

WHITE PAPER



Project-Based Learning and Academic Performance:

Comparing Schools that Implement Defined Learning Project-Based Learning to Schools that Do Not

Report Authors

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Introduction

In the spring of 2022, Defined commissioned MIDA Learning Technologies, LLC to conduct an independent, mixed methods retrospective study in Fort Wayne Community Schools to determine the impact of the Defined Learning (DL) project-based learning platform — a web-based application designed to promote effective and relevant instruction through engaging, hands-on, authentic experiences. The study was designed to use existing test data to determine if there were differences between schools that recorded high frequencies of DL use compared to schools with limited or no use of DL.

This mixed-methods study utilized a two-group, retrospective, quasi-experimental design to examine the effect of the project based learning (PBL) — specifically PBL using DL — on elementary students' reading and mathematics growth scores. In addition, qualitative data were collected utilizing focus groups and interviews of experimental group teachers and administrators.

The data collection consisted of existing test scores for the 2021–22 school term secured in April 2022. The data reflected student growth scores using the beginning of the year (BOY) and end of year (EOY) scores on FastBridge assessments conducted by the school district. FastBridge, a product from Illuminate Education, is a valid and reliable assessment tool to help educators identify students' academic and social-emotional behavior needs. Researchers isolated FastBridge student growth scores for third, fourth, and fifth grades in reading and mathematics.

This report contains a summary of the results of the statistical analysis and qualitative data related to the experience of implementing PBL.

Research Questions

1. Does Defined Learning influence classroom instruction and interaction?
2. Does a Defined Learning supported project-based learning instructional approach impact students' academic performance?

Existing Research

To contextualize the study around the two primary questions, it is essential to understand the existing body of research related to PBL.

Consistently across studies, findings indicate that PBL enhances student performance, motivation (Setiawan et al., 2021; Ummah et al., 2019), student engagement (Frydenberg & Mentzer, 2021), teacher/student interaction, the Five C's of 21st Century Learning [creativity, critical thinking (Mahasneh & Alwan, 2018), collaboration, cooperation, and communication], and social-emotional learning. PBL transcends a single academic discipline, offering the potential for employability skills that employers seek, such as teamwork, emotional intelligence, and critical and creative thinking (Lebid & Shevchenko, 2020). The research cited above suggests that there are implications for promoting student success across diverse backgrounds and abilities.

Research indicates that students who engage in PBL perform better on both standardized and local assessments than students in traditional direct instructional programs and that they develop both real-world application of skills (Yuliana et al., 2018) and analytical thinking (Boaler, 1999).



Study Design

This study used a mixed-methods, retrospective approach. In quantitative data, researchers utilized a retrospective approach that analyzed existing data from standardized district assessments. The pilot nature of the implementation of PBL provided a great deal of variability across the 32 elementary schools. The frequency of use data confirmed the variability of use. The disparity in patterns and frequency of use provided an opportunity to compare higher frequency using schools to lower frequency using schools.

District Demographics:

Location: Fort Wayne Community School District, Indiana

Number of K–12 Students: 28,460

32 Middle Schools

Urban Setting

Race/Ethnicity:

- 38.5% White
- 25% Black/African American
- 20% Hispanic
- 6.5% Asian/Pacific Islander

Free and Reduced Lunch: 65.9%

Sample Population

The sample for this study is comprised of the three most frequent DL using schools (experiment group) and the four least frequent using schools (control group).

	TEST GROUP	CONTROL GROUP
3rd Grade	241 students	289 students
4th Grade	239 students	291 students
5th Grade	254 students	271 students
Total	734 students	851 students

Students in the control group received standard district-approved mathematics and reading instruction without the support of DL PBL. In the experimental group, teachers implemented PBL units developed by Defined, which were embedded in the curriculum.

Quantitative Methodology

A nonequivalent, two-group quasi-experimental design was used in this study to examine the effect of PBL — specifically PBL utilizing DL — on students' achievement in mathematics and reading. This design used test results from the district's FastBridge assessment program and analyzed growth scores by comparing the beginning of the year (BOY) and end of year (EOY) results. The project-based lesson intervention was applied in the three elementary schools that represent the experimental treatment group. The intervention for each grade took place from September 2021 to May 2022. Growth scores assigned to each student were used to compare group performance between the experimental and control groups.

Data Analysis and Findings

The data were analyzed using statistical techniques in the Statistical Package for the Social Sciences, Version 27 (SPSS 27). Descriptive statistics were used, including frequency, percentages, central tendencies, and variation. Data were presented graphically to highlight similarities and differences in results and identify outliers of performance. Between-group differences were examined using an independent samples *t*-test. The means and standard deviations for third, fourth, and fifth grade performance are presented in the tables below.

