The Impact of Project-Based Learning on Minority Student Achievement: Implications for School Redesign

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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 causal-comparative study compared 7th and 8th students who had utilized the PBL with a comparison group in which PBL was non-existent. Using outcome measures of academic achievement in mathematics and reading, multivariate and univariate analyses of the data showed that the PBL groups performed at a higher achievement level than did the non-PBL students. Theoretical and practical implications are discussed.

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Since *A Nation at Risk* was published in 1983, schools have made considerable effort to prepare students for the ever-increasing demands of the 21st century. However, even when preparing students to adapt to 21st changing technologies, information, jobs, and social conditions (Barron & Hammond, 2008), too many students continue to drop out of school. One recent estimate was that three out of 10 high school students, the majority of these minority and poor students drop out of America's public high schools every school day (Rumberger, 2011). This intersection between increased rigor in teaching and learning while decreasing dropout rates is problematic for school districts.

Interestingly enough, researchers have suggested that the main reason students drop out of school is that they found their classes boring and in turn became disengaged from high school (Beekman, 2006; Bridgeland, Dilulio, & Morison, 2006; Prothero, 2014). It may be that the organizational forms and structure of schools contribute to student disengagement. It is suggested that conventional forms and structures continue to govern instruction remaining the same over time, with little change to the space, time, student classification, grading, and core operations of schools (Elmore & City, 2011; Tyack & Cuban, 1995). Compounding the issue are standards-driven reform efforts in which districts continue to rely on school-based management and school restructuring to improve the conditions and outcomes of failing schools (Elmore, 1997; Stein & D'Amico, 2002). Even with the advancement of technology in schools, conventional school reform approaches remain because "teachers and schools continue to control access to content and learning" (Elmore & City, 2011, p. 25), leaving little room for innovative practice (Wolk, 2010).

Although the current educational system remains designed for standardization, some school districts are engaging in ways in which to improve academic achievement for minority student and children of poverty, reduce dropout rates, and prepare students for the demands of the 21st century workforce through school redesign. School redesign has emerged as a means to focus on the core function of teaching and learning. Rather than layer school wide initiatives, one on top of the other, as is often the case with reform efforts (Tyack & Cuban, 1995), school redesign changes academic programs altogether (Christensen, Horn, & Johnson, 2008). Examples include 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).

Transforming low-performing urban public high schools through these types of programs have commanded much attention of late. 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 (Hemmings, 2012; Newmann, 1996). As Barron and Darling-Hammond (2008) noted, by engaging in authentic projects that draws subject knowledge to solve real-world problems, students learn at deeper levels and perform better on complex tasks. However, less is known whether school redesign efforts, such as PBL, are able to show evidence of success in a standardized arena. For this reason, the impact of PBL on student academic achievement in reading and mathematics in one middle school in South Texas was examined.

The Study

As a means to combat declining school enrollment, declining test scores and a school rating hovering around academically unacceptable performance, a school district in South Texas took a radical approach by redesigning a middle school. Rather than adding conventional approaches that are often associated with school reform (Elmore & City, 2011), this district envisioned a school that was fundamentally different than any other district middle school. A major part of the school redesign was to address improving academic achievement for middle school minority students and children of poverty. From grade configuration, curriculum, course offerings to the ability for students to gain or earn postsecondary course credit, the district's vision for this redesigned school, to some degree, included what Hess and Manno (2011) suggested are customized educational services for at-risk students.

In 2010, this district applied for and received a United States Department of Education grant to establish PBL as a guiding construct for one middle school redesign. Project-Based Learning was adopted to promote the diversity and increased choices for these middle school students by engaging them in the investigation of authentic problems. The purpose of this study was to explore how a middle school redesign using PBL impacted student achievement in mathematics and reading. In an era of high stakes testing, standards, and accountability, it is important to examine whether school redesign efforts that include whole school innovative educational practices have a place. Therefore, this study examined the impact of PBL on reading and mathematics achievement of seventh and eighth grade students, and to test the hypothesis that an innovative approach such as PBL is effective in impacting academic achievement.

