



BUCK INSTITUTE FOR EDUCATION

PBL EVIDENCE MATTERS
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Project Based Learning & Student Achievement:

What Does the Research Tell Us?

The **driving question** for this brief is based on the most common question that teachers, principals, school leaders, coaches, and grant writers ask us at the Buck Institute for Education (BIE) about Project Based Learning (PBL): **What evidence exists that shows the impact of Project Based Learning on student learning in core content areas?**

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BOTTOM LINE

The good news is that research shows that PBL *can* promote student learning and may be more effective than traditional instruction in social studies, science, mathematics, and literacy. The 20 studies reviewed in this brief show that PBL can promote student learning in social studies and science; and, to a more limited degree, in mathematics and literacy. The continued emergence of research findings to support PBL as a valid

A CALL TO ACTION

This first research brief is designed as a pilot to address the most common questions asked of BIE from our partners. Please complete this short survey to share your reaction to this brief, what PBL research you need, and how we can best support you as you implement PBL in your classrooms, schools, districts, and states. We encourage you to share this with other educators in your school, district, or community. Thank you in advance for partnering with us! Link to survey:

<https://tinyurl.com/PBL-Research>

instructional method for all students, including those who are furthest from opportunity, is promising. Yet, more research is needed to show causality between PBL and student outcomes. As research continues to build, practitioners who are interested in using PBL can point to the studies in this brief as evidence of the promise of PBL in improving student outcomes. The *Digging Deeper* section is designed to provide practitioners with a high-level overview of these studies.

SOURCES OF EVIDENCE

To answer the driving question, we analyzed four literature reviews and one study, spanning over 30 years from 1984 to 2017 that focus on improving student learning outcomes in key content areas. This brief includes 20 studies focused on social studies (9), science (8), mathematics (2), and English/Language Arts (1).

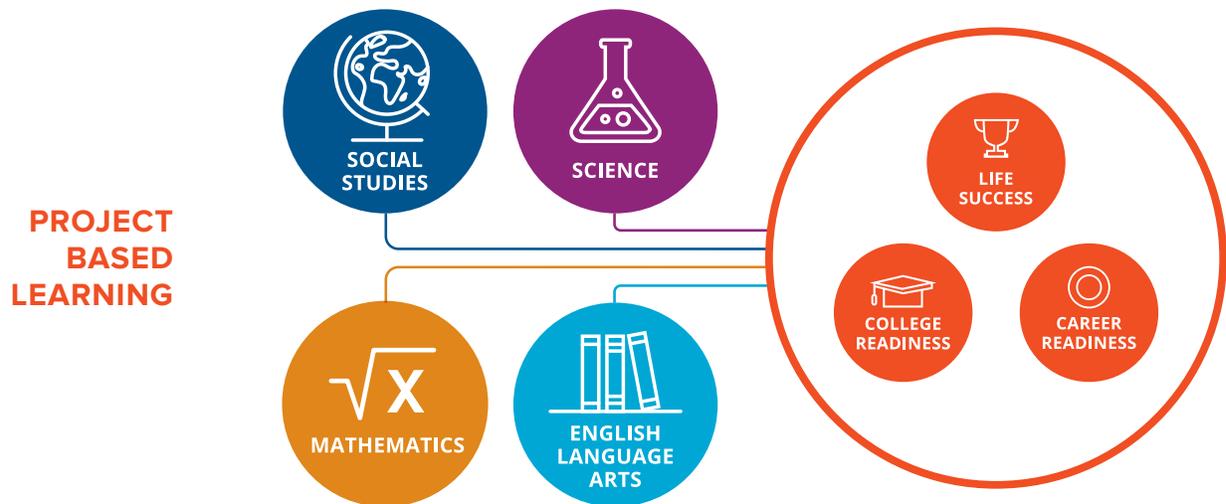
- **Condliffe, B., Quint, J., Visher, M.G., Bangser, M. R., Drohojowska, S., Saco, L., & Nelson, E. (2017).** This review commissioned by Lucas Education Research (LER) of the George Lucas Education Foundation (GLEF) primarily includes studies published from 2015 to 2017 focused on PBL implementation and its effects on student outcomes.
- **Condliffe, B., Visher, M. G., Bangser, M. R., Drohojowska, S., & Saco, L. (2016).** This review commissioned by Lucas Education Research (LER) of the George Lucas Education Foundation (GLEF) focuses primarily on studies published from 2000 to 2015.
- **Holm, M. (2011).** This review of PBL covers peer-reviewed studies on the effectiveness of PBL on PK-12 students from 2000 to 2011.
- **Thomas, J. W. (2000).** This review commissioned by the Autodesk Foundation covers research studies published between 1984 and 1999 conducted at the elementary and secondary levels that focus on project based learning, problem based learning, expeditionary learning, and problem based instruction. This review focuses on research on PBL practices that met five criteria: centrality, driving question, constructivist investigations, autonomy, and realism.

