producing a special collection of literary-inspired playlists, students read and analyze literature to develop music playlists that portray the

development of themes and/or characters over the course of the novel/story. Students publish their playlists, along with a detailed set of liner notes that provide an evidence-based analysis of the themes or character development throughout the written work and a rationale for the selection of each song.

*Although most PBLWorks model projects range from 2 to 4 weeks, timing for this project may vary greatly depending on the length and complexity of self-selected texts and the in-class versus out-of-class time provided for independent reading—you may zoom in and out of project activities over a period of time as students read their texts.

Project Path

Project Launch

What texts will we analyze and share through our literary playlists?

Entry event: Invitation from a fictitious streaming music service asking students to submit playlists that express the thematic and character development of their book club novels.

Form teams and prepare for effective collaboration.

Build Knowledge and Develop & Critique

How can we provide rationales that explain how each song captures the essence of the themes/ character development?

Write rationales for each song selection on the playlist and engage in peer critique to revise playlist "liner notes"/rationales.

What themes and/or character development will we communicate through our playlists?

Analyze the text for character development and/or theme.

How can we select songs that portray the themes/character development of our texts?

Select and analyze songs that express the key themes and character development for each section of the text.

Present Products

How can we effectively present our literary playlists to the public?

Publish literary playlists, gather audience feedback, and reflect on learning from the project.

Make It Yours

Reflect on your students

- What types of music do your students enjoy? How can you leverage this interest to engage them in deep analysis of literature?
- If you have students who are not interested in music, or who are hearing impaired, what alternative formats (e.g., image galleries, video essays) might they use to express their analysis of literary themes or character development?
- What novels or other literary works might resonate with your students? If they are working with a required core text, how will you support them in connecting with and/or relating to this text?

Reflect on your context

- What technology tools will students need to produce their playlists?
- What musical resources might be available to students? Is there a music librarian at a local library or college or a local radio dj who might be able to help students access and explore new music to incorporate into their playlists?

Reflect on the content & skills

- How will you scaffold students' understanding of key themes and/or character development in the text(s) they are reading?
- What structures (e.g., literature circles, workshop model) might you leverage to organize work time during the project and help students engage deeply with the text(s) they are reading?
- What structures and models might you provide to help students plan, write, and revise their liner notes? In

particular, how can you ensure that students support their analyses with specific textual evidence?

- How will you help students stay accountable to time and to the task at hand and help them self-manage throughout the course of the project?

Take It Further

Here are some ideas for expanding this project if you choose to do so:

- Host a book tasting (https://www.weareteachers.com/book-tasting/) to introduce students to the menu of texts they can choose from for their book clubs.
- Partner with a local music or literacy organization – a radio station, library, college/university, bookstore, book festival, or music festival. Ask a representative (https://my.pblworks.org/resource/working-outside-experts) from the organization (DJ, librarian, music historian, etc.) to share an in-person, video, or written invitation asking students to create their playlists for the partner organization to publish on their website, social media, or at an event. Consider providing the partner with talking points or a script for the video and/or writing the letter for the partner to sign.
- Collaborate with a music teacher to broaden students' awareness of various musical genres and/or support them in their song analysis of musical elements.
- Extend the creation of the final product by having students create an audio/video recording of their playlist, including verbal introductions and commentaries on each song.
- As a variation on the audience and purpose of the project, have students create a soundtrack for an audiobook recording or film version of their text. Include opportunities for students to listen to and analyze soundtracks of audiobooks or film versions of familiar literature, discussing how the music enhances, augments, or amplifies the character development and themes. (Introduce students to novels that include soundtracks, such as *The Law of Love: A Novel* by Laura Esquivel and *The Perks of Being a Wallflower* by Stephen Chbosky.)
- If you have students who are musicians, offer them the option to create original music to express their literary analysis.
- Help students if needed to avoid confusion between musical tone and tone in literature. Remember that musical tone refers to the duration, pitch, intensity, and timbre of the

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music; tone in literature expresses the writer's attitude or feelings toward the subject and audience.

