THE IMPACT OF PROJECT-BASED LEARNING ON MATHEMATICS AND READING ACHIEVEMENT OF 7TH AND 8TH GRADE STUDENTS IN A SOUTH TEXAS SCHOOL DISTRICT

A Dissertation

by

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This dissertation meets the standards for scope and quality of
Texas A & M University-Corpus Christi and is hereby approved.

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ABSTRACT

Since the introduction of *A Nation at Risk* (1983), *c*onsiderable efforts have been made to address the need for more innovative teaching and learning to prepare students to meet the changing demands of the 21st century. Project-Based Learning (PBL) serves as an instructional approach to classroom teaching and learning that is designed to engage students in the investigation of real-world problems to create meaningful and relevant educational experiences. The study examined the impact of PBL on reading and mathematics achievement of 7th and 8th grade students and tested the hypothesis that PBL is effective in impacting academic achievement.

The ex post facto study employed a causal-comparative research design. The characteristic-present sample was the group in which the PBL was utilized. The comparison group did not receive the PBL. The outcome measures were the State of Texas Assessments of Academic Readiness (STAAR) mathematics and reading achievement scores. The 7th grade participants consisted of a characteristic-present group (n=87) and a comparison group (n= 140). The 8th grade participants consisted of a characteristic-present group (n=84) and a comparison group (n=150).

Multivariate and univariate analysis of the data showed that the PBL groups performed at a higher achievement level on the majority of the tested Reporting Categories than did the non-PBL students on the basis of observed and adjusted scores for the outcome measures. The study did demonstrate that student participation in the PBL positively impacts academic achievement in 7th and 8th grade reading and mathematics based on STAAR outcome measures.

Participation in the PBL, as the curriculum, would likely benefit students in other school districts. The implementation of PBL would have implications for teacher professional development of innovative teaching and learning. The study revealed that student participation in the PBL favors academic achievement and would likely hold up to high stakes testing and accountability.

DEDICATION

I dedicate this dissertation to my family; Rick, Ryan, and Alyssa. You were my strength throughout this entire four year marathon that tested every bit of my being. It was your support, encouragement, prayers, and unconditional love that served as my "true north" and helped me to never lose sight of what truly matters…our family. Rick, I love you and thank you for selflessly making sacrifices for our dreams to come true. Ryan, I am so proud of the man you have become and the incredible future you have in store for you. Alyssa, you are a beautiful woman, inside and out. My hope is that I have shown you that women can have dreams and a family too. Rick, Ryan, and Alyssa, thank you for believing in me. I hope that this accomplishment gives you all the courage to pursue wherever your dreams take you and serves as an example that ANYTHING is possible.

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Finally, I would like to express my gratitude and deep appreciation to all those who went before me and created a path to help others succeed. It is my hope to do the same and pay it forward to others who dare to dream.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

TABLE PAGE

FIGURE PAGE

Chapter 1

Introduction

Background and Setting

Considerable efforts have been made, since *A Nation at Risk* (1983), to address the need for more innovative teaching and learning to prepare students to meet the changing demands of the 21st century. Voicing their stance, Barron and Darling-Hammond (2008) described that in order to provide an effective education that fully prepares children for their future, the use of simple transmission of information and memorization are no longer needed due to the changing workforce and skills required for 21st century. They further stressed that education today must focus on helping students learn how they learn so that they are able to adapt to the changing technologies, information, jobs, and social conditions (Barron & Hammond, 2008).

Preparing students for the demands of the 21st century is critical; however, the parallel issue of the dropout rate intensifies the urgency of the need for more innovative teaching and learning. According to Rumberger (2011), every school day, three out of 10 high school students fall through the cracks of America's public high schools. In addition, he reported that from the class of 2010 alone, an estimated 1.3 million students failed to graduate with a diploma. Most concerning is that while dropout rates vary across groups and setting, these students are likely members of ethnic minority groups, who experience acute academic failure and often live in poverty (Egemba, Crawford, & Kops, 2003; Griffin, 2002; Stillwell, 2010; Suh, Suh, & Houston, 2007).

According to the Alliance for Excellent Education (2009), if schools are not able to significantly reduce dropout rates, the 13 million students that are predicted to drop out in the next decade will reduce the national revenue by three trillion dollars. Students who drop out are more likely than high school graduates to be unemployed (Sum, Khatiwada, McLaughlin, & Palma, 2009) and if employed they earn less than high school graduates (Levin, Belfield, Muennig, & Rouse, 2007). Further compounding the issue is that high school dropouts are more likely to be dependent on public assistance, engage in criminal activities, and experience health problems (Rumberger, & Thomas, 2000; Moretti, 2007, Muennig, 2007; Waldfogel, Garfinkel, & Kelly, 2007).

While it is well recognized that a student dropping out of school profoundly puts the nation at risk (Pallas, Natriello, & McDill, 1989), little is understood about how schools and districts approach the needs of high school dropouts and what can be done to help dropouts stay in school. We know from the literature that the main reason students drop out of school was that classes were not interesting. From Beekman (2006) and Bridgeland, Dilulio, & Morison's (2006) work examining the perspectives of high school dropouts, they found 47% of students who drop out of school reported being bored and disengaged from high school. For many of these dropouts, dislike and boredom with school led to patterns of absenteeism, cutting classes, and a low rate of participation in extracurricular activities. Bridgeland, Dilulio & Morrison (2006) offer "again and again, participants recounted how high school was boring, nothing I was interested in, and the teacher just stood in front of the room talking and didn't really involve you" (p. 4).

As a result, the perspectives of the high school students gave voice to their struggles and it becomes the responsibility of the educators to address those factors that can be controlled. For instance, individual factors such as attitudes, behaviors and prior experiences, difficult transitions to high school, deficient basic skills, and a lack of engagement all serve as barriers to graduation

(Bridgeland, et al, 2006, & Rumberger, 2011) and thus are important for school officials to consider when trying to reduce dropout rates. However, it is equally important for school and district officials to consider contextual factors of school programs, more specifically how schools, through instruction and learning, work to engage students.

John Dewey (1944) believed the world was constantly changing and students needed to be active learners engaged in the learning process. In his opinion, traditional education created the wrong kind of experience to promote learning. Even today, his profound statement “If we teach today as we taught yesterday, we rob our children of tomorrow” (p. 167) supports the urgency created by high dropout rates and the need for powerful teaching and learning that prepares students for the future. So why is the work of John Dewey, and his profound statement made in 1944, still drawing attention to education today?

Reflecting on past decades since Dewey, schools today remain much as they did in eras gone by. In fact, the organizational forms that govern instruction have remained the same over long periods of time, with little change to the space, time, student classification, grading, and core operations (Tyack & Cuban, 1995). Tyack and Cuban (1995) referred to this as the basic grammar of schooling. They explained that the grammar of schooling modeled essential features of what Americans know a real school to be like and represented and embedded a culture that has been part of most Americans for many decades. One way they explained the grammar of schooling is that it is “analogous to the way grammar organizes meaning in verbal communication and neither need to be understood to operate smoothly” (p. 85). As such, it is no wonder that the deep roots associated with how schools are only differ when customary school practices are challenged.

However, since 1983 with the report *A Nation at Risk*, the United States has been engaged in the most intensive school reform to date. With *A Nation at Risk*, it was reported that the United States lagged behind many countries in mathematics and science and achievement dropped the longer students remained in school. As a result of this report, over the last thirty years, billions of dollars have been spent, numerous studies and reports conducted, regulations increased and countless programs generated with results showing little progress (Peterson & West, 2003). Not surprisingly with little evidence of progress noted, the grammar of schooling, as described by Tyack and Cuban in 1995, remains entrenched in standardization. For instance, Wolk (2010) noted that the current educational system was designed for standardization because of the way it organized students, teachers, curriculum and the building. While some may argue for school reform (Elmore & City, 2011; Hess, 2011), Christensen, Horn, and Johnson (2008) suggests that "our challenge is not to reform schools, but to redesign them" (pp. 37-38).

Thus several attempts to redesign schools and prepare students for the 21st century skills through innovative teaching and learning have become evident in one South Texas school district with academic programs such as Science, Technology, Engineering, and Mathematics (STEM), International Baccalaureate (IB), Early College High School (ECHS), and the focus of this study, Project-Based Learning (PBL). By design, these academic programs are innovative in nature because they concentrate on developing critical thinkers by engaging students in more authentic learning that requires solving real-world problems, collaboration, extensive research, inquiry, writing, analysis, collaboration, and effective communication (Newmann, 1996). As Barron and Darling-Hammond (2008) noted, students learn at deeper levels and perform better on complex tasks by engaging in authentic projects that draws subject knowledge to solve real-world problems.

In the quest to pursue deeper learning for students, PBL has emerged as a comprehensive approach to classroom teaching and learning that is designed to engage students in investigation of authentic problems (Blumenfeld et al, 1991; McGrath, 2004; & MaKinster et al, 2001). According to Krajcik, Blumenfeld, Marx, and Soloway (1994) and Thomas (2000), an effective PBL consists of five components: 1) an authentic and engaging driving question, 2) student generated artifacts, 3) student collaborated research, 4) an audience of community, and 5) the use of technology-based cognitive and communication tools.

Using the tenets of PBL, students pursue solutions to problems by asking and refining questions, debating ideas, making predictions, designing plans, collecting and analyzing data, drawing conclusions, communicating ideas, asking new questions, and creating artifacts (Blumenfeld et al, 1991; Thomas, 2000; & Mergendoller et al, 2006). As such, the PBL places students in realistic, problem-solving environments that serve to make connections between phenomena in the classroom and real life experiences (Blumenfeld et al, 1991). In addition, the PBL requires active engagement of students' effort over an extended period of time, promotes links among disciplines, presents an expanded view of subject matter and requires the activities to be meaningful to the learner to promote a deep level of understanding of the content (Blumenfeld et al, 1991).

Above and beyond, the PBL approach takes learning a step further than just mastery of content knowledge by enabling students to transfer their learning to new kinds of situations and problems and to use knowledge more proficiently in performance situations (Barron & Darling-Hammond, 2008). As a result, PBL provides students with the opportunity to work autonomously over periods of time and produce realistic products that may include presentations to strategic audiences who have interest in the solutions (Thomas, 2000).

McGrath (2004) reported that PBL recognizes learning as a social process where the design of the learning environment relies heavily on the promotion of collaboration. Furthermore, the student takes on the role of cognitive apprentice and explores problems by working with other peers and resources in the community (MaKinster et al, 2001). As a result, students in the PBL classrooms, which focus on authentic performance, collaboration, and students' choice of the learning activity, exhibit a higher degree of motivation than do non-PBL students (Blumenfeld et al, 1991).

The shift for innovation in teaching and learning through PBL presents challenges for the teacher accustomed to methods of recitation and direct instruction understood by the grammar of schooling. As a result, teachers are challenged to develop new content knowledge, pedagogical techniques, approaches to assessment and classroom management (Edelson et al, 1999; Hancock et al, 1992; Marx et al, 1997). The new primary role of the teacher in a PBL environment is that of a facilitator in order to assist and coach students in developing an understanding of the materials and subject (MaKinster et al, 2000).

Statement of the Problem

A school district in South Texas, hereafter referred to as the District, was awarded a federal magnet grant and received a total of $6,496,556 for the 2010-2013 school years for the creation of a kindergarten through high school (K-12) magnet school (CCISD, 2010). According to the Magnet Schools of America (2012), the United States Department of Education Magnet Schools Assistance Program (MSAP) was authorized by the No Child Left Behind Act. The purpose of the MSAP was to promote the development and design of innovative educational methods and practices that promoted diversity and increased choices in public schools and educational programs. Based on the principles of the MSAP, the grant required the District to address the areas of desegregation/reduction of minority group isolation, improving academic achievement, and building capacity for sustainability of the magnet program after the grant ended (MSA, 2012).

The District was one of 34 schools in the United States that was awarded a MSAP grant. With grant funding, the District established a new magnet (K-12) school, using the innovative approach of PBL as its guiding construct (CCISD, 2010). Even though the program had been in an implementation phase for two years, its effectiveness had not been systematically investigated; specifically, its impact on academic achievement.

Theoretical Framework

Kolb's (1984) Experiential Learning Theory (ELT) provided the study's theoretical framework. The ELT defines learning as the "process whereby knowledge was created through the transformation of experience from the combination of grasping and transforming experience" (p. 41). The ELT describes learning as a "holistic adaptive process that provided conceptual bridges across life situations such as school and work" (Kolb, 1984, p. 33). The term "experiential" is used to differentiate the ELT from cognitive and behavior learning theories and provides distinct emphasis and focus on the role that experience plays in the learning process. Experiences and experimentation are described as the way people make sense of the world (Kolb et al, 1999).

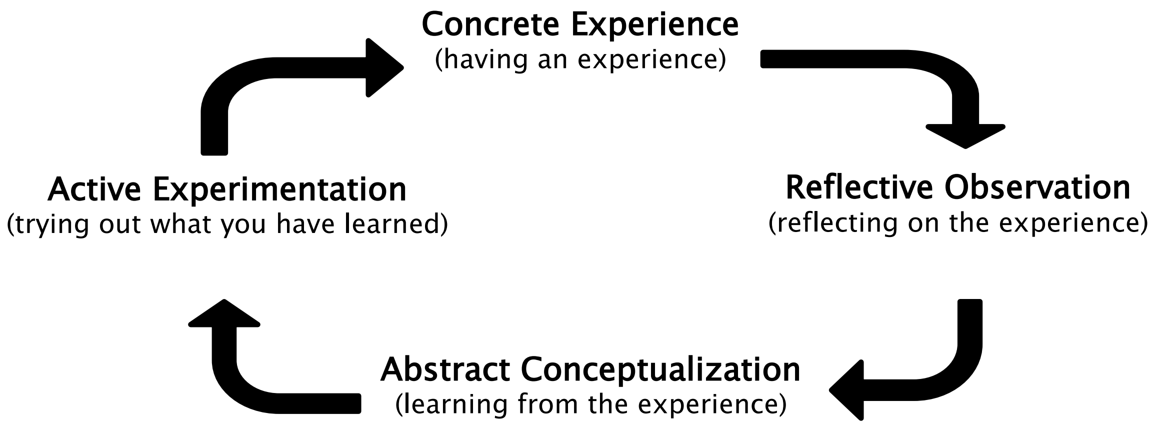
Constructivism was also explored as a theoretical framework guiding the study. According to Richardson (2003), the general sense of constructivism is that it is a theory of learning where individuals create their own new understanding on the basis of an interaction between what they already know and believe and ideas and knowledge with which they come into contact. Constructivism operates on the premise that perspectives of the world are constructed through individual experiences and schema (Schuman, 1996).