- **Duke, N. D., Halvorsen, A-L., Strachan, S. L., Kim, J., Konstantopoulos, S. (2017).**
A large-scale study examining the impact of Project PLACE: A Project Approach to Literacy and Civic Engagement on student achievement in social studies and informational reading in second grade.

IMPORTANT CONSIDERATIONS

Before digging deeper, there are several *Important Considerations* to think about:

- This brief highlights studies that show what PBL can do to improve student outcomes in core content areas.
- It is by no means exhaustive. This brief highlights those studies that were identified in previous literature reviews, which do not include studies that were either unpublished or unidentified by reviewers.
- It is by no means conclusive. As you will read in the detailed chart in the *Digging Deeper* section, PBL studies included in this brief have well-known limitations in PBL research, including those related to sampling, design, and measures.
- This brief is intended to bring into focus the studies that are related to PBL and improvement in student learning outcomes in core content areas. To use this research in practice, we encourage you to read the literature reviews or the studies in the reference section.
- Generally, research on PBL has weaknesses including, but not limited to: lack of experimental studies, varying fidelity of PBL, implementation challenges, and lack of validity and reliability of measures. Until more rigorous research is conducted, the effects of PBL are “promising, but not proven” (Condliffe, 2017, p. iii).



DIGGING DEEPER



SOCIAL STUDIES

GRADE LEVEL	PBL INTERVENTION	FINDINGS	STUDENTS	DEMOGRAPHICS	SETTING	LIMITATIONS	AUTHOR, YEAR
2	Four PBL units focused on economics, geography, history & civics and government, designed to address nearly all state social studies standards and all literacy standards. Projects were done over an extended period of time and focused on a real problem or opportunity in the world. Projects had embedded opportunities for student voice and choice about the project and how they would collaborate to accomplish it.	The PBL group showed statistically significantly higher growth in social studies. [See English/Language Arts section below.]	684	High-poverty, low-performing districts with at least 65% of the student population qualified for free or reduced-priced lunch with below state average student performance on state exams. FRLP = 80%; White = 40%; Black/African American = 33%; Multi-racial = 16%; Asian = 5%; Hispanic/Latino = 4%	Midwest USA	Lack of consistency in number of lessons across control and intervention groups Researcher-developed measures (not national standardized tests)	Duke et al., 2017
2	Economics and social studies projects targeting the Michigan Grade Level Content Expectations in economics, public discourse, decision-making, and citizen involvement and content area literacy	Students in the low socio-economic schools made statistically significant gains in social studies and content literacy. Their post-test results showed no statistically significant differences from the students in the high socio-economic schools in social studies and reading.	63	Low socio-economic schools: 80% of students eligible for free and reduced price lunch and with below average academic achievement in social studies, reading, and writing. High socio-economic schools: 2% or fewer students receiving free or reduced price lunch and school achievement above the state average on state exams in social studies, reading, and writing.	Michigan	Small sample size Lack of control groups Lack of information on instruction in classrooms in high socio-economic schools Researcher-created measures	Halvorsen et al., 2012
5	A highly student- and activity-centered social studies program, which puts an equal emphasis on knowledge and skills; takes into account students' personal experiences and differences; and allows for interactions with the surrounding environment	Students in the project-based class showed greater academic gains in social studies than their traditionally taught peers. Gains were also noted in higher order thinking and research skills. Students reported positive views of project-based learning, the content, and their efforts in completing the work.	40	Unidentified	Eskişehir, Turkey	No random assignment of students. Small sample size	Gültekin, 2005
8	An integrated technology-assisted PBL unit focused on 19th-century American history with four weeks of professional development and two weeks of computer-aided instruction	Students in the PBL class demonstrated greater knowledge gains than students in the control group based on pre- and post-tests and state examinations.	70	Intervention group: Hispanic = 18%; White = 63%; EL = 4.4% EL; FRLP = 15.5%	Northern California	No random assignment of students or teachers Limited ability to control for instruction in control group	Hernández-Ramos & De La Paz, 2009

SOCIAL STUDIES (CONT.)