- Introduce students to the history of liner notes for example, by sharing information about the Grammy Award for Best Liner Notes (https://en.wikipedia.org/wiki/Grammy_Award_for_Best_Album_Notes) or about efforts being made to "Restore Those Old Liner Notes in Music's Digital Era." (https://www.nytimes.com/2017/09/29/business/media/tunesmap-liner-notes.html)

Thank you to Honor Moorman for development of this project.

Option 2: Hunger from PBLWorks.org

Hunger

How can we help address the issue of hunger in our community?

Grades
3-12

Subjects
ELA, Social Studies

Estimated Duration
17-20 instructional hours

Key Content
hunger, community, service learning, informational/persuasive writing

In this project, students create informative and persuasive messages to educate the local community and get them involved in addressing the issue of hunger. After meeting with an expert to learn about the causes and effects of hunger in their community, student teams conduct a root cause analysis. Each team identifies a specific hunger-related issue to research and develops an action plan to address the issue. Teams create brochures or webpages that use the "3 A's" Framework to raise Awareness, engage in Advocacy, and take direct Action to address hunger. They also host an "Addressing Hunger in Our Community" event to inform and persuade stakeholders in the local community to join them in positively affecting the issue.

Project Path

Project Launch

What are the causes, effects, and underlying issues related to hunger in our community?

Entry event: Explore and discuss images and hear from a guest speaker about hunger in the local community.

Form teams and prepare for effective collaboration.

Build Knowledge and Develop & Critique

Which specific hunger-related issue in our community will we address?

Identify a particular focus issue related to the problem of hunger and determine a format (brochure or webpage) for their final product.

What should we share with the community to raise awareness about our selected hunger issue?

Research the selected issue to understand its causes and effects as well as potential solutions, and craft a message to raise awareness about the issue.

What kind of action should we take - and advocate for others to take - in order to address the selected hunger issue?

Brainstorm, select, and develop a research-based plan for taking action to address the local hunger-related issue.

How will we advocate for community members to join us in taking action to address hunger?

Compose a targeted persuasive message to convince members of the local community to join in taking action to affect the issue.

How do we best communicate our message of awareness, advocacy, and action to appropriate stakeholders?

Finalize and publish final products, and prepare presentations to inform and persuade the local community that the selected hunger-related issue needs attention and can be addressed through collaborative action.

Present Products

How will our audience respond to our informative and persuasive final product and presentation?

Host an "Addressing Hunger in Our Community" event to share information about hunger-related issues, champion team action plans, and enlist the audience's participation, then reflect on learning.

Make It Yours

Reflect on your students

- What will interest your students about this project? How can you help students connect emotionally to the issue of hunger?
- Do students in your class come from a variety of language and cultural backgrounds? How might you leverage this diversity as an asset in this project?
- How can you use this project as a way to help your students make their unique voices and perspectives heard and to highlight their varied communities and backgrounds?
- Are any of your students experiencing hunger? How can you facilitate this project in a way that is sensitive to your students?
- What types of sample brochures, webpages, or videos might engage students and feel relevant and authentic to their lives?

Reflect on your context	• What needs and opportunities exist in your community? How can you help students learn about these? • Are there existing community service organizations or initiatives that you and your students might partner with for this project? • What technology tools will students need to create their brochures, webpages, and videos?
Reflect on the content & skills	• What texts, activities, guest speakers, or field trips might help students build their understanding of hunger-related issues in the community? • How will you scaffold the knowledge and skills students will need in order to engage effectively in this project? • How will you help students identify, evaluate, and synthesize research about the issues they are exploring? • What models and examples might help students understand how to craft an effective brochure, webpage, or video? • How will you help students stay accountable to time and to the task at hand and help them self-manage throughout the course of the project?