For the purpose of the study, the ELT was considered a better fit, because the tenets provided conceptual connections across life experiences. According to Kolb, Boyatzis and Mainemelis (1999), the term experiential is used to emphasize the primary role that experience plays in the learning process. Additionally, the ELT "provides conceptual bridges across life situations such as school and work" (Kolb, 1984, p. 33). Furthermore, the ELT promotes learning transactions that take place between the individual and the environment (Kolb & Kolb, 2005). As such, ELT is applicable not only in classrooms but in all arenas of life.

According to Kolb and Kolb (2005), in the ELT model, Concrete Experience (CE) and Abstract Conceptualization (AC) are two related modes for grasping experience. Reflective Observation (RO) and Active Experimentation (AE) are the related modes for transforming experience. Experiential learning is a process of constructing knowledge that involves a creative tension among the four learning modes. This process portrays an idealized learning cycle where the learner has gone through each of the stages - experiencing, reflecting, thinking, and acting in response to the learning situation and what has being learned. The Experiential Learning Cycle, as shown in Figure 1, begins with the concrete experience that is the basis for observations and reflections. The reflections and observations then lead to abstract concepts that create new ideas and thinking. The new thinking promotes active experimentation that applies the new learning and serves as a guide in creating new experiences. The cycle allows an individual to begin at any stage and for the stages to be repetitive (Kolb & Kolb, 2005).

Figure 1

The Experiential Learning Cycle, (Kolb, 1984)



The ELT also focuses on the concept of learning styles, using the Learning Style Inventory (LSI) that assesses individual learning styles and preference for learning (Kolb, 1984). Kolb and Kolb (2005) described four distinct learning styles which are based on the four-stage learning cycle. Assimilators need sound logical theories to consider; less focused on people and more interested in ideas and abstract concepts. Convergers need practical applications of concepts and theories; prefer to experiment with new ideas, simulations, laboratory assignments, and practical applications. Accommodators need hands-on experiences; prefer to work with others to gets assignments done, to do field work, and to test out different ways to complete a project. Divergers need to observe and collect a wide range of information; prefer to work in groups, to listen with an open mind, and to receive personalized feedback.

The ELT and PBL support John Dewey's principles, because children are seen as naturally inclined to the scientific method and are curious to learn how various objects they encounter in daily life operate. The children constantly explore their environment and are involved in interactions with their world. It is through these interactions that they develop intelligence and the ability to solve problems. Learning becomes more social as children learn that they can consult with adults, children, and teachers. Growth, like experience, is on-going with each stage having its own logic and psychology that prepares the learner for the next stage (Gutek, 2005).

According to Gutek (2005), the ELT and PBL share beliefs with Dewey that “Life and learning involved a series of experiments by which human beings sought to control and direct their interactions with their environment. This process was “active, ongoing, and a cumulative flow of human experience that united the episodes of the past with the present and gave direction and control over the future” (pp. 256 - 257).

Like the ELT, the PBL is a model that focuses on project- and/or experience-based learning. The projects are complex tasks, based on challenging questions or problems and involve the students in the design, problem-solving, decision-making, or investigative activities. The PBL provides students with the opportunity to work autonomously over periods of time and produce realistic products that may include presentations (Thomas, 2000). According to Krajcik, Blumenfeld, Marx, and Soloway (1994), an effective PBL consists of five components: 1) an authentic and engaging driving question, 2) student generated artifacts, 3) student collaborated research, 4) a community of audience, and 5) the use of technology-based cognitive and communication tools.

The PBL models provide an effective approach to creating a classroom environment with authentic tasks as the major focus and enable the students to reflect and evaluate their understanding. The primary role of the teacher in a PBL environment is that of a facilitator in order to assist students in developing an understanding of the materials and subject. The student takes the role of cognitive apprentice and explores problems by working with other peers and resources in the community (MaKinster et al, 2001).

The PBL leads to the completion of the project that becomes the learning context. Like Kolb's ELT, the learning environment has relevance and meaning to both the participants and to the real-world audience. The completion of the classroom tasks is required to have applications that go beyond the classroom and establish a sense of community. When students work collaboratively toward a common goal, the experience allows them to become part of something larger than their individual experience (MaKinster et al, 2001).

Kolb's ELT framed the study on the basis of meaningful and authentic experiences for understanding how learning takes place in PBL. Meaningful learning requires that students are afforded opportunities to leverage prior knowledge and participate in tasks that are both meaningful to them and to the world at large (MaKinster et al, 2001).

Purpose of the Study

The purpose of the study was to examine the impact of PBL on reading and mathematics achievement of 7th and 8th grade students and to test the hypothesis that PBL is effective in impacting academic achievement. The 7th and 8th grades were chosen for three major reasons. First, the District data showed patterns of declining achievement among middle graders and research for instructional strategies and programs addressing this area of concern continues. A second reason for the selection of students for the study was that one of the middle schools was located on a high school campus, which was unique to the District. A final reason for the selection of the students and the designated magnet school was the use of PBL as its primary curriculum framework for instruction. The study was guided by the following research questions:

1. What is the impact of Project-Based Learning on student achievement in mathematics among 7th and 8th grade students in a South Texas school district?
2. What is the impact of Project-Based Learning on student achievement in reading among 7th and 8th grade students in a South Texas school district?

Operational Definitions

At the time of conducting the study, in the state of Texas, reading and mathematics achievement were being measured by the State of Texas Assessments of Academic Readiness, (STAAR) (Texas Education Agency, 2010). Achievement in mathematics in both grades was measured by 5 reporting categories, namely, 1: Numbers, Operations, and Quantitative Reasoning; 2: Patterns, Relationships, and Algebraic Reasoning; 3: Geometry and Spatial Reasoning; 4: Measurement; and 5: Probability and Statistics. Achievement in reading in both grades was measured by 3 reporting categories 1: Understanding/Analysis Across Genres; 2: Understanding/Analysis of Literary Texts; and 3: Understanding/Analysis of Informational Texts.

Glossary of Terms

The following definitions are provided to ensure clarity and understanding of terms used in the study:

Texas Assessment of Knowledge and Skills (TAKS): the state assessment designed to measure the extent to which a student has learned and is able to apply the defined knowledge and skills at tested grade levels 3-12 (Texas Education Agency, 2010).

State of Texas Assessments of Academic Readiness (STAAR): the standardized testing program that replaced the TAKS in 2012. The STAAR program at grades 3 - 8 is designed to assess the subjects of reading, writing, mathematics, science and social studies. At high school, however, grade-specific assessments are replaced with 12 end-of-course (EOC) assessments in Algebra, Geometry, Algebra II, Biology, Chemistry, Physics, English I, English II, English III, World Geography, World History, and U.S. History. The STAAR measures the readiness for success in subsequent grades and courses and ultimately for college and career (Texas Education Agency, 2010).

Project-Based Learning: a model that organizes learning around projects. Projects consist of complex tasks based on challenging questions or problems that involve students in design, problem-solving, decision making, or investigative activities and give students autonomy for the work over extended periods of time, ending with a product or presentation (Thomas, 2000).

Magnet School: a public elementary or secondary school that provides a unique or specialized curriculum in such a way as to attract a racially diversified student body. Magnet schools are distinct from other public schools because they offer specialized academic focus or themes for rigorous and competitive programs (MSA, 2012)

Delimitations, Limitations, and Assumptions

The study was delimited to one school district in South Texas and outcome measures of mathematics and reading. Due to the non-probability nature of sampling, external validity was limited to study participants. Due to the non-experimental nature of the study, no causal inferences were drawn. The study used existing data and it was assumed the data had been accurately measured. It was assumed that the participating schools followed the curricula accordingly. It was assumed that the researcher remained objective throughout the conduct of the study.

Significance of the Study

School districts have never ceased their search for ways to help students be successful. The significance of helping students succeed goes beyond the school walls, the community, the state, and the nation. Since student success rests on the shoulders of all educators, it becomes their responsibility to prepare the learners for entering the real world. The study was significant because it provided empirical evidence supporting the effectiveness of PBL on positively impacting academic achievement in mathematics and reading which may offer theoretical and practical implications in the areas of professional development, curriculum design, and resource allocation. The results of the study are useful as school districts explore further expansion or replication of services and resources associated with the PBL and continue to change the conception of learning by moving away from the teacher as the purveyor of knowledge and the learners as passive receivers.

The rapidly changing world has increased our demand for flexibility to leverage previous knowledge and experience in new and different ways. Educators have been held accountable for what learners know and are able to do. It is this accountability that has added pressure for educators to find new ways to help students learn and to design competency measures of learning and experiential techniques such as the PBL, to assess learner outcomes. In the job market, experiential approaches found in the PBL appear to be more effective in developing skills such as communication, the ability to work in teams, and workplace literacy (Lewis & Williams, 1994).

Chapter 2

Review of the Literature

Can America's public schools meet the many challenges faced today? According to Gordon (2006), the expectations faced by America's public schools appear overwhelming and to some, dangerous. In addition, these challenges created desperation and a climate of fear in a new age where measurement is identified from a single standardized assessment. New challenges in the approach to public education emerged from the social, political, and economic changes taking place in America and around the world. Elmore, Abelmann, and Fuhrman (1996) stated that "what is new is an increasing emphasis on student performance as the touchstone for state governance" (p. 65). Moreover, the educational accountability should focus less compliance with rules and more on increasing learning for students. Therefore, the answer is to figure out how to improve teaching and learning in whole systems instead of in isolated schools or classrooms (Elmore et al, 1996). Gordon (2006) stressed that outdated assumptions and a lack of consensus about the fundamental goals of America's schools had cast the future of public education as we know in doubt. Furthermore, there was always a push for school reform but many of the same broken assumptions that have prevented schools from advancing are the same ones used in plans and strategies for reform.

Chapter 2 provides a review of the literature and research related to student academic achievement approaches and Project-Based Learning. The review of the literature is organized in five sections: 1) Accountability, 2) Engagement, 3) Project-Based Learning, 4) Theoretical Framework, and 5) Summary.

Accountability

According to Peterson and West (2003) and Linn (2000), the accountability movement began in an enduring strife to measure cognitive aptitude and ability. As early as the 1950s, a small back-to-basics movement complained about progressive education and slipping academic standards in American schools. They further reported that the federal government in the late 1960s funded the National Assessment of Educational Progress (NAEP) test for 9-, 13-, and 17-year-old students to provide more complete information instead of relying upon the Scholastic Aptitude Test (SAT) taken only by college-bound juniors and seniors. Even though the NAEP was designed to not target individual schools on performance, it was a key instrument for moving the accountability movement forward (Peterson & West, 2003; Linn et al, 1990; Linn, 2000).

Tests and assessments have been key elements in several waves of reform and the quest for accountability. Both the roles that tests played in reform efforts and sometimes the nature of the tests have changed in each new wave of reform. As political pressures increased, so began the waves of reform and the set course for accountability. The responses to these political pressures were explored in three waves of reform: Wave 1-Student Performance, Wave 2-Structural Reform, and Wave 3-Systemic Reform.

<u>Wave I: Student Performance</u>

The first wave of reform was a call to raise the standards that began as a response to a perceived threat with the landmark 1983 report, *A Nation at Risk* (Gordon, 2006; Ravitch, 2010; Elmore, 1997). The document was the result of an 18 month study by the National Commission on Excellence in Education (NCEE), which had been created by the Secretary of Education to make recommendations for improving U. S. schools. The report stated, “If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might well have viewed it as an act of war" (NCEE, 1983).

According to Ravitch (2010), A *Nation at Risk* called for mainstreamed reforms to renew and repair the school system. Specifically, the reform recommendations called for strengthening the curriculum for all students, setting clear and reasonable high school graduation requirements that demonstrated students' readiness for postsecondary education or the workplace; establishing clear college entrance requirements; improving the quality of textbooks and tests; expecting students to spend more time on school work; establishing higher requirements for new teachers; and increasing teacher compensation (Ravitch, 2010).

Gordon (2006) reported that *A Nation at Risk* launched a national dialogue about education reform, and led to statewide standards and accountability testing programs. In addition, he warned that "our once unchallenged preeminence in commerce, industry, science, and technological innovation is being overtaken by competitors throughout the world is as relevant now as it was then" (Gordon, 2006, p. 2). The attention of the U.S. falling behind foreign competitors in the global economy launched a battle and the weapon was student performance. This threat was a wake-up call for the U.S. and generated the urgency to stay competitive in the world market (Elmore, 1997; Gordon, 2006; Ravitich, 2010).

Peterson and West (2003) explained that *A Nation at Risk* pushed the nation further toward accountability with educational issues coming to the forefront on state agendas. As a result, the ideology of accountability became evident as campaign platforms for marketable public relations at both the state and national levels. A future candidate and Texas businessman, H. Ross Perot, served as head of a state education commission and first called for tough requirements that would hold schools and students accountable. Perot had several proposals that had bipartisan appeal and public support. His influence on the Texas legislature called for testing procedures that would monitor the annual progress of students in each school, higher starting salaries for teachers, a teaching career ladder, management training for administrators, and a "no pass, no play" restriction on extracurricular activities. As a result, test scores in Texas began to rise faster than scores in other states and expedited the focus of accountability at the national level (Peterson & West, 2003).

The first wave of reform took a nation-wide flight in 2002, when *No Child Left Behind* (NCLB) was signed into law and mandated standards and accountability testing as the nation's primary engine of school improvement. The law required all students, including students with disabilities, to reach proficiency in reading and mathematics by 2014 (Jorgensen & Hoffmann, 2003).

