A Longitudinal Study Investigating the Effects of the PBL Approach in Secondary Mathematics Education

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Summer August 22, 2013.
A Longitudinal Study Investigating the Effects of the PBL Approach in Secondary Mathematics Education

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Abstract
This longitudinal study investigated the effect of Project-Based Learning (PBL) on Secondary mathematics students’ in order to determine both academic skill development and motivational factors that affect learning. Specifically, for two years, this study followed two comparable groups of 8th and 9th graders from a PBL school and a conventional public high school; these students represented a wide range of mathematical abilities (deep vs. superficial conceptual knowledge) and demographic diversity (race/ethnicity/SES). Each semester, on-line surveys, classroom observations, and student and teacher interviews were administered and analyzed.

RESULTS
Race was not a determining factor in PBL school performance, but SES factors were.

PBL & Comparison schools/ Fall 2012 Disaggregated standardized math scores
PBL overall 15.532(246) Comparison overall 17.885(301)

Academic factors

Participants. Note: In terms of mathematics achievement, number of low proficient students (% of student <60%) in PBL school is 10% more than that of the comparison school.

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<th>Atrition</th>
<th>14%, not significantly different between PBL and the comparison school (p = .431)</th>
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RESEARCH QUESTIONS

- What was the effect of PBL on secondary students’ mathematics-academic skill, and what were the factors that contributed towards the acquisition of such?
- How did PBL affect the motivational and social factors of secondary students’ mathematics learning?
- How did PBL fair with at-risk and racial/ethnic minority secondary mathematics students? Specifically, we investigated whether the PBL classroom provided an alternative setting for minority (Latino American and other minority students) and at-risk students as defined as Low SES students who were known to be underachieving in mathematics.

METHOD
quantitative data
participants’ standardized test scores

qualitative data
on-line survey, classroom observations, student and teacher interviews

Training for all researchers on coding of data and interviewing was held throughout the years to maintain 80% inter-rater reliability and the integrity of the research methodology.

CONFERENCE
Our study confirmed the current research finding of the benefit of PBL in motivational factors in general. However, as there have been not many studies that explored the motivational aspects of mathematical pedagogy, we felt that we are in uncharted waters. This is a pioneering effort in assessing a mathematical pedagogy holistically. In an effort to understand what will motivate these students to enjoy and appreciate mathematics, and thereby pursue STEM career in the future, this study provides some directions. As the results showed, PBL motivated students to study more effectively, seek help from and work with peers, and appreciate the value of mathematics.

The findings of this PBL empirical research study will impact mathematics education and reform as a whole. First, the findings will generate knowledge that is necessary to transform the mathematics teaching practice, both in the targeted school studied and in the field at large. Specifically, the study gathers data to help educators and researchers determine whether PBL is a viable approach to innovate curricula programming for secondary mathematics teaching and learning. Secondly, through adopting the PBL pedagogy the achievement gap of minority and at-risk populations should decrease while the mathematics conceptual learning, problem solving and cooperative learning skills of these students should increase. The findings can be utilized in secondary mathematics education courses to train our future workforce.

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