Take It Further

Here are some ideas for expanding this project if you choose to do so:

- During the entry event, incorporate the Zoom In thinking routine (http://www.rcsthinkfromthemiddle.com/zoom-in.html) to help students pay close attention to detail, make inferences, and generate questions as the image is revealed and discussed.
- Use the The 3 Whys thinking routine (https://pz.harvard.edu/resources/the-3-whys) to help students uncover the significance of hunger in multiple contexts, make local-global connections, and develop intrinsic motivation to investigate this topic.

- Use the student-identified features of high-quality (https://my.pblworks.org/node/11471) brochures, webpages, and/or videos to co-create a class rubric for the final product.
- Have individual students summarize and discuss their research in groups using the Headlines thinking routine (https://pz.harvard.edu/resources/headlines).
- When students are determining what kind of action to take (and advocate for), have them research what has already been tried and is already being done to address hunger in the community. If possible, have each team member research a different approach and report back on the answers to questions such as:
  - What was tried/is being done?
  - What was/is involved in this strategy?
  - What was/is the impact of this effort?
- Have students reconnect with the guest speaker from the entry event to ask about what strategies have been tried to address hunger in the local community and what their impacts were.
- Have students present their selected action ideas to peers, community partners, or key stakeholders (https://my.pblworks.org/resource/working-outside-experts), explaining their rationale for their selected solutions. Ask for feedback and have students revise their action plans as needed to apply the feedback they received.
- Have students use sentence stems and frames (https://www.valentinaesl.com/articles-for-educators/sentence-stems-or-sentence-frames) to give peer feedback on each other's brochure layouts, webpage wireframes, or video storyboards.
- Facilitate a World Cafe conversation (https://theworldcafe.com/key-concepts-resources/world-cafe-method/) or Microlabs protocol (https://www.schoolreforminitiative.org/download/microlabs/) to have students engage in collaborative reflection as they prepare their presentations addressing questions that include the following discussion prompts:
  - What is the most important thing you learned?
  - What is something that surprised you?
  - What is something you want to share with others?
  - What do you hope will happen as a result of your work?
- Work with students to identify the tone, level of formality, and linguistic style that are most appropriate for the presentation audience and context. Provide models to help students understand the appropriate register.
- Record students as they practice their presentations. Allow them to review the video and compare their performance to the Complex Communication Rubric (grades 3-5

(https://drive.google.com/file/d/1tF-JpEDVdXpGtwR65715N0jVz83ial5n/view) or grades 6-12 (https://drive.google.com/file/d/1DLO69YZGtPHyQ8s8HhQDJPDx2tCUKsU3/view)) reflecting on opportunities for improvements.

- Make the "Addressing Hunger in Our Community" gathering a ticketed event by inviting audience members to donate canned food or other nonperishable items as a ticket. Give those donations to a local food bank. Check with the food bank to see what donations they accept or need.
- If a team solution such as creating a school garden, supplying the needs of local food banks, or gaining an increased awareness through fundraisers for hunger relief organizations is doable and applicable, help students organize, lead, and carry out their proposed solution. Partner with experts, mentors, and community members to help make their propositions a reality.
- What specific success skills might you want to teach and assess through this project? How will you scaffold these skills?

Thank you to Myla Lee and Honor Moorman for development of this project. This project is an adaptation of a collaboration between PBLWorks and Students Rebuild, a program of the Bezos Family Foundation.

Appendix J

Mathematics Lesson Plan

Week 1: Inequalities

Standard:
6.14 The student will a) represent a practical situation with a linear inequality in one variable and b) solve one-step linear inequalities involving addition or subtraction and graph the solution on a number line.
Objective: The students will apply the one-variable inequality concept to the world around them.