According to Guskey (2007) and Gordon (2006), in order to receive federal funds, the NCLB required that students must be making progress toward the standards set by each state. Ravitch (2010) wrote that the NCLB called for federally mandated testing of a wide range of student groups from K-12. Assessment results are disaggregated within each state, school district, and campus by student demographic subgroups. Gordon (2006) added that the NCLB established sanctions for schools in which students in racial, ethnic, income, and special education subgroups failed to meet adequate yearly progress (AYP) goals toward the standard for acceptable performance set by each state. Under the terms of the NCLB, schools that failed to demonstrate adequate progress toward the goal of making every student proficient in mathematics and English by 2014 would be subjected to increasingly onerous sanctions (Ravitch, 2010). States retained latitude in determining several critical features of AYP requirements and determined what proficiency meant. Since states made these determinations, immense disparities in state's definitions of proficient achievement were documented (Guskey, 2007; Ravitch, 2010).

As noted by Ravitch (2010), test-based accountability, not standards, became the national education policy of the NCLB. In addition, Gordon (2006) added that the NCLB's requirements constituted uncommon federal involvement in American education. The law was politically popular because it addressed concerns widely held with business and political leaders about international comparisons to American students and achievement gaps. Many felt that the common statewide standards and accountability mandated by the NCLB placed everyone on the same page (Gordon, 2006). According to Wolk (2010), one harmful assumption that policymakers made is that the achievement gap between white and minority students could be closed by holding all students to the same standard, providing them with a common curriculum and requiring them to take standardized high-stakes tests each year. Furthermore, Wolk (2010) stated "standards are essential but contrary to the conventional wisdom, standards don't educate kids if we lack the processes and resources to achieve them" (p. 17). Ravitch (2010) revealed that the NCLB introduced a new definition of school reform that was applauded by Democrats and Republicans alike. In this new era, school reform was characterized as accountability, high stakes testing, data-driven decision making, choice, charter schools, privatization, deregulation, merit pay, and competition among schools (Ravitch, 2010).

The first wave of reform and accountability continued to be highly evident and established in the United States. In 2009, House Bill 3, from the 81st Texas Legislative session, mandated the development of the new State of Texas Assessments of Academic Readiness (STAAR) program (TEA, 2010). In addition, the Transition Plan for House Bill 3 contained a detailed description of the process the Commissioner of Education used to develop and implement the provisions of House Bill 3. As a result, the Transition Plan for House Bill 3 included sections that covered the development of the new STAAR program; the development of new performance ratings for Texas public schools; federal requirements for assessment and accountability; accreditation, sanctions, and interventions; and financial accountability (Texas Education Agency, 2010).

In the spring of 2012, the STAAR replaced the Texas Assessment of Knowledge and Skills (TAKS) (TEA, 2010). The state standardized testing program included tests for students in grades 3-12 and measured the Texas Essential Knowledge and Skills (TEKS) curriculum standards. Furthermore, the STAAR program, at grades 3-8, assesses the same subjects of mathematics, reading, writing, and science. At high school, however, grade-specific assessments were replaced with 12 end-of-course (EOC) assessments in the subjects of Algebra I, Geometry, Algebra II, Biology, Chemistry, Physics, English I, English II, English III, World Geography, World History, and U.S. History (TEA, 2010). As a result, students are required to cumulate overall passing scores in all EOC tests to graduate from high school. However, even though the opportunity of retesting was permitted, high stakes testing continues to be the standard in the new STAAR. One major change in the STAAR program was that tests now have a time limit requirement. The STAAR is more rigorous and contains more test questions with a higher cognitive complexity level at most grade levels. As outlined by the Texas Education Agency (2010), in reading, the test places greater emphasis on critical analysis compared to literal understanding. In writing, students are required to write two essays rather than one. In social studies, science, and mathematics, process skills are assessed in context, not in isolation. In science and mathematics, the number of open-ended items was increased. Overall, the new and rigorous program focuses on readiness for success in subsequent grades and courses and ultimately for college and career (TEA, 2010).

The ideology of accountability emerged during the first wave of reform in many arenas, platforms, and regulations. Accountability was center stage in the political arenas where Democrats and Republicans were in agreement of an urgent need for raised standards of student performance that ensured the U.S. remained a top competitor in the global market. The ideology of accountability was the political platform that leaders used in order to get to the national and state levels. Presidential candidates rode the wave of reform and accountability. Their platforms impacted legislation with regulations that targeted graduation requirements, passing grades for participation in extracurricular activities, basic competency testing, and emphasis on the core academic areas. Accountability, in the first wave of reform, became about mandates, bureaucracy, standardization, and control of school performance in response to a perceived threat from the past, present and future of the United States.

Wave II: Structural Reform

The second wave of reform centered on the restructuring of school and empowered those most affected by the direct compliance and mandates of standards. Congress left to the states the specific standards to be set, the design of the testing instruments, and the administration of their accountability systems. Standards became a major part of political discourse in state and local governments and the range of people involved in their development had expanded to include many groups that were not involved in the early formation (Elmore, 1997).

According to Elmore (1999) and Peterson and West (2003), standards-based reform thrived and had strong backing from the groups whose support was necessary for its success such as legislators, policymakers, administrators, teachers, and members of the public. In addition, most public schools and school systems were not equipped to meet the demands of standards-based reform and stood to lose public confidence if they failed. If a school failed, parents were empowered with the right to send their children to non-failing public schools within the same district. Thus, the transparency of student performance with parents and community placed a new pressure on schools. Peterson and West (2003) concluded that the legislation's impact was highly dependent upon the way it was administered by the states and on the specific strategies they devised to promote improvement.

Tyack and Cuban (1995) reported that policymakers generated mandates that called for comprehensive school reform and goals that created effective schools during the second wave of reform. When the reforms failed to work out in practice, there were many different explanations and targets for blame. Practitioners believed policymakers did not know what schools really needed and proposed reforms that could never work as planned. The best way they learned to function with these new mandates was to "adapt innovations to local circumstance, or comply in minimal ways, or sabotage unwanted reforms" (p. 61).

To emphasize their views on school reform, Tyack and Cuban (1995) used case studies to explore how schools changed reforms. Generally, reforms have tended to layer, one on top of the other; added to, rather than replaced what went before. In a case study in New York City, reformers sought to improve education by changing the governance of schools and adopting various strategies to increase academic achievement. When an approach failed to work, new alternatives were created but the original reform laws were left and regulations tended to counteract and conflict with each other.

According to Tyack and Cuban (1995), "the major goal of the state legislature was to promote educational excellence and the target became lazy students and incompetent teachers"

(p. 78). In addition, the action strategy called for more school days, longer hours, additional academic courses, major attention to basics, better criteria for evaluating and compensating teachers, increased standardized testing of students, and more elaborate reports of test results.

As a result of increased accountability, high stakes testing and increased pressure for local districts created a situation where games were played to increase test scores by finding ways to bypass the effects (Tyack & Cuban, 1995). Some examples included teachers excluding low-performing students from taking the test; extending passing periods to show a longer school day; padding grades for students who did not meet the no-pass, no-play rule in athletics; renaming old courses to look like new required ones; and adjusting the graduation and promotional cut-off scores to ensure higher examination passing rates (Tyack & Cuban, 1995).

Tyack and Cuban (1995) reported that faith in top-down state mandates began to die down and the new buzzword for educational reform became known as restructuring. People regarded restructuring as an opportunity for choice, empowerment or decentralization, and school site management. Furthermore, restructuring was also seen as increased parent involvement, national standards with aligned tests, deregulation, new forms of accountability, and basic changes in curriculum and instruction. Thus, the struggle of what role school districts played in the top-down and bottom-up of restructuring now became the third wave of reform-systemic reform.

Wave III: Systemic Reform

Linn (2004) noted that the centerpiece of George W. Bush's education agenda was the reinforcement of accountability that served as the major theme of state policies aimed at improving education. Also, accountability systems were introduced based on student testing tied to state content standards. Systemic reform included three dimensions for improved academic achievement by "clarifying expectations and motivating greater effort on the part of students and teachers, using student achievement as a primary mechanism of accountability" (p. 73).

Linn (2000) reported that assessment was appealing to policymakers because it is relatively inexpensive compared to making program changes, it can be externally mandated, it can be implemented rapidly, and it offered visible results. Ablemann and Elmore (1999) wrote that growing political and fiscal pressure on schools led to the conception of accountability. The political pressure stemmed from the increasing visibility of school performance as a policy issue at the state and local levels and the increased capacity of state and local governments to measure and monitor student achievement. In addition, the fiscal pressure came from heightened awareness about educational expenditures as a component of state and local budgets. Abelmann and Elmore (1999) added that the results of various assessments such as the Third International Mathematics and Science Study (TIMSS) and the National Assessment of Educational Progress (NAEP) fueled public concern over what American students are taught and know in comparison with students from other countries.

In his book, *The World is Flat,* Friedman (2005) argued that the capacity to distribute information and services globally has created a new reality. He shared that for the first time in history, jobs that demanded intellectual capital are not tied to geography. Jobs that can be considered commodities now go where the labor is the cheapest. When it comes to cheap labor, America cannot compete with huge emerging economies and populations like India and China. Instead, as economists, business leaders, and journalists noted, in order for America to maintain its dominant world position, it has to be through innovation. It must come from the consistent flow of fresh ideas that results in new goods and services. He wrote "the United States' economic preeminence isn't a given in the 21st century. It depends in large part on the capacity of our schools to make greater use of the energy and natural talents of more students than ever before. The jobs are going to go where the best-educated workforce that has the most competitive infrastructure and environment for creativity and supportive government" (p. 419).

Ebersole (2010) reported that the Commission on the Future of Higher Education in 2006 concluded that the U.S. does not have the workforce it needs for the economy. The Commission noted that if current trends are not reversed, the U.S. economy and per capita income will actually decrease over the next 15 years, for the first time in U.S. history (Ebersole, 2010). In response to this concern, he added that President Obama set a national goal of increasing undergraduate degree completion by 60% over the next 15 years. He noted that according to the National Center for Higher Education Measurement Systems (NCHEMS), this level of degree production is necessary to maintain America's competitive position within the knowledge-based global economy. Having once led the world in the percentage of adult workers age 25-64 who have a degree, in 2006 the U.S. ranked 17th among those with a bachelor's degree and was tied for 11th overall (Ebersole, 2010). Taken together, these pressures have created strong incentives for elected state legislators and local school boards as well as local administrators for a continued interest in school performance (Abelman & Elmore, 1999).

Linn (2003) argued that broadly shared responsibility was needed for accountability systems and systemic reforms to contribute to improved education. In doing so, he suggested that systems needed to be designed in ways that are consistent with research and past experience by setting ambitious performance standards and improvement targets that could reasonably be achieved given sufficient effort and supporting resources. Elmore (1999) recommended creating a new model of distributed leadership that involves describing the ground rules that leaders would have to follow in order to carry out the improvement and describing how they would share responsibility. Thus, this model of distributed leadership assumes that what goes on in the classroom is a collective good and a common concern of the whole institution.

According to Linn (2000), policymakers could enhance the validity, credibility, and impact of assessment and accountability systems while minimizing their negative effects by considering the following seven suggestions. First, provide safeguards against selective exclusion of students from assessment. Second, make the case that high-stakes accountability requires new high-quality assessments each year that are equated to those of previous years. Third, seek multiple indicators instead of placing all weight on one test, which increases the validity of inferences based upon observed gains in achievement. Fourth, place more emphasis on comparisons of performance from year to year than from school to school. This allows for differences in starting points while mainstreaming an expectation of improvement for all. Another suggestion was to consider value added and status in the system. Value added provides schools that start far behind a reasonable chance to show improvement while status guards against institutionalizing low expectations for those same students and schools. Sixth, policymakers are asked to recognize, evaluate, and report the degree of uncertainty in the reported results. Seventh, implement a system for evaluating both the intended positive effects and the more likely unintended negative effects of the system.

Use of tests and assessments were key elements in all waves of educational reform that ranged from tests used for tracking and selection, program accountability, minimum competency assessments, as well as school and district accountability to the current use of tests for standards-based accountability systems. Elmore (1999) noted that the demand for accountability would not go away, even if standards-based reform did, because policymakers were still left with the problem of how to account for the public expenditures they are making and what to do about the governance structure of public education. Gordon (2006) reinforced the following:

> The reality of high stakes testing is that the existing factory system requires every student at a particular grade level to be at a similar point on the assembly line at any given time. Teachers feel pressured to cover the material required by the accountability tests and move on, even if many of the students don't fully understand the content, or others with a stronger affinity for the topic are so bored by the prescribed presentation that they merely check out (p. 35).

Fallis and Optow (2003) gathered data from high school student interviews and documented that students cut class because they found school boring due to top-down instruction, isolated activities and unengaged relationships with teachers. According to Mora (2011), students reported that classes with few group activities and projects led to boredom and a feeling of disconnect from the learning. Mora (2011) referred to the unintended consequences of high stakes testing that rob students of engaging activities that develop higher order thinking skills and lead fewer students to consider further education.

Elmore (1999) asked "what if we seize the opportunity that the standards movement offers and remake the way schools are organized so they are tightly focused on the core functions of teaching and learning?" (p. 4). Reflection on this question led to the exploration of solutions and ideas for keeping students from checking out in spite of our grammar of schooling and the new constant of accountability.

Educators are in constant search of a "silver bullet" because of the extreme pressures associated with high-stakes testing, rigorous standards and accountability. Educators continue to seek innovative strategies, methods, and programs for increased passing rates and graduation rates. Standardized testing has placed a ceiling on learning due to the pressure of focusing on the test rather than the learning. Educators continue to resort back to old habits and bypass the valuable role of assessment as the vehicle to inform instruction. During this age of accountability and the upgrade of standardized testing, educators will have to “unlearn” habits of drill and kill, desks in rows, prohibiting social devices, and collaboration, if we are to stand a chance in redesigning the school of grammar and shifting our focus back to the learning.