Background

Considerable empirical evidence exists that when students drop out of high school, the economic and social health of America is jeopardized. Dropouts are likely to be dependent on public assistance, engage in criminal activities, and experience health problems (Muennig, 2007; Rumberger, & Thomas, 2000; Waldfogel, Garfinkel, & Kelly, 2007). Much of the attention on dropouts has focused on high schools and their efforts to build and sustain high levels of student engagement in school and learning through innovative practices (Finn, 1993; Marks, 2000). However, as Orthernr, Cook, Rose and Randolph (2002) reported, many students do not have access to these innovative efforts because they disengage from their education well before high school. In fact, "the social-psychological and behavioral disengagement from school that leads to dropping out often begins in middle school" (Orthernr, Cook, Rose, & Randolph, 2010, p. 223). Equally concerning are the difficult transitions middle school students experience and the impact of such transitions on standardized test scores. Randolph, Fraser and Orthner (2006) reported that if students experienced difficult transitions from fifth to sixth grade, their math and reading scores significantly declined.

On one hand, adolescents, ages 10-15, go through rapid change and are vulnerable to their emotions (Johnson, 2012). Johnson goes on to say, they are fun, excited about life, sensitive, overwhelmed and in turmoil. Their emotions are high and logic rarely prevails. Friends begin to replace parents and peer acceptance, socialization, appearance and body image are everything. The middle school student continuously tests and breaks the rules but needs boundaries. They demand independence but seek the reassurance of love and caring from adults.

The middle school student is a conflicted human being. On the other hand, we know little of how middle schools are approaching these student behaviors amidst standardization.

Evidence exists that intervention programs aimed at over-age middle school students help students back on track for on-time graduation (Finnan & Kombe, 2011). These accelerated programs help students develop confidence through academic accomplishments, a sense of belonging and engagement in the classroom. However, with these types of intervention programs limitations exists because they rarely include preparing students for experiences outside of the classroom and as a contributing member of society. Furthermore, academic accomplishments do not necessary translate to whether a student is able to apply what he or she has learned to his or her daily life. As Dewey (1900) suggested, it is important to consider whether educational experiences isolate the student from life experiences. Others, such as Richardson (2012), suggested a shift in curriculum and pedagogy to allow for personalized learning experiences that allow students to connect his or her passions and interests as learners with society expectations. It is with this understanding that led the South Texas district in this study to adopt Project-Based Learning (PBL).

Project-Based Learning: A School Redesign

In the quest to pursue deeper learning for students, Project-Based Learning (PBL) classrooms are designed to engage students in the investigation of authentic real world problems (Blumenfeld et al., 1991; MaKinste, Barab, & Keating 2001; McGrath, 2004). According to Krajcik, Blumenfeld, Marx, and Soloway (1994) and Thomas (2000), an effective PBL environment consists of five components: (a) an authentic and engaging driving question, (b) student generated artifacts, (c) student collaborated research, (d) an audience of community, and (e) the use of technology-based cognitive and communication tools.

Within 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; Mergendoller, Maxwell, & Bellisimo, 2006; Thomas, 2000). Students are placed 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, PBL promotes interdisciplinary studies, coupled with in-depth exploration of the subject matter over extended periods of time that are then linked to meaningful activities for students thus resulting in a deep level of understanding of the content and concept (Blumenfeld et al., 1991).

Above and beyond, the PBL approach is more than student mastery of content knowledge; rather it enables 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, Barab, & Keating, 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).

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" (Kolb, 1984, 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, Boyatzis, & Mainemelis, 1999).

The ELT tenets provide 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.

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).

The ELT compliments the tenets of PBL 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. According to Gutek (2005), 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).

Kolb's ELT is demonstrated in the PBL tenets because 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 and experiences 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, Barab, & Keating, 2001).

Kolb's ELT framed the study on the basis of meaningful and authentic experiences for understanding how learning takes place in PBL. From MaKinster, Barab, and Keating (2001), we know that 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.