The data analysis revealed that students in a DL PBL environment outperformed their peers in non-PBL classes. An increase in performance was identified at all three grade levels included in the study in both reading and mathematics. However, in fifth grade mathematics, the increased performance difference did not meet the significance level.

Grade 3

An independent-samples *t*-test indicated a significant difference between the experimental and control group for third grade mathematics, $t(481.215) = 5.934$, $p < .000$. The experimental group ($M = 68.02$, $SD = 26.37$) scored significantly higher than the control group ($M = 52.58$, $SD = 30.92$) in mathematics performance in the third grade.

GROUP STATISTICS: 3RD GRADE MATH

3rd Grade	N	Mean	Std. Deviation	Std. Error Mean
Experimental	233	68.02	26.377	1.728
Control	253	52.58	30.925	1.944

INDEPENDENT SAMPLES TEST: 3RD GRADE MATH

	Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of Difference	
3rd Grade	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	15.332	.000	5.896	484	.000	15.436	2.618	10.292	20.580
Equal variances not assumed			5.934	481.215	.000	15.436	2.601	10.325	20.547

A significant difference was also found at the third grade level in reading increased performance $t(475.752) = 4.008$, $p < .000$. The experimental group ($M = 61.24$, $SD = 26.75$) scored significantly higher than the control group ($M = 50.80$, $SD = 30.24$) in reading performance in the third grade.

GROUP STATISTICS: 3RD GRADE READING

3rd Grade	N	Mean	Std. Deviation	Std. Error Mean
Experimental	231	61.24	26.750	1.760
Control	248	50.80	30.237	1.920

INDEPENDENT SAMPLES TEST: 3RD GRADE READING

	Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of Difference	
3rd Grade	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	6.870	.009	3.991	477	.000	10.440	2.616	5.300	15.580
Equal variances not assumed			4.008	475.752	.000	10.440	2.605	5.322	15.558

Grade 4

An independent-samples t-test indicated a significant difference between the experimental and control group for fourth grade mathematics, $t(480.387) = 5.815$, $p < .000$. The experimental group ($M = 63.56$, $SD = 27.65$) scored significantly higher than the control group ($M = 48.36$, $SD = 29.92$) in mathematics performance in the fourth grade.

GROUP STATISTICS: 4TH GRADE MATH

4th Grade	N	Mean	Std. Deviation	Std. Error Mean
Experimental	233	63.56	27.653	1.852
Control	263	48.36	29.917	1.845

INDEPENDENT SAMPLES TEST: 4TH GRADE MATH

	Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of Difference	
4th Grade	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	5.229	.023	5.777	484	.000	15.199	2.631	10.030	20.369
Equal variances not assumed			5.815	480.387	.000	15.199	2.614	10.063	20.335

An independent-samples t-test indicated a significant difference between the experimental and control group for fourth grade reading, $t(462.866) = 3.205$, $p < .001$. The experimental group ($M = 53.77$, $SD = 27.53$) scored significantly higher than the control group ($M = 45.12$, $SD = 30.68$) in reading performance in the fourth grade.

GROUP STATISTICS: 4TH GRADE READING

4th Grade	N	Mean	Std. Deviation	Std. Error Mean
Experimental	218	53.77	27.533	1.865
Control	247	45.12	30.678	1.952

INDEPENDENT SAMPLES TEST: 4TH GRADE READING

	Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of Difference	
4th Grade	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	5.379	.021	3.184	463	.002	8.653	2.718	3.312	13.994
Equal variances not assumed			3.205	462.866	.001	8.653	2.700	3.348	13.958

Grade 5

An independent-samples t-test indicated a significant difference between the experimental and control group for fifth grade reading, $t(485) = 2.542$, $p = .011$. The experimental group ($M = 51.21$, $SD = 27.69$) scored significantly higher than the control group ($M = 44.54$, $SD = 30.24$) on reading performance.

An independent-samples t-test indicated no significant difference between the experimental and control group for fifth grade mathematics, $t(481) = 1.453$, $p = .147$. The experimental group ($M = 52.80$, $SD = 28.75$) scored higher than the control group ($M = 49.00$, $SD = 28.77$) on mathematics performance but the difference was not significant.

GROUP STATISTICS: 5TH GRADE

	School	N	Mean	Std. Deviation	Std. Error Mean
Reading	5	247	51.2146	27.69107	1.76194
	6	240	44.5375	30.24362	1.95222
Math	5	249	52.8032	28.74817	1.82184
	6	234	49.0000	28.76574	1.88048

INDEPENDENT SAMPLE TEST: 5TH GRADE

		Levene's Test for Equality of Variances				t-test for Equality of Means			95% Confidence Interval of Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Reading	Equal variances assumed	2.805	.095	2.524	485	.011	6.67707	2.62642	1.51651	11.83764
	Equal variances not assumed			2.539	478.491	.001	6.67707	2.62975	1.50979	11.84436
Math	Equal variances assumed	.071	.790	1.453	481	.147	3.80321	2.61821	-1.34133	8.94776
	Equal variances not assumed			1.453	479.106	.147	3.80321	2.61826	-1.34148	8.94791

Discussion

This study examined the impact of PBL on students' academic performance in mathematics and reading at the third, fourth, and fifth grade levels. The retrospective, quasi-experimental design revealed significant differences between the control and experimental groups in the third and fourth grades in both reading and math. The experimental group demonstrated higher performance levels in both areas. At the fifth grade level, the experimental group's performance scores were higher in reading and math, although the difference was only significant in reading.