Engagement

The NCLB and other reform initiatives of the past two decades attempted to raise standards as a short-term strategy and further raised the barriers to student engagement (Gordon, 2006). According to Nelson (1985),“many students find learning in schools an uninteresting, boring, and impersonal standardization to bureaucratic routine” (p. 149). In a high stakes accountability system, Meyer (1996) reported that teachers and administrators are likely to exploit all avenues to improve measured performance by resorting to practices of teaching to the test. Mora (2011) and Moses and Nanna (2007) suggested that the testing culture contributed to a sense of boredom among students by pressuring teachers to continue classes with regular lectures, test preparation and practice exams in search of the short wins. According to Barron and Darling-Hammond (2008), traditional academic approaches and narrow tasks will not help student learn more deeply unless educators provide them with more engaging, thought-provoking and authentic learning.

Gordon (2006) introduced the new voices from influential leaders outside of education that had begun contending that improving schools meant more than just raising standards. In addition, these leaders supported the idea that schools must work harder to address students’ distinctive interests and to help them locate career paths that tap into their natural enthusiasm and motivation. These outside leaders of public schools called for change and for educators to be bold and radically different (Gordon, 2006).

Leadbeater (2009) targeted the education system and stated that schools are factories for learning that emphasized cognitive skills and focused too little on soft skills such as teamwork, socialization, and respect. He stressed the importance of asking the right questions in order to move forward to create possibilities in a digital world. Leadbeater believes that creativity is collaborative and includes a balance of participation, recognition, and collaboration. To further express the impact of change he stated that in the 20^{th} century, we were identified by what we owned and in the 21^{st} century, we are defined by how we shared.

Sir Ken Robinson (2001), an internationally recognized leader in the area of creativity, noted the biggest problem in our educational system was how we continue to use the model of education influenced by the industrial revolution. Robinson said that we systemically alienated people from their own talents as the education system became more dreary and monotonous. As a result, this type of system created a dropout problem, and those that stay in schools were detached. He explained that the rationalist tradition has driven a wedge between intellect and emotion in human psychology; between the arts and sciences in society at large. Therefore, it has distorted the idea of creativity in education and unbalanced the development of millions of people. Robinson stood on the belief that people perform better and reach mastery of a particular skill when they are engaged and inspired. He added that taking ownership of their own learning will take them way beyond the four walls of the classroom (Robinson, 2001).

Pink (2009) described the definitional tasks of the 21^{st} century as complex and creative. Thus, solving complex problems required an inquiring mind and the willingness to experiment a way to a fresh solution. In addition, education calls for more autonomy and experimentation with the learning process in schools. Pink stated the key to high performance in our schools was intrinsic and internal motivation as a strategy to follow interests, figure out solutions to problems, and understand the benefits.

Elmore (2002) reported that internal accountability must precede external accountability in order to improve student learning. Therefore, school personnel need to share a coherent, explicit set of norms and expectations about what a good school looks like before they can use signals from the outside to improve student learning.

According to Pink (2009), using autonomy and mastery experiences that tap into students' natural curiosity and intrinsic motivation to learn is the underlying power of personalizing learning. He goes on to note that the current reality, however, is that in many classrooms and schools, students often have little autonomy or control over their own learning, which leaves them unmotivated or even resistant to learning. As a result, teachers often turn to the old version of motivation which consists of rewards and punishments. He further discussed the net effect of these carrot-and-stick approaches in that over time, students viewed learning not as something they should want to do but rather as something they had to do if they wanted the reward. Moreover, the effect of these incentives tended to diminish over time (Pink, 2009).

Gardner (2000) is known for his work on multiple intelligences and stated that education was at a crossroads. He noted that the common fact-based approach to teaching is becoming increasingly outdated as technology makes information easier and faster to access. He emphasized that schools should develop students' creative talents and should teach them to use information to solve problems and gain deeper understanding rather than to recall facts.

Bill Gates, a highly prominent voice from outside of education, had been concerned that most schools precluded students from aspiring to excellence. In an option to promote an alternate model, the Bill and Melinda Gates Foundation supported the development of small, theme-based high schools where students had a greater opportunity to focus on an area which was of interest to them (Gordon, 2006). Thornburg (2006) shared the mission of the Bill and Melinda Gates Foundation that strongly believed all students should be provided with an effective teacher in every class, every year. In addition, the Foundation supports clear college-ready standards, consistent across the states, improved data systems, and innovative programs that increase college readiness and remove barriers to high-quality education. Business leaders like Gates are increasingly appreciative of the difference that capturing employees' talents and keeping them emotionally connected and engaged to their work make the success of their enterprises (Gordon, 2006).

In his speech on education, Gates (2005) spoke about the need for fundamental change and the 3 Rs. The first R reaffirmed the need for rigor that ensures all students are given a challenging curriculum that prepares them for college or work. The second R features the importance of relevance that makes sure students have courses and projects that clearly relate to their lives and goals. The final R highlights relationships and ensures students have a number of adults who know them, look out for them, and push them to achieve.

Csikszentmihalyi (1999) coined the word *flow* to identify the experience people feel when they perform tasks that make full use of their abilities and completely engage their attention. He further described the participants as so absorbed in the task that they do not think about the steps and frequently lost track of time. Simply described, *flow* is thought of as engagement at its highest level.

Robinson (2009) described the place where the things people love to do and the things that people are good at come together as their *element*. In addition, the *element* is a different way of defining our potential. However, it manifests itself differently in every person but the components of the *element* are universal. Robinson (2009) states that “finding your *element* is essential to your well-being and ultimate success, and by implications, to the health of our organizations and the effectiveness of our educational systems; that if we can each find our *element*, we all have the potential for much higher achievement and fulfillment” (p. 6).

Motivation, according to Usher and Kober (2012), is described as a necessary precursor to engagement. Motivation affects how students approach school in general, how they relate to teachers, how much time and effort they devote to their studies, how much support they seek out when they are struggling, how they perform on tests, and many other aspects of education (Usher & Kober, 2012; Truby, 2010). Higher motivation to learn is linked not only to better academic performance, but to greater conceptual understanding, satisfaction with school, self-esteem, social adjustment, and school completion rates (Usher & Kober, 2012).

Gordon (2006) noted that higher average test scores can often be achieved through relatively short, pressure-filled periods of drill and kill. However, he voiced that this tactic is not considered a success if it happens at the cost of leaving students with less enthusiasm for learning and teachers with less enthusiasm for teaching. As a result, even good schools, where proficiency levels on state and national tests are high, are subject to low levels of engagement. In these cases, students are just going through the motions with minimal effort and little enthusiasm.

Schlechty (2002) is the founder and CEO of the Center for Leadership in School Reform. He noted that from kindergarten to high school graduation, toy and game marketers are much more successful than schools at engaging the minds and emotions of students. First, marketers know how to leverage active involvement by creating stimulating activities and attractive end products that produce desired behaviors in young people. Second, those selling products and services to young people understand that students are volunteers. In contrast, Schlechty (2002) pointed out that students are required to go to school, take certain classes, and pass a multitude of tests. He concludes that the insight schools fail to acknowledge is that students cannot be coerced to be actively involved.

According to Schlechty (2002), five types of engagement may be used by a student to respond to any school task. The first type of engagement highlights authentic engagement. Authentic engagement is described as the task, activity, or work that students are assigned and associate with a result or outcome that has clear meaning and immediate value to the student. The second type of engagement is ritual engagement. The immediate end of the assigned work has little or no inherent meaning or direct value to the student, but the student associates it with extrinsic outcomes and results that are of value. Passive compliance is identified as the third type of engagement. The student is willing to expend whatever effort is needed to avoid negative consequences, although he or she sees little meaning in the tasks assigned or the consequences of doing those tasks. The fourth type of engagement involves retreatism. Retreatism is identified as a student becoming disengaged from the tasks, expends no energy in attempting to comply with the task, but does not act in ways that disrupts others. The final type of engagement is rebellion. Here, a student refuses to do the assigned task act in ways that disrupt others, or attempts to substitute activities preferred instead of the teachers' task.

Richardson (2012) posed the following questions that are now asked about education. "Are we personalizing learning experiences that allow students to connect our expectations to students' passions and interests as learners? Are we preparing students to learn without us?"(p. 23). Voicing his stance, Richardson (2012) emphasized that shifting curriculum and pedagogy has been essential in helping students form and answer their own questions, develop patience with uncertainty and ambiguity, appreciate and learn from failure, and develop the ability to go deeply into the subjects about which students have a passion to learn.

We live in a world where customization has become the new normal. In the past, personalized learning experiences were seen as opportunities; today they are an expectation. In the mist of this culture of customization, personalization becomes evident in how Americans live today as seen with our playlists through iTunes, our vehicles, our reading through Amazon, our Google searches, our Iphone apps and even our hamburgers. We customize our engagement with the subjects that peak our interest and kept us wanting more. Education is now challenged to do the same.

Project-Based Learning

Project-Based Learning (PBL) has been described as an innovative approach to learning that teaches a multitude of strategies critical for success in the 21st century compared to the traditional model (Bell, 2010; Barron & Darling-Hammond, 2008; Blumenfeld et al, 1991; D'Orio, 2012). The PBL is differentiated from a traditional model in that students drive their own learning through inquiry, as well as work collaboratively to research and create projects that reflect their knowledge (Bell, 2010; Barron & Darling-Hammond, 2008; Blumenfeld et al, 1991; McGrath, 2004). According to Bell (2010) and David (2008), PBL incorporates a student-driven, teacher facilitated approach to learning where learners pursue knowledge by asking questions that trigger their curiosity. In addition, inquiry creates the framework of a project. Primarily, students develop a question and are guided through the research under the teacher's supervision. Further, discoveries are created through projects and shared with a select audience. By design, student choice serves as the key element of this approach (Bell, 2010; Thomas, 2000;

Blumenfeld et al, 1991).

Project-Based Learning can be traced back to the early 20th century. Early in the 1920s, William Heard Kilpatrick advocated project-based instruction (Bas & Beyhan, 2010). According to Foshay (1999), Kilpatrick's notion was that such instruction should include four components: purposing, planning, executing, and judging. Project-based instruction continues to create new instructional practices that reflect the environment in which children live and learn (Bas & Beyhan, 2010).

Dewey (1900) believed that all the waste in education was due to isolation because it lacked unity in the aims of education and lacked coherence in its studies and methods. More so, he saw waste in education from the student's inability to apply what the student was learning at school to daily life. Dewey summarized that "the isolation of school is isolation from life" (p. 67).

According to Harris and Katz (2001), the PBL instructional method centers on the learner. Thus, instead of using a rigid lesson plan that directs a learner down a specific path of learning outcomes or objectives, the PBL allows in-depth investigation of a topic worth learning more about and the relevance it brings to students (Harris & Katz, 2001). Project-Based Learning serves as a comprehensive approach to classroom teaching and learning that is designed to engage students in investigation of complex, authentic problems and carefully designed products and tasks (Blumenfeld, et at., 1991; Bell, 2010; Barron & Darling-Hammond, 2008; MaKinster et al, 2001).

David (2008) described PBL as the basis of the curriculum and not just as a supplementary activity that supports learning. In addition, PBL created opportunities for groups of students to investigate meaningful questions that required them to gather information and think critically. Overall, David (2008) emphasized the core idea of PBL is that real world problems capture students' interest and provokes critical thinking as the students gain and apply new knowledge through problem-solving.

Larmer and Mergendoller (2010) identified eight essential elements of meaningful projects for the PBL. The first essential element includes significant content that derives from the standards and is meaningful to the lives and interests of the students. Another essential element relies on the need to know that introduces the project with information and intrigue. The teacher activates a student's need to know content by launching a project with an event that engages student interest and initiates questions and curiosity. The third essential element consists of a driving question. A good driving question captures the heart of the project in clear, compelling language, which gives students a sense of purpose and challenge. Furthermore, the questions should be provocative, open-ended, complex, and linked to the core of what a teacher wants students to learn. A fourth essential element includes student voice and choice. As such, voice and choice make a project feel meaningful to the students but also includes the creative design of the project by the teacher.

Larmer and Mergendoller (2010) identified the use of 21st century skills as the fifth essential element. As a result, a project provides students with opportunities to build skills such as collaboration, communication, critical thinking, and the use of technology. In addition, the exposure to authentic skills prepares students for the workplace and life. The sixth essential element highlights inquiry and innovation. In real inquiry, students follow a trail that begins with their own questions, leads to a search for resources and the discovery of answers which ultimately leads to generating new questions, testing ideas, and drawing their own conclusions. Furthermore, real inquiry leads to innovation with a new answer to the driving questions, a new solution to a problem, or a new product. The seventh essential element focuses on feedback and revision. Formalizing a process for feedback and revision during a project makes learning meaningful because it emphasizes that creating high-quality products and performances is an important purpose and goal. As a result, students learn that most first attempts are not high quality but revisions are a frequent feature of real-world work. The final essential element calls for students to publicly present products to a real audience and not just the teacher or for the test. When students present their work to a real audience outside of school, they care more about the quality and even create real products and solutions people outside the school could use.

In order to assist in the broad and varied definitions and practices of the PBL, Thomas (2000) used five criteria: 1) projects as central to the curriculum, 2). projects focus on questions or problems that drive students to encounter and struggle with concepts, 3) projects involve students in a constructive investigation, 4) projects are student-driven, and 5) projects are realistic, not school-like.

Boaler (2002) compared student mathematics achievement in two similar Britain secondary schools; one used traditional instruction and the other used project-based instruction. After three years, students in the PBL school significantly outperformed the traditional school students in mathematics skills as well as conceptual and applied knowledge with three times as many students passing the national exam. As a result, Boaler noted that students in the traditional school relied on remembering the use of mathematical rules while the PBL students had developed a more flexible type of mathematical knowledge that engaged them in thought. He concluded that students acquire a different kind of knowledge from using a PBL approach.

In another study, elementary students in three Dubuque, Iowa schools raised their IOWA Test of Basic Skills scores from “well below average” to the district average in two schools and to “well above the district average” in another school with the PBL. In three years, reading gains ranged from 15% in one school to over 90% in the other two schools while the district average remained the same (Thomas, 2000).

According to Thomas (2000), an inner city, racially diverse school in Boston implemented a PBL program called Expeditionary Learning. The results showed that eighth grade students exhibited the second highest scores in the district on the Stanford 9 Open Ended Reading Assessment.

