



Project-Based Learning Increases Science Achievement in Elementary School and Advances Social and Emotional Learning

Introduction

Rigorous project-based learning has strong, positive effects on science achievement and aspects of social and emotional development related to science learning among elementary school students. This brief highlights these findings based on a study on the effects of Multiple Literacies in Project-Based Learning (ML-PBL), a project-based approach to teaching science in elementary school.

The researchers, developers, and teachers who developed ML-PBL sought to transform science classrooms from places where students typically learn disconnected facts and memorize procedures to environments that call for making sense of ideas and engaging in real-life scientific disciplines and practices. The developers aligned ML-PBL to Next Generation Science Standards (NGSS). Its interdisciplinary focus emphasizes science learning and literacy and math knowledge and skill, as well as aspects of social and emotional learning (SEL). Questions that focus on real-world problems and complex scientific phenomena drive the learning and anchor the lessons. The ML-PBL approach includes curricular and instructional resources,

assessments, and professional-learning support for teachers.

To test the efficacy of ML-PBL, researchers at Michigan State University and the University of Michigan conducted a randomized controlled trial to determine if the approach improved third-grade students' science learning and aspects of their social and emotional development related to science learning. The result was that students in the ML-PBL program significantly outperformed their peers in typical classrooms on a science assessment and more frequently reported the value of reflection and collaboration, hallmarks of SEL.

About the study

In the 2018–19 school year, researchers randomized 46 schools across Michigan for the study. This led to 23 treatment and 23 control schools with a total of 2,371 third-grade students.

Schools in the study were located in different regions of the state of Michigan and represented a range of economic and racial diversity. Table 1 provides a summary of the demographic composition of the student sample from across all schools and regions participating in the research program.



Table 1. School-Level Demographics

	Percent of Student Sample					
	Free and Reduced- Priced Lunch	White	Black	Hispanic	Asian	American Indian
Treatment	62.2	44.6	40.8	8.5	3.2	0.2
Control	61.6	40.6	42.1	11.9	2.1	0.4
Overall	61.9	42.6	41.4	10.2	2.7	0.3

**STUDY
DETAILS**

To evaluate the impact of ML-PBL, test items aligned with the third-grade NGSS performance standards were released to the researchers through a contract with the Michigan State Department of Education. Since the researchers did not develop these test items, the science assessment created with them was free from any unintended bias.

In addition, researchers developed a student survey designed and validated to assess three aspects of social and emotional learning: reflection, collaboration, and ownership. A recent Lucas Education Research [paper](#) identified these aspects as integral to both high-quality project-based learning and SEL.

Teachers using the ML-PBL program participated in six days of in-person trainings on ML-PBL throughout the year as well as virtual sessions, while members of the control group participated in the same professional learning they would get in a typical year. A key feature of the ML-PBL professional learning was that teachers experienced and were guided through the kind of active, inquiry-based learning that their students would experience.

For comprehensive information about the study’s methodology and analytical approach, see the [researchers’ report](#) .

Lucas Education Research, a division of the George Lucas Educational Foundation, funded the development and study of ML-PBL.

Results

On average, third graders in ML-PBL classrooms performed 8 percentage points better on the science assessment as compared with students in the control group classrooms. These results are statistically significant: $ES = 0.266, p < 0.01$. Note that *ES* stands for “effect size,” a simple way of quantifying the difference between two groups. The *p* stands for “probability.” A *p* value helps to determine the significance of the results. Importantly, the researchers found this positive effect across schools with differing racial and ethnic makeups and household-income statuses and throughout the major regions of the state.