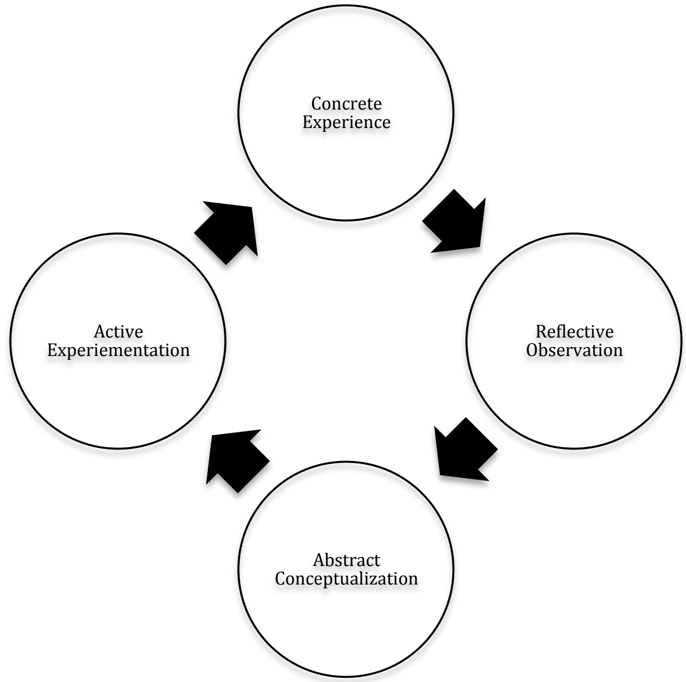

Figure 1. The Experiential Learning Cycle (adapteed from Kolb, 1984)

Method

Research Design

The researcher utilized an ex post facto, causal-comparative research design (Gall, Gall, & Borg, 2007), which 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. 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 State of Texas Assessments of Academic Readiness (STAAR) mathematics and reading achievement scores.

Subject Selection

The subjects for the study were from two middle schools in an urban school district in south Texas as of 2011 – 2012 school year. The characteristic-present group consisted of a non-probability sample of 87 Grade seven students and 84 Grade eight students in the magnet school that incorporated the PBL as part of the curriculum. The comparison group consisted of 140 Grade seven students and 150 Grade eigth students in the other middle school where PBL was not used as part of the curriculum.

Instrumentation

In 2011-2012, the new 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 (Texas Education Agency, 2013). For the purpose of the study, the 2012 STAAR scores in mathematics and reading for Grade seven students and Grade eight students were used. The proportion of correct answers was used to measure each STAAR Reporting Category. The data were obtained from the school district in which the study took place.

Achievement in Grade seven 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 Grade eight 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 Grade seven 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 Grade eight 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.

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. The level of significance was set, a priori, at .01 to reduce the probability of making Type I errors due to performing multiple tests. 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. 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). Pre-experimental equivalence was established by comparing the two groups on the basis of reading and mathematics achievement sores one year prior to the implementation of the PBL program and finding no statistically significant differences.

Grade Seven Results

A Profile of Subjects

The characteristic-present group (n = 87) included seventh grade students who had participated in the PBL program and the comparison group (n =140) consisted of seventh grade students who had not participated in the PBL program. Age differences between the PBL (M = 13.60, SD = .62) and non-PBL (M = 13.73, SD = .62) groups 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 (88.50%, n = 77) and non-PBL (89.90%, n = 125) groups were economically disadvantaged, as determined by eligibility for free or reduced lunch; the differences were not statistically significant, χ^2 (1, N = 226) = .01, p = .90.

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 1.

Table 1
STAAR Reading Achievement Measures, Seventh Grade

	PBL Group (n = 87)		Non PBL Group (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 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.

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 2.

Table 2
Mean Difference Effect Sizes, STAAR Reading Achievement Measures, Seventh 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

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 3.

Table 3
STAAR Mathematics Achievement Measures, Seventh 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 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. Mean difference effect sizes were used to analyze practical significance of the findings as computed by Cohen's d. Results are summarized in Table 4.

Table 4
Mean Difference Effect Sizes, STAAR Mathematics Achievement Measures, Seventh 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

Eighth Grade Results

A Profile of Subjects

The characteristic-present group (n = 84) included eighth grade students who had participated in the PBL program and the comparison group (n =150) consisted of eighth grade students who had not participated in the PBL program. 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); 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, $p < .01$.

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 5.

Table 5
STAAR Reading Achievement Measures, Eighth Grade

STAAR Reporting Category	PBL Group (*n* = 84) M*	SD	Non-PBL Group (*n* = 150) 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 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. 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, Eighth 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 7.

Table 7
STAAR Mathematics Achievement Measures, Eight Grade

Mathematics Reporting Category	PBL Group (n=84) M*	SD	Non-PBL Group (n = 150) 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 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. Mean difference effect sizes were used to analyze practical significance of the findings as computed by Cohen's d. Results are summarized in Table 8.

Table 8
Mean Difference Effect Sizes, STAAR Mathematics Achievement Measures, Eighth 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

Among seventh graders, although group differences on the basis of selected demographic variables were not statistically significant, a fair number of simple correlations between the demographic data and outcome measures were statistically significant. The demographic variables were treated as covariates and multivariate analysis of covariance (MANCOVA) was performed to compare the PBL and non-PBL groups on the basis of the adjusted outcome measures. The MANCOVA and MANOVA results were the same. 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 five mathematics categories.