A similar study in Maine concluded that a middle school using a PBL approach showed significant increases in all achievement areas on the Maine Educational Assessment Battery after one year. The gains were three to ten times higher than the state average (Thomas, 2000). Bell (2010) described that children retain more information when they learn by doing which also has a greater benefit in shaping students’ learning with high quality experiences, as well as continuity of experiences.

As shown in the review of literature, PBL does not fit the skill and drill model found in traditional education. The research shares examples of cutting-edge schools that demonstrated how effectively the PBL related to the skills needed by students in today’s workforce. With the PBL, engaged students learn not only the curriculum and the concepts involved in the PBL, but they also learn a multitude of critical 21st century skills. They learn how to organize and present their thoughts, how to manage a complex project within a certain period of time, how to solve problems, how to make decisions, and how to collaborate with other members of a group. These skills are important for preparing the next generation and ensuring our existence as a nation.

Theoretical Framework: Experiential Learning Theory (ELT)

Experiential Learning Theory drew on the work of several theorists about the interplay between experience and learning (Kolb & Kolb, 2005). Kolb (1984) theorized that learning is a continuous cycle of experience, observation, and reflection; with each cycle, the student modifies his or her understanding and then tests the new insight with another cycle of experience and observation. In addition, components of the learning cycle, in turn, correspond to preferred learning styles.

The Experiential Learning Theory is built on six propositions (Kolb, 1984). Proposition 1: Learning is best conceived as a process, not in terms of outcomes. To improve learning, the focus is on engaging students in a process that best enhances their learning and feedback is included on their effectiveness of their learning. Primarily, ideas are formed and reformed through experience and not fixed. Proposition 2: All learning is relearning. Therefore, learning is facilitated by a process that draws out on the students' beliefs and ideas about topics that may be examined, tested, and integrated with new and refined ideas. Proposition 3: Learning requires conflict differences and disagreements to drive the learning process. The process of learning is called upon to move back and forth between opposing modes of reflections and feeling and thinking. Proposition 4: Learning is a holistic process of adaptation to the world that involves the integrated functioning of the total person-thinking, feeling, perceiving, and behaving. In addition, it encompasses models of adaptation from the scientific method to problem-solving, decision making, and creativity. Proposition 5: Learning results from synergetic transactions between the person and the environment. As a result, learning occurs through assimilation of new experiences into existing concepts and accommodating existing concepts to new experiences. The possibility of each new experience determines the range of choices and decisions. The choices and decisions made determine the events lived, and the events influence future choices. Proposition 6: Learning is the process of creating knowledge.

The ELT proposes that social knowledge is created and recreated in the personal knowledge of the learners. This stands in contrast to the "transmission" model on which much current educational practice is based, where pre-existing fixed ideas are transmitted to the learner (Kolb, 1984).

Learning Cycle

Kolb's (1984) ELT described learning as a holistic adaptive process that "provides conceptual bridges across life situations such as school and work" (p. 33). Kolb's learning theory is based on four stages: Concrete Experience (CE), Reflective Observation (RO), Adaptive Conceptualization (AC), and Active Experimentation (AE).

According to the four-stage learning cycle shown in Figure 1 (p. 8), immediate or concrete experiences are the basis for observations and reflections. These reflections and observations are assimilated into abstract concepts that create new ideas and thinking and action can be drawn. These implications and new thinking promote active experimentation that can be tested and served as guides in creating new experiences. This cycle allows an individual to begin at any stage and for the stages to be repetitive (Kolb & Kolb, 2005). "The learning cycle is portrayed as an idealized learning cycle or spiral where the learner touches all bases- experiencing, reflecting, thinking, and acting- in a recursive process that is responsive to the learning situation and what is being learned" (Kolb & Kolb, 2005, p. 194).

Learning Style

The concept of learning style describes individual differences in learning based on the learner's preference for employing different phases of the learning cycle. Because of our life experiences, the demands of our environment and what is hereditary, we develop a preferred way of choosing among the four learning modes. We resolve the conflict between being concrete or abstract and between being active or reflective in patterned characteristic ways (Kolb & Kolb, 2005).

The ELT situates learning as the major determinant of human development and how individuals learn and shape the course of their personal development. Previous research (Kolb, 1984) has shown that learning styles are influenced by personality type, educational specialization, career choice, and current job role and tasks.

The ELT focuses on the concept of learning styles, using the Learning Style Inventory (LSI) that assesses the individual learning style and the preference for learning (Kolb, 1984). Although individuals tested on the LSI show many different patterns of scores, previous research with the instrument identify four learning styles that are associated with different approaches to learning, namely, diverging, assimilating, converging, and accommodating. The following summary of the four basic learning styles are based on both research and clinical observations of these patterns of LSI scores (Kolb, 1984).

An individual with a *diverging style* has Concrete Experience (CE**)** and Reflective Observation (RO) as dominant learning abilities. People with this learning style are best at viewing concrete situations from many different points of view. The style is labeled diverging because a person with it performs better in situations that call for generation of ideas, such as a brainstorming session. People with a diverging learning style have broad cultural interests and like to gather information. They are interested in people, tend to be imaginative and emotional, have broad cultural interests, and tend to specialize in the arts. In formal learning situations, people with diverging style prefer to work in groups, to listen with an open mind, and to receive personalized feedback (Kolb & Kolb, 2005). Divergers prefer to move from concrete experiences to reflective observations. They are the students most likely to work from one practical example to thinking about how its results apply in other circumstances (Miley & Read, 2011).

An individual with an *assimilating style* have Adaptive Conceptualization (AC) and Reflective Observation (RO) as dominant learning abilities. People with this learning style are best at understanding a wide range of information and putting it into concise, logical form. Individuals with an assimilating style are less focused on people and more interested in ideas and abstract concepts. People with this style find it more important that a theory has logical soundness than practical value. The assimilating learning style is important for effectiveness in information and science careers. In formal learning situations, people with this style prefer readings, lectures, exploring analytical models, and having time to think things through (Kolb & Kolb, 2005).

An individual with a *converging style* have Adaptive Conceptualization (AC) and Active Experimentation (AE) as dominant learning abilities. People with this learning style are best at finding practical uses for ideas and theories. They have the ability to solve problems and make decisions based on finding solutions to questions or problems. Individuals with a converging learning style prefer to deal with technical tasks and problems rather than with social and interpersonal issues. These learning skills are important for effectiveness in specialist and technology careers. In formal learning situations, people with this style prefer to experiment with new ideas, simulations, laboratory assignments, and practical applications (Kolb & Kolb, 2005). Convergers conceptualize ideas, like to test the results with active experimentation, and tweak the results until they are satisfied with them (Miley & Read, 2011).

An individual with an *accommodating style* has Concrete Experience (CE) and Active Experimentation (AE) dominant learning abilities. An individual with this learning style has the ability to learn from primarily hands-on experience. They enjoy carrying out plans and involving themselves in new and challenging experiences. Their tendency acts on gut feelings rather than logical analysis. This learning style is important for effectiveness in action-oriented careers such as marketing or sales. In formal learning situations, people with the accommodating learning style prefer to work with others to get assignments done, to set goals, to do field work, and to test out different approaches to completing a project (Kolb & Kolb, 2005). Accommodators prefer concrete experiences and active experimentation with the hands-on, practical work they undertake themselves and then build their understanding from their observations (Miley & Read, 2011).

The Experiential Learning Theory clearly defined learning style as a dynamic state arising from an individual's preferential resolution of the dual dialectics of experiencing/conceptualizing and acting/reflecting. Kolb (1984) stated that "people created themselves through the choice of actual occasions they live through" (Kolb, 1984, pp. 63-64).

Learning Space

The concept of learning space is built on Lewin's field theory and his concept of life space. According to Lewin, both person and environment are interdependent variables, a concept he translated into a mathematical formula, B=f (p,e), where behavior are a function of person and environment. Life space embraces needs, goals, memories, influences, beliefs, events of a political, economic, social nature, and anything else that has direct effect on behavior (Kolb & Kolb, 2005).

The ELT learning space concept emphasizes that learning is not one universal process but a map of learning territories, a frame of reference within which many different ways of learning may flourish and interrelate. It is a holistic framework that orients the many different ways of learning to one another (Kolb & Kolb, 2005).

Experiential designs encourage individuals to strengthen their learning, pull meaning from their experiences, and to share learning through collaboration. The Experiential Learning Theory provides insight about learning outlined in cycles, styles, and provides processes and tools about the way students learn in order to maximize the teacher's ability to create the learning experiences for development and learning. The research shows that requiring learners to engage in experience is not enough. Experiences must be processed through reflection and debriefing in order to maximize the learning. Reflection and debriefing are often left out of the learning experience due to time restraints and the lack of value educators place on this process. The ELT helps to counter that assumption and provides insight on the benefits to maximize learning.

Summary

The research examined the challenges and implications of learning for success in the 21st century. In this world, connected by technology information networks, creativity and innovation in learning are seen as important factors in determining the survival and growth of our nation. Because the nature of work in education has changed so rapidly and radically, a shift is occurring from a training emphasis to a learning emphasis so that people are prepared to deal with the new challenges our world brings. The research examined how we must shift gears from industrial and production power to creativity, innovation, and thinking power. Learning experiences must be created to naturally condition our students to think. Students must be tapped into the talents that lie within them and are waiting to be released.

We heard the voices of the present – Tyack and Cuban, Ravitch, Goodman, Sir Ken Robinson, Daniel Pink, Bill Gates, Phillip Schlechty, Mihally Csikszentmihalyi, Charles Leadbeater, and Howard Gardner, all sound in unison with the voices of the past - John Dewey, William Heard Kilpatrick, Kurt Lewin, and David Kolb. Together, the sounds of past and present voices are supported by our need to become better learners in order to survive the rapid changes and demands our world expects today. By adjusting our lenses to a value added system of learning, with multiple measures of a student's performance and a shared responsibility by all, we can redefine our grammar of schooling and redesign accountability to create our next wave of reform.

Chapter 3

Method

Introduction

The purpose of the study was to examine the impact of Project-Based Learning (PBL) on reading and mathematics achievement of 7th and 8th grade students. The following questions guided the study:

1. What is the impact of Project-Based Learning on student achievement in mathematics among 7th and 8th grade students in a South Texas school district?
2. What is the impact of Project-Based Learning on student achievement in reading among 7th and 8th grade students in a South Texas school district?

Research Design

The study utilized an ex post facto, causal-comparative research design. Ex post facto is a Latin phrase meaning "operating retroactively" (Gall, Gall, & Bourg, 2007, p. 296). This type of research focuses on examining the relationship between the independent and dependent variables, which is more suggestive than proven, and does not involve the manipulation of the independent variable. Causal-comparative research is a type of ex post facto investigation that seeks to identify potential cause-effect relationships by forming groups of individuals in whom the independent variable is present or absent, followed by comparing the groups on the basis of one or more dependent variables. No causal inferences may be drawn due to non-experimental nature of the study (Gall, Gall, & Borg, 2007).

In this study, the independent variable was the PBL program with two levels. The characteristic-present group was identified as the group in which PBL was utilized. The comparison group was the group in which PBL was non-existent. The outcome measures were the STAAR mathematics and reading achievement scores.

Subject Selection

The subjects for the study were from two middle schools in the District, as of 2011 – 2012 school year. The characteristic-present group consisted of a non-probability sample of 87 7^{th} grade and 84 8^{th} grade students in the magnet school that incorporated the PBL as part of the curriculum. The comparison group consisted of 140 7^{th} grade and 150 8^{th} grade students in the other middle school where PBL was not used as part of the curriculum. Permission to conduct the study was obtained from the Institutional Review Board at Texas A & M University Corpus Christi and the District (Appendix A).

Instrumentation

In order to constitute a baseline comparison, reading and mathematics achievement scores in a year preceding the implementation of PBL were obtained. Specifically, the Texas Assessment of Knowledge and Skills (TAKS) test scores were used. The TAKS was enacted by Senate Bill 103 and implemented as the statewide assessment program in 2003. The TAKS was designed to measure student's understanding and knowledge of the Texas Essential Knowledge and Skills (TEKS), which is the state curriculum (TAKS Technical Digest, 2009). The TAKS reading and mathematics raw scores were used to establish pre-experimental equivalence for the PBL and non-PBL groups.

In 2011-2012, the new State of Texas Assessment for Academic Readiness (STAAR) standardized testing program was implemented to test students in the core subject areas of reading, writing, mathematics, science, and social studies in grades 3 - 12. The STAAR test was designed to measure the readiness for success in subsequent grades and courses and ultimately for college and career (STAAR Technical Report, 2013). For the purpose of the study, the 2012 STAAR scores in mathematics and reading for 7th and 8th grade students were used. The proportion of correct answers was used to measure each STAAR Reporting Category.

Achievement in 7th grade STAAR mathematics was measured by 5 Reporting Categories and a total of 54 items. Reporting Category 1 contained 13 items and assessed numbers, operations, and quantitative reasoning. Reporting Category 2 included patterns, relationships, and algebraic reasoning with 13 items. Reporting Category 3 consisted of 10 items associated with geometry and spatial reasoning. Reporting Category 4 targeted measurement with 8 items. Reporting Category 5 assessed Probability and Statistics with 10 items.

Achievement in 8th grade STAAR mathematics was measured by 5 Reporting Categories and a total of 56 test items. Reporting Category 1 assessed numbers, operations, and quantitative reasoning with 11 items. Reporting Category 2 consisted of 14 items that targeted patterns, relationships, and algebraic reasoning. In Reporting Category 3, a total of 8 items measured geometry and spatial reasoning. Reporting Category 4 had 13 test items that assessed measurement. Reporting Category 5 used 10 items to measure probability and statistics.

Achievement in 7th grade STAAR reading was measured by 3 Reporting Categories and a total of 50 items. Reporting Category 1 targeted the understanding/analysis across genres and included 10 items. Reporting Category 2 focused on the understanding/analysis of literary texts, using 21 items. In Reporting Category 3, 19 items were used to measure understanding/analysis of informational texts.

Achievement in 8th grade STAAR reading was measured in 3 Reporting Categories and consisted of 52 test items. Reporting Category 1 assessed the understanding/analysis across genres and used 10 items. Reporting Category 2 measured the understanding/analysis of literary texts and used 22 items. Reporting Category 3 targeted understanding/analysis of informational texts with 20 test items.