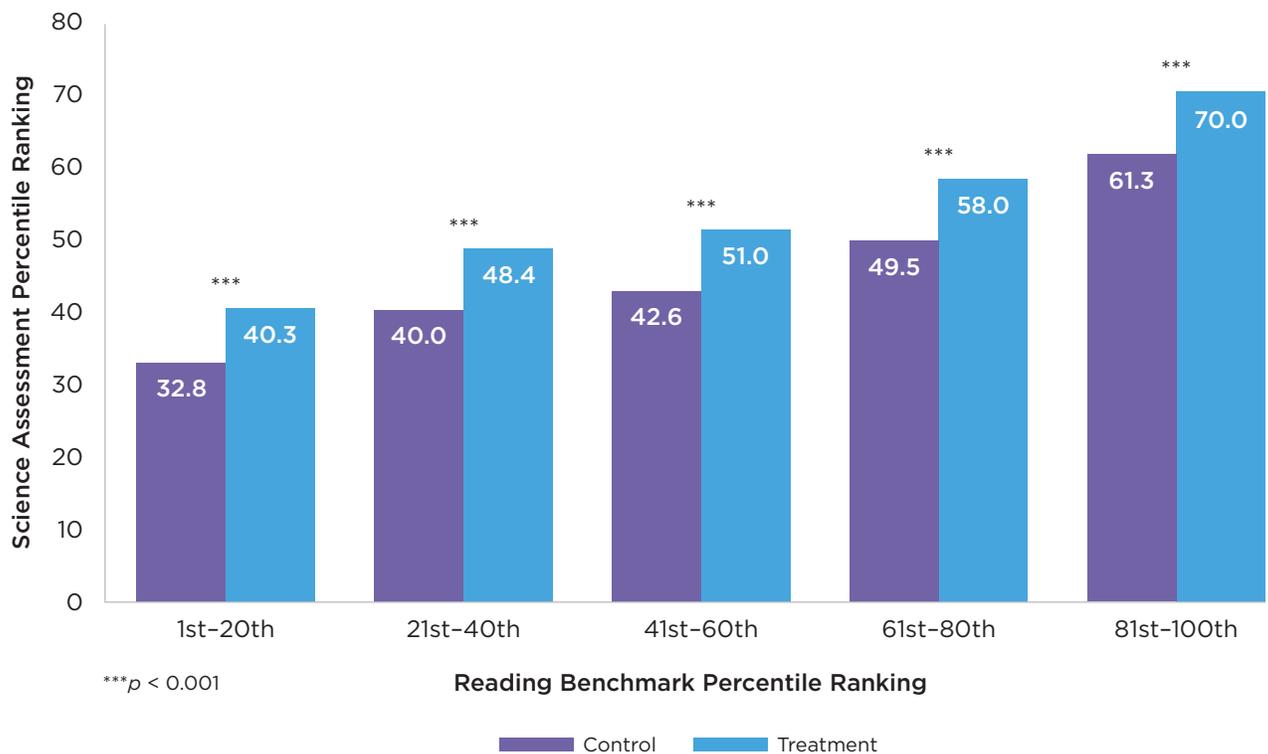
When researchers further analyzed the sample of students by their reading ability in the fall, they reported that the significant effects on the science test in favor of ML-PBL held across students performing at all reading ability levels. See Figure 1 for more details.

ML-PBL also had significant and positive effects on two of the three aspects of social and emotional learning related to science learning. Specifically, students in ML-PBL classrooms more frequently reported the value of reflection and collaboration in science classrooms.

A final analysis of the demographic composition of the study schools confirmed that findings can be generalized to students beyond Michigan: The students in the study sample were representative of third graders across Michigan and throughout the country.



Figure 1. Student Performance by Baseline Reading Level



Discussion

Few elementary science programs that improve instruction and learning have the scope and depth of ML-PBL, and researchers have not studied these with such rigorous techniques. In this case, the developers thoughtfully created texts that supported the hands-on, real-life learning opportunities. It is important to note that this interdisciplinary approach to science and literacy resulted in a significant improvement in performance for all students on an independent measure of science knowledge.

This improvement regardless of reading level is notable because it shows that rigorous project-based learning coupled with professional learning is effective for all learners. Additionally, the fact that these significant effects persisted across schools with differing racial and ethnic makeups and household-income statuses and in various regions of the state further substantiates the claim that this approach is beneficial for all students.

The positive effects found for two aspects of SEL, collaboration and reflection, are also important indicators of successful learning and are integral to high-quality project-based learning. Collaboration is a key feature of ML-PBL as it underscores the importance of allowing all students to participate in experiences, thus providing equitable opportunities for every student to learn in the science classroom. Reflection in the service of revising project work helps students learn how to incorporate and interpret feedback from others. In this way, reflection encourages growth and helps students develop self-management skills that empower them to persevere through difficulties.

ML-PBL takes a comprehensive approach to changing science instruction, bringing together interdisciplinary, project-based learning instructional materials with high-quality, sustained professional learning. It is important to note that these findings were contingent upon providing teachers with the opportunity to engage in high-quality and sustained professional learning.



About Multiple Literacies in Project-Based Learning

The curriculum developers designed ML-PBL to enhance students' curiosity about the natural world, pique their interest in problems that have relevance to their lives, and support them as they solve real-world problems. The program builds usable science knowledge, fosters mathematics and literacy skills, and creates access to and ownership of science learning for all students. It includes instructional materials, unit assessments, and sustained professional-learning opportunities for teachers.

Students in third-grade ML-PBL classrooms work on four projects throughout the year. Students address and make sense of these driving questions:

- Why do I see so many squirrels, but I can't find any stegosaurus?
- How can we design fun moving toys that other kids can build?

- How can we help the birds near our school grow up and thrive?
- How can we plan gardens for our community to grow plants for food?



Conclusion

This randomized study demonstrated a positive effect on student outcomes when schools and systems linked high-quality project-based learning instructional materials, assessments, and sustained professional learning. This approach promotes a new method of science instruction and advances student social and emotional learning goals.

The study's findings on student achievement gains within one year and the generalizability of

the results across Michigan and beyond should encourage the expansion of ML-PBL and prompt educators and curriculum developers to consider using its design features as a model for teaching and learning.

The study highlighted in this brief investigated the effects of ML-PBL on third-grade learning. Notably, work on expanding ML-PBL to fourth and fifth grade is underway. Education researchers should further evaluate these new programs and analyze their results.

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