Among eighth graders, a notable number of simple correlations between the demographic data and outcome measures were statistically significant. The demographic variables were treated as covariates and MANCOVA was performed to compare the PBL and non-PBL on the basis of the adjusted outcome measures. On the basis of reading, $F(3, 225) = 7.63$, $p < .01$, and mathematics, $F(5, 223) = 4.22$, $p < .01$, 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 the mathematics category of Geometry and Spatial Reasoning. Thus, the MANOVA and MANCOVA results were the same.

Discussion

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). Districts and schools are under increased pressure to reduce dropouts while at the same time increase rigor in the classroom. 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 increased core standards in order to assess students based on what they produce or demonstrate rather than recall for a test. Project-Based Learning involves the 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.

It may be that educational reform, specifically school redesign in the United States, is difficult because of the embedded culture of what Americans know a school to be like; specifically the basic grammar of schooling that relies on traditional organizational management (Tyack and Cuban, 1995). Coupled with the accountability reforms in recent years, society in general has grown accustomed to the *bubble tests* brought about from the No Child Left Behind Act of 2001. Educational stakeholders are now conditioned to function using a standardized assessment and focus on increasing scores and meeting targets. Even though districts and schools remain accountable to traditional state assessments, there is some evidence they are shifting the instructional models towards innovative concepts such as Project-Based Learning.

Amidst the standards and accountability movement, teachers and administrators are challenged 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 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. The school district in this study had 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 district's decision to redesign one middle school did not come easy. In a time when high stakes testing impacts student graduation rates, together with test scores tied to federal funding and sanctions, there exists an uncertainty. While the concept and practice of PBL is well known, little research has been conducted that examines PBL's impact on student acheivment.

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 study did demonstrate that student participation in the PBL positively impacts academic achievement in seventh and eighth grade reading and mathematics based on STAAR outcome measures and generates implications.

The school district in which the study took place, would likely consider the expansion of the PBL to other middle 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.

Implications

There are several implications that can be generated from the study; changing the teaching and learning environment in schools and districts, and professional development for teachers *and* administrators. 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, Gordin, & Pea, 1999; Hancock Kaput, & Goldsmith, 1992; Marx, Blunfeld, Krajcik, & Soloway, 1997). Whereas many school and district leaders work in systems that have not developed the capacity to shift from a results-driven to a mission-driven focus by engaging in new ways to affect teaching and learning practice at scale (Fink & Silverman, 2014; Enfield & Spicciati, 2014). As such, when faced with a new initiative such as PBL, professional development for school leaders should be supported by districts by establishing networks focused on instructional leadership practices, and differentiated support to meet individual leadership needs and capacity.

Teachers. The new primary role the teacher must learn 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, Barab, & Keating, 2001). Professional development implications call for a need to shift resources to provide PBL training and systems to support its sustainability. Instructional support will need to be established to provide continuous coaching and training in order to ensure PBL is the curriculum.

Educational Leadership. Leadership is another key implication in sustaining PBL. School administrators and central office leaders must provide flexibility in areas such as hiring practices, budget, curriculum, policies, programs, facilities and school operations to support PBL schools. For example, perhaps one of the significant practices a school administrator can assume is that of coach and mentor, especially when helping to build capacity within the system to accept a new program or innovative practice. Coaching is a fundamental practice that can be specifically designed to address implementation challenges, support evidence-based teaching practices as well as focus on school redesign efforts. One way in which leaders can better support school improvement and/or school redesign, is by establishing a natural system that allows for open and robust feedback and honest conversation. When coaching and mentoring are used accordingly, opportunities exist for teachers to enage in the process of ownership of their own learning and in turn new iniatitives may be implemented with fidelity. While coaching is often seen at the campus level, school administrators can also benefit when coached by central office adminsitrators. When doing so, school adminsitrators and central office administrators partner to leverage resources, address curriucluar issues, model motivation, and adjust strategies to meet goals for student success.

Conclusion

In order to prepare the learners for the real-world, PBL calls for teachers and administrators to redesign instruction and assessments by giving students real-world problems to solve. The restructuring of educational reform now targets career and college readiness that spotlights a student's future beyond the classroom and K-12 experiences. Gone are the days where students only needed strong, basic, academic skills to have a hopeful future. Today, now more than ever, educators must help students graduate with 21st century skills such as collaboration, creativity, teamwork, problem-solving and decision-making in order for our students to learn, practice, adapt, thrive and succeed in a future we don't know.

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