The processes and statistics used to develop the STAAR are described in the STAAR Standard Setting Technical Report (STAAR Standard Setting Technical Report, 2013). However, the psychometric properties of each individual test had not been documented at the time of conducting this study. External validity studies relied on the STAAR Standard Setting Policy Committee process that established the expectations. Other committees set the passing criteria for the reporting levels and any phase-in of criteria that were used. In order to have a solid scale, the TEA statistically related the difficulty of the tests from grade level to grade level. This ensured that the test difficulty increased somewhat systematically from one grade to the next in each subject (Texas Education Agency, 2010).

Data Collection

The data were obtained from the Office of Assessment and Accountability in the District. The TAKS data included raw scale scores in reading and mathematics for the characteristic-present and comparison groups one year prior to the measurement of STAAR achievement test scores. The STAAR data included raw scale scores for each of the categories in mathematics and reading. Data on age, gender, ethnicity, limited English proficiency and socioeconomic status were the only demographic data which were provided to the researcher by the District. Permission to use the data for the purpose of the study was obtained from the District (Appendix A).

Data Analysis

The raw data were exported into the Statistical Package for the Social Sciences (SPSS), which was used for the purpose of data manipulation and analysis. The proportion of the total number of test questions answered correctly to the total number of questions in each reporting category was used to measure student achievement in mathematics and reading. Descriptive statistics were utilized to organize and summarize the data.

A t-test for independent samples (Field, 2013) was performed to compare the characteristic-present and comparison groups on the basis of age. A series of chi-square test of independence was performed to compare the two groups on the basis of gender, ethnicity, limited English proficiency, and socioeconomic status.

A series of t-test for independent samples was performed to compare the two groups on the basis of baseline TAKS data. The Levene's F was used to test the homogeneity of variances assumption. Welch approximate t (Stevens, 2009) was employed when the variances were unequal.

A series of multivariate analysis of variance (MANOVA) was performed to test the hypotheses that the PBL group outperformed the non-PBL group on the basis of the outcome measures of mathematics and reading. The MANOVA is used to compare groups on the basis of two or more correlated outcome measures (Field, 2013). The mathematical expression, vector, is used to represent each subject's score on more than one response variable. The mean of the vectors for each group is called a centroid. The MANOVA is used to differentiate among groups with respect to their centroids (Stevens, 2009). A series of univariate F-test was performed for the purpose of post hoc analysis. Mean difference effect size, Cohen's d, was computed to examine the practical significance of the findings and characterized as .2=small, .5=medium, and .8=large (Cohen, 1988). Correlational analyses showed that some of the demographic characteristics were significantly correlated with some of the outcome measures. Such characteristics were treated as covariates and a series of multivariate analysis of covariance

(MANCOVA) was performed (Stevens, 2009). The MANOVA and MANCOVA results were the same.

Chapter 4

Results

The purpose of the ex post facto causal-comparative study was to compare academic achievement in reading and mathematics objective test scores of 7^{th} and 8^{th} grade students in a Project-Based Learning (PBL) program to the academic achievement in reading and mathematics objective test scores of 7^{th} and 8^{th} grade students in a non-PBL program. It was hypothesized that the students in the PBL program would outperform the students in the non-PBL program on the basis of the outcome measures. The study was guided by the following research questions:

1. What is the impact of Project-Based Learning (PBL) on student achievement in mathematics among 7^{th} and 8^{th} grade students in a South Texas school district?
2. What is the impact of Project-Based Learning (PBL) on student achievement in reading among 7^{th} and 8^{th} grade students in a South Texas school district?

The data were obtained from the school district and coded, entered into computer, and analyzed by using the Statistical Package for the Social Sciences (SPSS). Achievement in reading and mathematics was measured by the 2011-2012 State of Texas Assessments of Academic Readiness (STAAR) test. In addition to STAAR data, achievement in reading and mathematics raw test scores, measured by the Texas Assessment of Knowledge and Skills (TAKS), were obtained and served as baseline data. Specifically, the data pertained to one year prior to their 7^{th} and 8^{th} grade year were compared to establish pre-experimental equivalence.

7^{th} Grade Results

A Profile of Subjects

The characteristic-present group (n = 87) included 7th grade students who had participated in the PBL program and the comparison group (n =140) consisted of 7th grade students who had not participated in the PBL program. The two groups were compared on the basis of the demographic variables which were made available to the researcher by the school district. The level of significance was set at .01 to reduce the probability of making a type I error due to performing multiple tests. Age differences between the PBL (M = 13.60, SD = .62) and non-PBL (M = 13.73, SD = .62) group were not statistically significant, $t(225) = 1.54$, $p = .12$. The PBL group included more females (60.90%, n = 53) than males (39.10%, n = 34) while the non-PBL group included more males (54.30%, n = 79) than females (45.7%, n = 64). The group differences were not statistically significant, χ^2 (1, N = 227) = 4.37, p = .04. Ethnicity was coded as either Hispanic or non-Hispanics. The majority of the students in the PBL (85.10%, n = 74) and non-PBL (92.90%, n = 130) programs were Hispanic; group differences were not statistically significant, χ^2 (1, N = 227) = 2.78, p = .09. The majority of the students in both the PBL and non-PBL groups were economically disadvantaged, as determined by eligibility for free or reduced lunch. The PBL (88.50%, n = 77) and non-PBL (89.90%, n = 125) free or reduced lunch students were similarly represented in both groups and differences were not statistically significant, χ^2 (1, N = 226) = .01, p = .90. The difference in number of limited English proficient students in the PBL program (4.60%, n = 4) compared to the non-PBL program (7.10%, n = 10) was not statistically significant, χ^2 (1, N = 227) = .24, p = .62. Results are summarized in Table 1.

Table 1

A Profile of Subjects, 7th Grade

Demographic Characteristic	PBL Group (*n*=87) F	PBL Group (*n*=87) %	Non-PBL Group (*n*=140) F	Non-PBL Group (*n*=140) %
Gender[a]				
Female	53	60.90	64	45.70
Male	34	39.10	76	54.30
Ethnicity[b]				
Hispanic	74	85.10	130	92.90
Non-Hispanic	13	14.90	10	7.10
Socio-economic Status[c]				
Free/Reduced Lunch	77	88.50	125	89.90
Non-Free/Reduced Lunch	10	11.50	14	10.10
Limited English Proficiency[d]				
LEP	4	4.60	10	7.10
Non-LEP	83	95.40	130	92.90
Age[e]	M	SD	M	SD
	13.60	.62	13.73	.62

[a] χ^2 (1, N = 227) = 4.37, p = .04
[b] χ^2 (1, N = 227) = 2.78, p = .09
[c] χ^2 (1, N = 226) = .01, p = .90. There was one missing case.
[d] χ^2 (1, N = 227) = .24, p = .62
[e] t(225) = 1.54, p = .12

<u>Baseline Comparison</u>

The TAKS reading and mathematics raw scores were used to establish pre-experimental equivalence for the PBL and non-PBL groups one year prior to the STAAR test outcome measure and exposure to the PBL academic program. A series of t-test for independent samples was performed to compare the characteristic-present and comparison groups on the basis of reading and mathematics raw scores. With respect to reading and mathematics measures, the homogeneity of variances assumption was not met, Levene's F = 6.66, $p < .05$ and Levene's F = 7.58, $p < .01$, respectively. Welch approximate t showed that group differences were not statistically significant for reading, *t*(180.84) = .87, *p* = .38, and mathematics, *t*(171.24) = .87, *p* = .38. The findings suggested that the two groups were equivalent at the start of the 7^{th} grade. Results are summarized in Table 2.

Table 2

Means and Standard Deviations for Baseline Measures, 7^{th} Grade

	PBL Group (*n* = 87)		Non-PBL Group (*n* = 140)	
Baseline Measure	M	SD	M	SD
Reading[a]	725.38	103.00	750.92	321.09
Mathematics[b]	701.15	85.71	725.26	309.36

[a]*t*(180.84) = .87, *p* = .38
[b]*t*(171.24) = .87, *p* = .38

Outcome Measures

The outcome measures included STAAR Reporting Categories for reading and mathematics. Reading included: Category 1: Understanding/Analysis across Genres (10 items), Category 2: Understanding/Analysis of Literary Texts (21 items), and Category 3: Understanding/Analysis of Informational Texts (19 items). Mathematics included: Category 1: Numbers, Operations, and Quantitative reasoning (13 items), Category 2: Patterns, Relationships, and Algebraic Reasoning (13 items), Category 3: Geometry and Spatial Reasoning (10 items), Category 4: Measurement (8 items), and Category 5: Probability and Statistics (10 items).

Reading Achievement

Achievement in reading was measured by the proportion of correct answers to questions in each of the three Reporting Categories. The means and standard deviations are summarized in Table 3.

Table 3

STAAR Reading Achievement Measures, 7th Grade

	PBL Group (n = 87)		Non PBL Grou| (n = 140)	
STAAR Reporting Category	M*	SD	M*	SD
Category 1	.72	.21	.60	.25
Category 2	.64	.17	.55	.22
Category 3	.65	.20	.54	.22

*Proportion of correct answers

Note: Category 1: Understanding /Analysis across Genres
Category 2: Understanding/Analysis of Literary Texts
Category 3: Understanding/Analysis of Informational Texts

The reading Reporting Category test scores were correlated with each other (Table 4) and MANOVA was used to compare the PBL and non-PBL groups on the basis of the group centroid.

Table 4

Correlation Matrix for STAAR Reading Category Scores, 7^{th} Grade

Factor	Reading Score 1	Reading Score 2	Reading Score 3
Reading Score 1	1.00	.73*`	.70*
Reading Score 2		1.00	.78*
Reading Score 3			1.00

*$p < .01$

The MANOVA showed that the group differences on the basis of the centroids were statistically significant, $F(3, 223) = 5.92$, $p < .01$, favoring the PBL group. The post hoc analysis showed that the PBL group outperformed the non-PBL group on all three STARR Reporting Categories. Results are summarized in Table 5.

Table 5

Post Hoc Analysis of STAAR Reading Achievement Measures, 7th Grade

STAAR Reporting Category	SS	df	MS	F
Category 1	.84	1	.84	14.85*
Category 2	.39	1	.39	9.47*
Category 3	.65	1	.65	14.66*

*p < .01

Note: Category 1: Understanding /Analysis across Genres
Category 2: Understanding/Analysis of Literary Texts
Category 3: Understanding/Analysis of Informational Texts

Mean difference effect sizes, as computed by Cohen's d, were used to examine the practical significance of the findings. Results are summarized in Table 6

Table 6

Mean Difference Effect Sizes, STAAR Reading Achievement Measures, 7th Grade

STAAR Reporting Category	Mean Difference	*p*	Effect Size*
Category 1	.13	<.01	.51
Category 2	.09	<.01	.41
Category 3	.11	<.01	.51

* .2 = small effect, .5 = medium effect, .8 = large effect

Note: Category 1: Understanding /Analysis across Genres
Category 2: Understanding/Analysis of Literary Texts
Category 3: Understanding/Analysis of Informational Texts

<u>Mathematics Achievement</u>

Achievement in mathematics was measured by the proportion of correct answers to questions in each of the five Reporting Categories. The means and standard deviations are summarized in Table 7.

Table 7

STAAR Mathematics Achievement Measures, 7th Grade

	PBL Group (*n*=87)		Non-PBL Group (*n* = 140)	
Mathematics Reporting Category	M*	SD	M*	SD
Category 1	.53	.23	.40	.22
Category 2	.54	.21	.42	.22
Category 3	.61	.21	.43	.22
Category 4	.46	.28	.31	.19
Category 5	.50	.20	.38	.18

*Proportion of correct answers

Note: Category 1: Numbers, Operations, and Quantitative Reasoning
Category 2: Patterns, Relationships, and Algebraic Reasoning
Category 3: Geometry and Spatial Reasoning
Category 4: Measurement
Category 5: Probability and Statistics

The mathematics Reporting Category test scores were correlated with each other (Table 8) and MANOVA was used to compare the PBL and non-PBL groups on the basis of the group centroid.

Table 8

Correlation Matrix for STAAR Mathematics Category Scores, 7^{th} Grade

Factor	Math Score 1	Math Score 2	Math Score 3	Math Score 4	Math Score 5
Math Score 1	1.00	.74*	.67*	.59*	.61*
Math Score 2		1.00	.62*	.62*	.56*
Math Score 3			1.00	.61*	.55*
Math Score 4				1.00	.40*
Math Score 5					1.00

*$p < .01$

The MANOVA showed that the group differences on the basis of the centroids were statistically significant, F (5, 221) = 8.50, $p < .01$, favoring the PBL group. The post hoc analysis showed that the PBL group outperformed the non-PBL group on all five STARR Reporting Categories. Results are summarized in Table 9.

Table 9

Post Hoc Analysis of STAAR Mathematics Achievement Measures, 7th Grade

STAAR Reporting Category	SS	df	MS	F
Category 1	.92	1	.92	18.50*
Category 2	.81	1	.81	17.07*
Category 3	1.91	1	1.91	38.16*
Category 4	1.11	1	1.11	20.92*
Category 5	.81	1	.81	22.19*

*$p < .01$

Note: Category 1: Numbers, Operations, and Quantitative Reasoning
Category 2: Patterns, Relationships, and Algebraic Reasoning
Category 3: Geometry and Spatial Reasoning
Category 4: Measurement
Category 5: Probability and Statistics

Mean difference effect sizes were used to analyze practical significance of the findings as computed by Cohen's d. Results are summarized in Table 10.