In all grades, the experimental group, which received the treatment of a PBL curriculum using DL, outperformed the control group. The quantitative findings of this study demonstrate the ability of DL to promote student learning across the curriculum. This evidence supports the development of students' capacity to attain higher performance scores in mathematics and reading.

Students demonstrated a higher academic performance by engaging in meaningful and authentic tasks developed by DL and embedded in the classroom.



Qualitative Findings

Principals

In speaking specifically with the principals of schools that implemented DL, they reported that it helped their teachers to achieve a standing goal of deeper learning. Consistent with the current literature, several principals suggested that the material helped their teachers reach a wide range of student needs.

“The platform has a great balance of research. The collaboration piece was a point of success for our teachers and kids. Our high-ability kids, high-achievers were able to partner with kids who were at a variety of different levels. Doing so allowed everyone to experience a feeling of success.”

—Principal, Fort Wayne Public Schools



Principals in the test and control groups indicated it would be easier for teachers to identify projects if they were aligned to the scope and sequence of the curriculum.

Teachers

Teachers who had used DL in their classrooms were asked to report on their experiences, their students’ reactions, and any challenges that they had faced. The data showed that teachers’ comfort levels with PBL were varied, and so too were their perceptions of the methodology’s overall effectiveness in engaging students.

Teachers were pleased to see how motivated their students were, especially for topics that seemed to interest them the most. Teachers also emphasized that the materials for the PBL lesson were all included on the DL platform, which saved them a great deal of time.

But teacher responses varied on ease of use and clarity in directions. Some of the participants in the interviews suggested that they found directions for some projects vague and difficult to follow. Teachers reported that it was easier to reach all students in the PBL class. It was easier to differentiate, especially at the product level of each project. Also, they reported that pairing more advanced learners with struggling students made a difference in overall performance. They stressed the collaboration that they observed among students of varying abilities.

“The best thing about it for me was the number of different topics there were because I was able to tailor it to my students’ interest. I felt like there were a lot of options as far as topics.”

—Teacher, Fort Wayne Public Schools



Summary

Student growth scores were retrospectively analyzed in third, fourth, and fifth grade mathematics and reading. Specifically, students were grouped into two categories — those who experienced PBL throughout the school year and those who did not. In all cases, students in the PBL classes outperformed their peers in non-PBL classes. A statistical analysis of student growth scores indicated that those higher scores were significant in reading at all three grade levels and in mathematics at the third and fourth grade levels.

Findings from the current study are consistent with the existing research in that overall academic performance is enhanced in a project-based learning environment. In addition to the statistical findings, interviews with principals and teachers revealed both pros and cons of engaging in PBL. Again, qualitative findings were consistent with existing literature. Interviews revealed themes of increased student engagement and motivation. Interviews also suggested that learners of all ability levels benefited from the PBL environment. Participants also suggested an increase in soft skills like collaboration, cooperation, and creativity. One principal stated that the school had been striving to get at deeper learning and that PBL had helped teachers to facilitate activities that better supported that goal.

Teachers also reported difficulties in adapting to a PBL environment. Issues that emerged included the time-consuming nature of identifying appropriate projects to align with curricula, trouble monitoring student progress, confusion around how to assign and engage students in products, and an unfamiliarity with the DL platform that made some tasks cumbersome. These too are consistent with sentiments shared by teachers who first engage in PBL. Effective PBL requires a firm understanding of the methodology that can only be gained through professional development and hands-on experience in the classroom.

PBL has consistently demonstrated its ability as a teaching methodology to increase students' engagement, motivation, soft skills development, and academic performance. Yet it also requires a great deal of pre-planning, resource development, and a change in teacher-student interaction. The current study suggests that the DL platform clears that impediment by providing much of the up-front framework and resources for teachers.





About Defined Learning

Defined Learning is an online project-based learning solution that provides K–12 teachers with the tools they need to implement high-quality PBL — including a library of standards-aligned performance tasks, career videos, research resources, and more. Our engaging projects are based on real-world situations in STEM careers to give students the opportunity to apply their knowledge and skills to real-world challenges.

Defined Learning creates excitement about careers and empowers students to build the critical skills they need to succeed in college, careers, and life.

To learn more, visit www.definedlearning.com.

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