Part 1

Research:

- Survey 6 different groups of people (one being yourself) to gather data to create an inequality.
- Ask each group a different question and record your data in the chart (see the part labeled)
    - Be sure your question is something that can be answered with a number (see example)

People to ask:

1. Yourself
2. Your family (You must ask everyone that you live with)
3. Your extended family (grandparents, aunts, uncles, cousins, etc.) You must use at least three relatives
4. Your friends (you must ask at least four friends)
5. Your classmates (you must ask at least four classmates)
6. Your teammates/club/other group (one other group that you belong to or participate with)
    1. You must ask at least three people in this group)

Part 2

Create your project

- Once all of your data is collected, you can put your project together:
    - Start with a clean, white poster board, approximately 11’ x 17’/
    - Title your poster
    - Divide your poster into six sections
        - Each section of the poster will represent one question and inequality from the chart
- For each section of the poster, do the following:
    - Write the question that you asked (these do not have to go in the order that you asked them)
    - Define a variable for that question. Use a different variable for each question.
    - Write an inequality for the set of answers that you found

- Be sure to write one inequality for each of the six symbols, $<$, $>$, $=$, $\leq$, $\geq$, $\neq$
- Graph each inequality
- Write the answer the graph represents using a complete sentence and essential inequality vocabulary. Use "no more than," "no less than," "at least," "at most," "greater than," "not equal to," etc.
- Do not use "greater than or equal to" or "less than or equal to"
- Glue your survey chart onto the back of your poster.
- Use markers to make your poster colorful and attractive
- Decorate your poster
- Be neat!

Directions and Notes:

- Run off the 1st page of directions for the student and the grading rubric on one page, front to back. This can be turned in with the poster for grading or glued onto the back with the grading rubric facing out.
- Run off the survey chart - by itself. They'll need to record their data on this sheet and glue it to the back of their poster.
- Run off the example chart and example poster front to back. This can be handed to the student individually, or if the project is done in class, a class set can be made to refer to as an example. I also make an example that my students can look at while they work (for an in-class project).
- If this is a class-wide project, surveying the classmates is easy. Just give the students about 10 minutes to go around the room to gather their data.
- Since talking about real-life things, the two "less than inequalities" should stop at zero. Whether you want to bring this to their attention is up to you. If you have some savvy students, they will notice this. If this is the case or you have a higher-level group of kids, allow them to make these two inequalities compound inequalities that stop at zero. For lower-level students, I would use the inequalities like in the example and let the graph go past zero (we just won't be technically mathematically correct)
- Yes, any of this data can be fudged. But is the project's purpose to have them gather data or to understand how to represent the data as an inequality? I don't worry about the actual numbers or whether the data is legit. I want them to develop six questions and data that can be written with the six inequalities.
- I would encourage the students to come up with examples and not use all six questions I have asked in my example. This is just a sample so they can see what the finished project should look like. The questions are there to help them think of the questions to ask. I don't mind if they borrow a question or two, but I would like most of their questions to be original.

Grading Rubric

_____ 6 different questions were asked (6 points)
_____ The minimum number of people per question was met (6 points)
_____ Poster has an appropriate title (6 points)
_____ The poster is divided into six sections, and each section corresponds to one of the questions asked on the chart (6 points)
_____ chart is filled out correctly including participants initials (6 points)

_____ Each section of the poster has the following:
- _____ Question asked is written (10 points)
- _____ A variable is defined (different from the rest) (10 points)
- _____ An appropriate and correct inequality is written (10 points)
- _____ The inequality, if graphed correctly (10 points)
- _____ A complete sentence is written answering the question and explaining the answers depicted in the graph (10 points)

_____ Key vocabulary is correctly used in the appropriate places (6 points)
_____ Survey chart with name is glued onto the back of the poster (4 points)
_____ Poster is neat, colorful, and decorated (10 points)

Example Survey Chart:

What question did you ask?	**Who did you ask?** Write their names below. Then they initial.	**What was their answer?**
	You	
How many brothers do you have?	Julie Smith	2
	Your Family	
How many glasses of water do you drink in a day?	My Mom	8
	My Step-Dad	5
	My brother Jeff	7
	My brother Jim	6
	Your Extended Family	
How many books have you read in the past year?	My Grandma	12
	My Grandpa	2