Table 10

Mean Difference Effect Sizes, STAAR Mathematics Achievement Measures, 7th Grade

STAAR Reporting Category	Mean Difference	*p*	Effect Size*
Category 1	.13	<.01	.57
Category 2	.12	<.01	.55
Category 3	.19	<.01	.82
Category 4	.14	<.01	.61
Category 5	.12	<.01	.63

* .2 = small effect, .5 = medium effect, .8 = large effect

Note: Category 1: Numbers, Operations, and Quantitative Reasoning
Category 2: Patterns, Relationships, and Algebraic Reasoning
Category 3: Geometry and Spatial Reasoning
Category 4: Measurement
Category 5: Probability and Statistics

8th Grade Results

A Profile of Subjects

The characteristic-present group (n = 84) included 8th grade students who had participated in the PBL program and the comparison group (n =150) consisted of 8th grade students who had not participated in the PBL program. The two groups were compared on the basis of gender, age, ethnicity, SES, and LEP status at the .01 level of significance. Age differences between the PBL (M = 14.58, SD = .68) and non-PBL (M = 14.71, SD = .65) group were not statistically significant, $t(232) = 1.44$, $p = .15$. The PBL group included more females (56.00%, n = 47) than males (44.00%, n = 37), while the non-PBL group included more males (53.30%, n = 80) than females (46.70%, n = 70); however, the group differences were not statistically significant, χ^2 (1, N = 234) = 1.50, $p = .22$. The majority of the students in the PBL (83.30%, n = 70) and non-PBL (96.00%, n = 144) programs were Hispanic; group differences were statistically significant, χ^2 (1, N = 234) = 9.49, $p < .01$. The majority of the students in both the PBL (76.20%, n = 64) and non-PBL (90.70%, n = 136) groups were economically disadvantaged, as determined by eligibility for free or reduced lunch, and differences were statistically significant, χ^2 (1, N = 234) = 7.96, $p < .01$. The difference in number of limited English proficient students in the PBL program (4.80%, n = 4) compared to the non-PBL program (6.00%, n = 9) was not statistically significant, χ^2 (1, N = 234) = .01, $p = .92$. Results are summarized in Table 11.

Table 11

A Profile of Subjects, 8th Grade

	PBL Group (*n*=84)		Non-PBL Group (*n*=150)	
Demographic Characteristic	F	%	F	%
Gender[a]				
Female	47	56.00	70	46.70
Male	37	44.00	80	53.30
Ethnicity[b]				
Hispanic	70	83.30	144	96.00
Non-Hispanic	14	16.70	6	4.00
Socio-economic Status[c]				
Free/Reduced Lunch	64	76.20	136	90.70
Non-Free/Reduced Lunch	20	23.80	14	9.30

Limited English Proficiency[d]				
LEP	4	4.80	9	6.00
Non-LEP	80	95.20	141	94.00
Age[e]	M	SD	M	SD
	14.58	.68	14.71	.65

[a] χ^2 (1, *N* = 234) = 1.50, *p* = .22
[b] χ^2 (1, *N* = 234) = 9.49, *p* < .01
[c] χ^2 (1, *N* = 234) = 7.96, *p* < .01
[d] χ^2 (1, *N* = 234) = .01, *p* = .92
[e] t(232) = 1.44, *p* = .15

Baseline Comparison

To establish pre-experimental equivalence, the two groups were compared on the basis of TAKS reading and mathematics raw scores one year prior to the implementation of the PBL academic program. With respect to reading and mathematics measures, the homogeneity of variances assumption was not met, Levene's *F* = 11.81, *p* < .01 and Levene's *F* = 11.45, *p* < .01, respectively. Welch approximate t showed that group differences were not statistically significant for reading, *t*(218.60) = 1.71, *p* = .08, and mathematics, *t*(229.49) = 1.47, *p* = .14, suggesting that the two groups were equivalent at the start of the 8th grade. Results in Table 12.

Table 12

Means and Standard Deviations for Baseline Measures, 8th Grade

	PBL Group (*n* = 84)		Non-PBL Group (*n* = 150)	
Baseline Measure	M	SD	M	SD
Reading[a]	761.71	183.79	831.91	438.16
Mathematics[b]	752.04	230.17	818.49	461.42

[a] *t*(218.60) = 1.71, *p* = .08
[b] *t*(229.49) = 1.47, *p* = .14

Outcome Measures

The outcome measures included STAAR Reporting Categories for reading and mathematics. Reading included: Category 1: Understanding/Analysis across Genres (10 items), Category 2: Understanding/Analysis of Literary Texts (22 items), and Category 3: Understanding/Analysis of Informational Texts (20 items). Mathematics included: Category 1: Numbers, Operations, and Quantitative reasoning (11 items), Category 2: Patterns, Relationships, and Algebraic Reasoning (14 items), Category 3: Geometry and Spatial Reasoning (8 items), Category 4: Measurement (13 items), and Category 5: Probability and Statistics (10 items).

Reading Achievement

Achievement in reading was measured by the proportion of correct answers to questions in each of the three Reporting Categories. The means and standard deviations are summarized in Table 13.

Table 13

STAAR Reading Achievement Measures, 8th Grade

	PBL Group (*n* = 84)		Non-PBL Group (*n* = 150)	
STAAR Reporting Category	M*	SD	M*	SD
Category 1	.74	.18	.61	.21
Category 2	.63	.20	.55	.18
Category 3	.66	.22	.52	.20

*Proportion of correct answers

Note: Category 1: Understanding /Analysis across Genres
Category 2: Understanding/Analysis of Literary Texts
Category 3: Understanding/Analysis of Informational Texts

The reading Reporting Category test scores were correlated with each other (Table 14) and MANOVA was used to compare the PBL and non-PBL groups on the basis of the group centroid.

Table 14

Correlation Matrix for STAAR Reading Category Scores, 8th Grade

Factor	Reading Score 1	Reading Score 2	Reading Score 3
Reading Score 1	1.00	.62*`	.65*
Reading Score 2		1.00	.72*
Reading Score 3			1.00

*$p < .01$

The MANOVA showed that the group differences on the basis of the centroids were statistically significant, $F(3, 230) = 946.11$, $p < .01$, favoring the PBL group. The post hoc analysis showed that the PBL group outperformed the non-PBL group on all three STARR Reporting Categories. Results are summarized in Table 15.

Table 15

Post Hoc Analysis of STAAR Reading Achievement Measures, 8th Grade

STAAR Reporting Category	SS	df	MS	F
Category 1	.96	1	.96	24.01*
Category 2	.38	1	.38	10.68*
Category 3	1.01	1	1.01	23.29*

*$p < .01$

Note: Category 1: Understanding /Analysis across Genres
Category 2: Understanding/Analysis of Literary Texts
Category 3: Understanding/Analysis of Informational Texts

Mean difference effect sizes, as computed by Cohen's d, were used to examine the practical significance of the findings. Results are summarized in Table 16.

Table 16

Mean Difference Effect Sizes, STAAR Reading Achievement Measures, 8th Grade

STAAR Reporting Category	Mean Difference	*p*	Effect Size*
Category 1	.13	<.01	.64
Category 2	.08	<.01	.43
Category 3	.14	<.01	.63

* .2 = small effect, .5 = medium effect, .8 = large effect

Note: Category 1: Understanding /Analysis across Genres
Category 2: Understanding/Analysis of Literary Texts
Category 3: Understanding/Analysis of Informational Texts

Mathematics Achievement

Achievement in mathematics was measured by the proportion of correct answers to questions in each of the five Reporting Categories. The means and standard deviations are summarized in Table 17.

Table 17

STAAR Mathematics Achievement Measures, 8th Grade

	PBL Group (*n*=84)		Non-PBL Group (*n* = 150)	
Mathematics Reporting Category	M*	SD	M*	SD
Category 1	.35	.27	.38	.24
Category 2	.29	.24	.25	.17
Category 3	.32	.27	.23	.19
Category 4	.29	.23	.27	.19
Category 5	.34	.26	.32	.21

*Proportion of correct answers

Note: Category 1: Numbers, Operations, and Quantitative Reasoning
Category 2: Patterns, Relationships, and Algebraic Reasoning
Category 3: Geometry and Spatial Reasoning
Category 4: Measurement
Category 5: Probability and Statistics

The mathematics Reporting Category test scores were correlated (Table 18) and MANOVA was used to compare the PBL and non-PBL groups on the basis of the group centroid.

Table 18

Correlation Matrix for STAAR Mathematics Category Scores, 8th Grade

Factor	Math Score 1	Math Score 2	Math Score 3	Math Score 4	Math Score 5
Math Score 1	1.00	.69*	.64*	.68*	.72*
Math Score 2		1.00	.66*	.69*	.70*
Math Score 3			1.00	.59*	.62*
Math Score 4				1.00	.69*
Math Score 5					1.00

*p < .01

The MANOVA showed that the group differences on the basis of the centroids were statistically significant, F (5, 228) = 4.90, p < .01, favoring the PBL group. The post hoc analysis showed that the PBL group outperformed the non-PBL group on Reporting Category 3: Geometry and Spatial Reasoning only. Results are summarized in Table 19.

Table 19

Post Hoc Analysis of STAAR Mathematics Achievement Measures, 8th Grade

STAAR Reporting Category	SS	df	MS	F
Category 1	.04	1	.04	.62
Category 2	.06	1	.06	1.44
Category 3	.48	1	.48	9.80*
Category 4	.02	1	.02	.49
Category 5	.03	1	.03	.48

*p < .01

Note: Category 1: Numbers, Operations, and Quantitative Reasoning
Category 2: Patterns, Relationships, and Algebraic Reasoning
Category 3: Geometry and Spatial Reasoning
Category 4: Measurement
Category 5: Probability and Statistics

Mean difference effect sizes were used to analyze practical significance of the findings as computed by Cohen's d. Results are summarized in Table 20.

Table 20

Mean Difference Effect Sizes, STAAR Mathematics Achievement Measures, 8^{th} Grade

STAAR Reporting Category	Mean Difference	*p*	Effect Size*
Category 1	-.03[a]	.43	.10
Category 2	.03	.23	.16
Category 3	.09	<.01	.41
Category 4	.02	.48	.09
Category 5	.02	.49	.09

* .2 = small effect, .5 = medium effect, .8 = large effect

[a] The non-PBL outperformed the PBL but the difference was not statistically significant.

Note: Category 1: Numbers, Operations, and Quantitative Reasoning
Category 2: Patterns, Relationships, and Algebraic Reasoning
Category 3: Geometry and Spatial Reasoning
Category 4: Measurement
Category 5: Probability and Statistics

Covariate Analysis

7^{th} Grade

Although group differences on the basis of selected demographic variables were not statistically significant, as can be seen in Table 21, a fair number of simple correlations between the demographic data and outcome measures were statistically significant.

Table 21

Simple Correlations Between Outcome Measures and Demographic Characteristics, 7th Grade

STAAR Reporting Category	SES	Ethnicity	LEP	Sex	Age
Reading 1	-.04	-.18***	-.13*	-.15*	-.22***
Reading 2	-.07	-.16**	-.21***	-.13*	-.21***
Reading 3	-.17**	-.16**	-.19***	-.04	-.17**
Mathematics 1	-.07	-.06	-.11	-.01	-.15*
Mathematics 2	-.09	-.07	-.04	-.07	-.15*
Mathematics 3	-.09	-.03	-.08	-.10	-.11
Mathematics 4	-.05	.01	.08	-.07	-.06
Mathematics 5	-.09	-.07	-.12	-.04	-.17**

$*p < .05$, $** p < .01$, $*** p < .001$

Reading Category 1: Understanding /Analysis across Genres
Reading Category 2: Understanding/Analysis of Literary Texts
Reading Category 3: Understanding/Analysis of Informational Texts
Mathematics Category 1: Numbers, Operations, and Quantitative Reasoning
Mathematics Category 2: Patterns, Relationships, and Algebraic Reasoning
Mathematics Category 3: Geometry and Spatial Reasoning
Mathematics Category 4: Measurement
Mathematics Category 5: Probability and Statistics

The five demographic variables were treated as covariates and multivariate analysis of covariance (MANCOVA) was performed to compare the PBL and non-PBL on the basis of the adjusted outcome measures. On the basis of reading, $F(3, 217) = 5.55$, $p < .01$, and mathematics, $F(5, 215) = 7.69$, $p < .01$, the PBL group outperformed the non-PBL group, and post hoc results showed that group differences were statistically significant with respect to all three reading and 5 mathematics categories. Thus, the MANOVA and MANCOVA results were the same.

8th Grade

A notable amount of simple correlations between the demographic data and outcome measures were statistically significant; however, group differences on the basis of selected demographic variables were not statistically significant (Table 22).

Table 22

Simple Correlations Between Outcome Measures and Demographic Characteristics, 8th Grade

STAAR Reporting Category	SES	Ethnicity	LEP	Sex	Age
Reading 1	-.25***	-.04*	-.16**	-.21***	-.17***
Reading 2	-.26***	-.03	-.10	-.10	-.24***
Reading 3	-.23***	.02	-.10	-.09	-.24***
Mathematics 1	.06	-.10	-.04	.57	.14*
Mathematics 2	.06	.05	-.03	.06	.04
Mathematics 3	-.04	.04	-.03	.08	-.00
Mathematics 4	.03	.09	.05	.09	.09
Mathematics 5	.09	.07	-.03	.07	.03

*$p < .05$, ** $p < .01$, *** $p < .001$

Reading Category 1: Understanding /Analysis across Genres
Reading Category 2: Understanding/Analysis of Literary Texts
Reading Category 3: Understanding/Analysis of Informational Texts
Mathematics Category 1: Numbers, Operations, and Quantitative Reasoning
Mathematics Category 2: Patterns, Relationships, and Algebraic Reasoning
Mathematics Category 3: Geometry and Spatial Reasoning
Mathematics Category 4: Measurement
Mathematics Category 5: Probability and Statistics

Summary

It was hypothesized that the 7th and 8th grade students in the PBL program would outperform the 7th and 8th grade students in the non-PBL program on the basis of academic achievement in reading and mathematics, as measured by the 2012 STAAR test data. Multivariate and univariate analysis of the data showed that PBL groups performed at a higher achievement level on the majority of the tested Reporting Categories than did non-PBL students on the basis of observed and adjusted scores for the outcome measures.

A baseline comparison was established, using TAKS reading and mathematics raw scores for one year prior to the STAAR test outcome, for both the PBL and non-PBL groups. The results showed that group differences were not statistically significant for reading and mathematics.

With respect to achievement in reading, the PBL 7^{th} and 8^{th} grade groups outperformed the non-PBL groups on the basis of all observed and adjusted test scores for all Reporting Categories as follows: Reporting Category 1: Understanding/Analysis across Genres, Reporting Category 2: Understanding/Analysis of Literary Texts, and Reporting Category 3: Understanding/Analysis of Informational Texts.

With respect to achievement in mathematics, the PBL 7^{th} grade group outperformed the non-PBL groups on the basis of all observed and adjusted test scores for all of the following Reporting Categories: Reporting Category 1: Numbers, Operations, and Quantitative Reasoning, Reporting Category 2: Patterns, Relationships, and Algebraic Reasoning, Reporting Category 3: Geometry and Spatial Reasoning, Reporting Category 4: Measurement, and Reporting Category 5: Probability and Statistics. However, in 8^{th} grade, the PBL group outperformed the non-PBL group in only one category that showed a statistically significant group difference in Reporting Category 3: Geometry and Spatial Reasoning.

Chapter 5

Summary, Conclusions, and Discussions

Although Project-Based Learning (PBL) has a long history in education, dating back to John Dewey, it has gotten a second wind in the past decade as a strategy to engage diverse learners in rigorous learning. Districts are considering PBL strategies to increase rigor and relevance as they transition to the demands of newly developed common core standards in order to assess students based on what they produce or demonstrate rather than recall for a test. The new generation of assessments targets readiness for college and career (Boss, 2012). The PBL involves active engagement of students and places students in realistic, problem-solving environments that serve to make connections between the classroom and real life experiences. The activities of the PBL are designed to promote a deep level of understanding of the content that is meaningful to the learner and high in collaboration (McGrath, 2004). Even though the PBL is gaining momentum, the literature revealed that the movement is a slow and steady process for multiple reasons.

Tyack and Cuban (1995) analyzed the history of education reform in the United States and introduced the basic grammar of schooling, which is the force that pulls and tugs on educational reforms because of the embedded culture of what Americans know a real school to be like. Administrators are accustomed to the bubble tests of the NCLB and struggle with the decision to implement the PBL across a school system. Administrators have been conditioned to function in a standardized assessment world by staying focused on the scores and meeting targets. Districts remain accountable to traditional state assessments, even if they are shifting the instructional models towards the PBL. It is the new generation of assessments that will force a district to jump in with both feet instead of keeping one foot in the traditional mode of recall testing and the other foot in the engaged learning mode of open-ended testing (Boss, 2012).

What educators cannot lose sight of is that more than 7,200 high school students fall through the cracks and drop out each day (Rumberger, 2011). According to Bridgeland, Dilulio and Morrison (2006), students dropped out of school due to boredom and irrelevance. Even with various reform efforts since the 1980s, the United States lags behind in mathematics and science compared to other international countries (Peterson & West, 2003). The standards and accountability movement continue to challenge educators to find ways to increase academic achievement, engage students, and prepare them for the real world; therefore, the impact of the PBL must be determined.

The purpose of the study was to examine the impact of the PBL on reading and mathematics achievement of 7th and 8th grade students, and to test the hypothesis that the PBL is effective in impacting academic achievement. The study was guided by the following research questions:

1) What is the impact of Project-Based Learning on student achievement in mathematics among 7th and 8th grade students in a South Texas school district?
2) What is the impact of Project-Based Learning on student achievement in reading among 7th and 8th grade students in a South Texas school district?

Summary of Results

Pre-experimental equivalence was established on the basis of the TAKS reading and mathematics scores for one year prior to the administration of the. Analysis of the data showed that the PBL groups performed at a higher achievement level on the majority of the outcome measures than did the non-PBL students.

With respect to achievement in reading, the PBL 7th and 8th grade groups outperformed the non-PBL groups on the basis of all measures, namely, Category 1: Understanding/Analysis across Genres, Category 2: Understanding/Analysis of Literary Texts, and Category 3: Understanding/Analysis of Informational Texts. The mean difference effect size ranged from .41 to .64.

With respect to achievement in mathematics, the PBL 7th grade group outperformed the non-PBL groups on all measures: Category 1: Numbers, Operations, and Quantitative reasoning, Category 2: Patterns, Relationships, and Algebraic Reasoning, Category 3: Geometry and Spatial Reasoning, Category 4: Measurement, and Category 5: Probability and Statistics. The effect sizes ranged from .55 to .82. In 8th grade, the PBL group outperformed the non-PBL group in only one category, Reporting Category 3: Geometry and Spatial Reasoning, and the mean difference effect size was .41. The outcome measures were adjusted on the basis of the potential extraneous variables and results remained the same.

Conclusions

The researcher had hypothesized that participation of 7th and 8th grade students in the PBL program would outperform the 7th and 8th grade students in the non-PBL program on the basis of academic achievement in reading and mathematics, as measured by the 2012 STAAR test results. Analysis of the data at the multivariate level supported the hypothesis. Specifically, it may be concluded that participation in the PBL does impact academic achievement in 7th and 8th grade reading and mathematics but not all Reporting Categories in 8th grade mathematics.

Discussion

The study's South Texas school district has been using the PBL as a new strategy for improving academic achievement as well as engaging and preparing students for real world experiences during this age of accountability and standards-based reform.

The review of the literature provided great insight into the evolution and waves of education reform in the United States that brought us to this point. Tyack and Cuban (1995) described the basic grammar of schooling as the organizational forms that govern instruction, which has remained the same, over long periods of time, with little change due to space, time, student classification, grading, and core operations. Because of the culture created by the grammar of schooling, attention occurs whenever we deviate from the customary and embedded school practices. The implementation of the PBL does deviate from the customary and traditional school practices and serves to challenge the practice of drill and kill as the only strategy to survive in the age of accountability. According to Blumenfeld, et al., (1991), the PBL serves as a comprehensive approach to classroom teaching and learning that is designed to engage students in the investigation of authentic problems to bring relevance and meaning to educational experiences. The review of literature provided extensive information on the topic of engagement and student success. Other key concepts associated with engagement includ the importance of creativity, motivation, relationships, relevance, and soft skills such as teamwork, collaboration, and respect.

The practice of the PBL generates a shift away from the grammar of schooling and is drawing attention of business and educational leaders to assess if student achievement practices, outside of the traditional model, can hold up to the demands of standards-based reform and accountability.

Engagement is in the center of the PBL, accented with the use of creativity, collaboration, teamwork, motivation, relevance, and establishment of relationships while working on authentic projects. In Chapter 2, various studies were cited that reported improvement of achievement scores of students who participated in the PBL. However, the review of the literature showed very limited studies which focused on the benefits of the PBL in Texas schools. Gordon (2006) noted that higher test scores can sometimes be achieved with drill and kill but that happens at the cost of leaving students with less enthusiasm for learning and teachers with less enthusiasm for teaching. Bell (2010) described that children retain more when they learn by doing and these learning experiences shape their lives.

The Experiential Learning Theory (ELT) was the theoretical framework selected and deemed appropriate for the study because it supports the major PBL tenet of experience. The ELT model bridges learning experiences across life situations such as school and work or school and real world. Experiences and experimentation are described as the ways used by people to make sense of the world (Kolb, 1984). Like the ELT, the PBL focuses on experience-based learning by using projects to create learning experiences that are relevant, engaging, rigorous and authentic. Like the ELT, the PBL provides students the opportunity to have concrete experiences, reflect on experiences, learn from the experiences, and apply the learning experience to other situations. MaKinster, Barab, and Keating (2001) reported that meaningful learning requires that students are provided opportunities to leverage prior knowledge and participate in tasks that are both meaningful to them and the world at large.

Thus, we come to the current reality that educators must figure out how to improve teaching and learning with high pressure demands from standards-based reform and accountability created from the waves of educational reform. This does not come easy in a time of high stakes testing that impacts student graduation rates, federal funding and sanctions that can bring a school and district to its knees with the moving target of accountability, and the uncertainty caused by restructuring. This demand exacerbates the need for data related to the PBL and student achievement.

According to Thomas (2000), there is evidence that eighth grade students exhibited the second highest scores in the district on the Stanford 9 Open Ended Reading Assessment. In addition, a similar study concluded that a middle school using the PBL approach showed significant increases in all achievement areas on the Maine Educational Assessment Battery after one year. In this study, students who participated in the PBL outperformed nonparticipants in reading and mathematics achievement.

Academic achievement was measured by STAAR reading and mathematics scores. The proportion of correct answers was used to measure each STAAR Reporting Category. Students in the 7^{th} and 8^{th} grade PBL groups outperformed the non-PBL group in all reading Reporting Categories. In mathematics achievement, the PBL 7^{th} grade group outperformed the non-PBL groups on all five Reporting Categories. However, in 8^{th} grade, the PBL group outperformed the non-PBL group in only Reporting Category 3: Geometry and Spatial Reasoning. To speculate on this particular outcome, a closer look at the 8^{th} grade PBL projects would provide additional information about specific mathematic skills that may be emphasized in the PBL projects. Most likely, the PBL projects incorporate the Texas Essential Knowledge and Skills (TEKS) of measurement, which are the easiest skills to apply by both the teachers and students. As the PBL projects continue throughout the year, teachers and students may become better in conducting projects, thus, strengthening their measurement skills such as those tested in Reporting Category 3: Geometry and Spatial Reasoning. Another factor to be explored is the scope and sequence of the curriculum to determine when particular mathematics skills are taught throughout the year and how they are incorporated in the PBL projects. Are there differences in the 7^{th} and 8^{th} grade scope and sequence of the curriculum that led to the outcome? Are there differences in the design of the 7^{th} and 8^{th} grade PBL projects that specifically did not address the mathematics TEKS in 8^{th} grade? Overall, the key factors may lie in further exploration of the actual PBL projects to assess the likelihood of the design of the project influencing the shortcomings.

In order to prepare the learners for the real-world, educators must redesign instruction and assessments by giving them real-world problems to solve. The restructuring of educational reform targets career and college readiness that spotlights a student's future beyond the classroom and K-12 experiences. In addition, educators must help students graduate with 21^{st} century skills such as collaboration, creativity, teamwork, and decision-making, and provide them with opportunities to practice and learn these skills to be ready for the real world.

Implications

The implementation of the PBL has been in place for two years in the study's South Texas school district,; however, its effectiveness had not been systematically investigated on its impact on academic achievement,; thus, providing the opportunity and the need to conduct the study. The review of the literature showed multiple PBL studies in different parts of the country and across the globe that did target achievement in the middle grades; however, research was not evident in South Texas. The study did demonstrate that student participation in the PBL positively impacts academic achievement in 7^{th} and 8^{th} grade reading and mathematics based on STAAR outcome measures. The District would likely consider the expansion of the PBL to other schools and seek additional grants and funding for its implementation. Participation in the

PBL, as the curriculum, would likely benefit students in other districts across Texas and the United States. The association between a student's participation in the PBL and achievement in reading and mathematics shows that the PBL does make a difference and would likely hold up to the demands of standards-based reform and accountability.

Recommendations for Further Research

The study's delimitations, limitations, and assumptions offer opportunities for further research: 1) due to the non-probability nature of sampling, external validity was limited to study participants; 2) the study was delimited to one school district in South Texas; 3) the study was delimited to two grade levels and two middle schools; 4) the study was delimited to the outcome measures of academic achievement in reading and mathematics based on the STAAR standardized test; 5) it was assumed that the existing data used had been accurately measured the criteria; and 6) it was assumed that the participating PBL school followed the curricula accordingly. To enhance the generalization of the results, the researcher recommends the: 1) replication of the study in other school districts in Texas; 2) replication of the study in other grade levels; 3) replication of the study in other academic achievement subjects; 4) replication of the study to examine graduation rates; 5) further exploration of the 8th grade STAAR mathematics achievement and PBL; and 6) replication of the study for multiple years of STAAR.

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Appendices

Appendix A: School District Letter

Office of Assessment and Accountability

CORPUS CHRISTI INDEPENDENT SCHOOL DISTRICT
P. O. Box 110 • Corpus Christi, Texas 78403-0110
3130 Highland Avenue • Corpus Christi, Texas 78405
Office: 361-844-0396 • Fax: 361-886-9371
Website: www.ccisd.us

September 9, 2012

Bernadine Cervantes
7714 Beauvais
Corpus Christi, Texas 78414

Dear Mrs. Cervantes:

Formal permission is granted to you to conduct your research entitled *Project Based Learning: Its Impact on Mathematics and Reading Achievement* in the Corpus Christi Independent School District (District). This permission indicates that your proposal meets all research/evaluation and FERPA standards.

It is a pleasure to welcome you to the District as you begin this significant research initiative. At the conclusion of your work, please provide my office with a copy of the results.

Should you need additional assistance during your study or have changes in the proposal, please contact me at 361-844-0396, ext. 44253 and/or via e-mail at James.Gold@ccisd.us.

Sincerely,

James H. Gold

James H. Gold
Executive Director

JHG/mdf

cc: Mr. D. Scott Elliff

Appendix B: IRB Approval Letter

TEXAS A&M UNIVERSITY
CORPUS CHRISTI

ERIN L. SHERMAN, MAcc, CRA, CIP
Research Compliance Officer
Division of Research, Commercialization and Outreach

6300 OCEAN DRIVE, UNIT 5844
CORPUS CHRISTI, TEXAS 78412
O 361.825.2497 • F 361.825.2755

September 18, 2012

Ms. Bernadine Cervantes
7714 Beauvais Dr.
Corpus Christi, TX 78414

Dear Ms. Cervantes,

The research project entitled "Project-Based Learning: Its Impact on Mathematics and Reading Achievement of 7th and 8th Grade Students in an Urban South Texas School District" (IRB# 106-12) has been granted approval through an exempt review under category 7.1.2(4). You are authorized to begin the project as outlined in the IRB protocol application.

Please submit an IRB Amendment Application for any modifications to the approved study protocol. Changes to the study may not be initiated before the amendment is approved. Please submit an IRB Completion Report to the Compliance Office upon the conclusion of the project. Both report formats can be downloaded from IRB website.

All study records must be maintained by the researcher for three years after the completion of the study. Please contact me if you will no longer be affiliated with Texas A&M University – Corpus Christi before the conclusion of the records retention timeframe to discuss retention requirements.

Please contact me if you have any questions.

Sincerely,

Erin L. Sherman

Erin L. Sherman

THE ISLAND UNIVERSITY