	My Aunt Nancy	4
	My cousin Michelle	6
	My cousin Nicole	5
	Your Classmates	
How many pets do you have?		
	Chris	1
	Kendall	4
	Lizabeth	0
	Charlie	3
	Other Group	
How many goals have you scored this year? (my soccer team)		
	Olivia	6
	Morgan	4
	Meredith	1
	Kylie	0

Survey Chart for Students

What question did you ask?	**Who did you ask?** Write their names below. Then they initial.	**What was their answer?**

Week 2: Circles

Standard:

6.7 The student will
a) derive π (pi);
b) solve problems, including practical problems, involving the circumference and area of a circle

OVERVIEW

Project 1: Research the history of Pi, estimate the value with provided items, then create an item and solve a real-world problem using the circumference and area of circles.

PROJECT

1. Research the history and significance of pi.
2. Using the items provided, estimate the value of pi (measuring the circumference and diameter of various circles) (aligns with 6.7a)
3. Use the derived value of Pi to calculate the circumference and area of circles of different sizes.
4. Create the following items below and solve real-world problems involving circles, such as (aligns with 6.7b)
    1. Research an aquatic animal and the specific amount of space the animal needs to survive adequately. Create a circular tank that matches the dimensions (circumference, area, etc.) and present it to the class.

Week 3: Area and Perimeter

Area and Perimeter

Driving Question or Challenge:
How can we use our understanding of area and perimeter to design the most efficient garden layout for a local community center?

Real-world Context:

- **Option 1:** In this project, students will apply their knowledge of area and perimeter to solve a real-world problem a local community center faces in designing an outdoor space that maximizes aesthetics and functionality.
- **Option 2:** In this project, students will have the autonomy to make decisions regarding park design elements, such as the placement of recreational equipment and walkways. They will choose how to present their park designs through digital models, posters, or oral presentations.

In-depth Inquiry:
Students will explore the concepts of area and perimeter, exploring how they are calculated for triangles and rectangles. They will investigate practical applications of these measurements in designing spaces and structures, engaging in hands-on activities to deepen their understanding.

Student Voice and Choice:
Students will be free to choose the design elements for the garden layout based on their understanding of area and perimeter calculations. They will decide on the shape of the garden beds, paths, and other features and how to optimize space usage while considering aesthetic appeal.

Reflection:
Throughout the project, students will regularly reflect on their design choices, the challenges they encounter, and the strategies they use to overcome them. Reflection will help students track their progress, identify areas for improvement, and celebrate their successes.

Critique and Revision:
Students will engage in peer feedback sessions, where they will provide constructive criticism of their classmates' designs and receive feedback on their work. This process will encourage collaboration, communication, and critical thinking as students revise and refine their garden layouts.

Public Product:
At the end of the project, students will present their final garden design plans in a public exhibition within the school community. This tangible product will showcase their understanding of area and perimeter concepts applied in a real-world context.

Collaboration:

Students will work in small teams to combine their strengths and ideas in designing the garden layout. Collaborative discussions will allow students to learn from each other, share diverse perspectives, and develop essential teamwork skills.

Teacher Facilitation:
The teacher will be a facilitator, providing guidance, resources, and support as students work through the project. Instead of direct instruction, the teacher will encourage inquiry, assist in problem-solving, and mentor students in exploring area and perimeter concepts.

Interdisciplinary Connection:
This project will integrate math, art, and practical design skills, emphasizing the interdisciplinary nature of real-world challenges. Students will see how different subjects intersect and complement each other in solving complex problems.

Assessment:
Assessment will include formative and summative methods, such as rubrics for evaluating the completeness and accuracy of garden designs, presentations where students explain their design choices, and peer reviews that assess collaboration and communication skills.