GRADE LEVEL	PBL INTERVENTION	FINDINGS	STUDENTS	DEMOGRAPHICS	SETTING	LIMITATIONS	AUTHOR, YEAR
9-12	PBL social studies curriculum	Project Based Instruction (PBI) students out-performed peers who learned from a traditional curriculum in both social studies and College & Career Readiness (CCR). The PBI high school had the highest social studies pass rates for all students (99%), as well as for African American (97%), Hispanic (99%), White (>99%), and “socioeconomically disadvantaged” (98%) sub-groups in 2010.	Unidentified	70% of the district’s students were low income, based on free and reduced lunch eligibility	Southwest USA	No description of PBL curriculum in social studies Inequitable distribution of socioeconomically disadvantaged students between the two campuses Randomization issues Lack of definition of CCR standards	Summers & Dickinson, 2012
11, 12	PBL-designed Advanced Placement (AP) US Government & Politics Course, based on five course design principles: rigorous projects as the spine of the course, quasi-repetitive project cycles (looping), engagement first, teachers as co-designers, and an eye for scalability.	PBL students scored significantly higher on the Advanced Placement (AP) test than the traditionally taught AP students. More PBL students achieved a passing score on the AP test than traditional students. PBL students more deeply understood the AP content to the point that they were able to apply it in a novel situation to solve a complex problem.	314	Unidentified	Western USA	Non-randomized intervention design Researcher created tests Adaptions made as part of design-experiment methodology	Parker et al., 2011
11, 12	PBL-designed Advanced Placement (AP) US Government & Politics Course, based on five course design principles: rigorous projects as the spine of the course, quasi-repetitive project cycles (looping), engagement first, teachers as co-designers, and an eye for scalability.	Students in PBL-Advanced Placement (AP) classes scored significantly higher on the AP test than the traditionally taught AP students. Students in PBL-AP classes scored significantly higher on the AP test than students in the high achievement and moderate achieving comparison schools.	289	PBL Intervention group: School A: FRLP = 11.6%, White = 61.8%, High achievement; School B: FRLP = 49.8%; White = 57.4%, Moderate achievement Comparison group: Schools C&D: FRLP = 37.2%, White = 52.4%, Moderate achievement	Pacific Northwest	Non-randomized intervention design Differences in AP test completion rates Adaptions made as part of design-experiment methodology	Parker et al., 2013
12	Problem-based economics curriculum taught over the course of two semesters with five days of professional development and ongoing support	Compared to students in traditional classes, students engaged in PBL scored higher on standardized tests as well as assessments of problem-solving skills and application of content to real-world problems.	4,350	Control group: Hispanic = 40%; EL = 30.6% Intervention group: Hispanic = 37.3%; EL = 28.1%	Arizona California	Study focus on problem-based learning (not PBL). Teacher attrition	Finkelstein et al, 2011
12	Problem-based learning economics curriculum unit, the President’s Dilemma with one week-long professional development session under guidance of university economics professor and problem creator and ongoing conversations as teachers facilitated the unit and after to debrief.	PBL was more effective than traditional approaches for students with average verbal ability and below, students who were more interested in learning economics, and students who were most AND least confident in their abilities to solve problems.	346	Unidentified	California	Lack of in-depth information about differences in instruction in PBL classes and traditional classes	Mergendoller et al., 2006



GRADE LEVEL	PBL INTERVENTION	FINDINGS	STUDENTS	DEMOGRAPHICS	SETTING	LIMITATIONS	AUTHOR, YEAR
6	Project-Based Inquiry Science (PBIS) is a comprehensive, three-year middle school science curriculum that is sold and distributed by It's About Time® publishers (www.iat.com) developed through funding from the National Science Foundation with professional development: workshops at three points during the school year as well as a three-day summer institute	Students who participated in the project-based science curriculum outperformed students in the comparison curriculum on outcome measures that were aligned to core ideas and science practices in the K-12 Framework for Science Education. Students in PBIS classrooms scored higher on both post-unit tests than students in comparison classrooms.	2,400+	African American = 42%, White = 32%, Hispanic/Latino = 6%, FRLP = 54.7%; and students underrepresented in science, technology, & math (STEM)	Unidentified	Teachers using PBL were new to the curriculum and likely faced challenges commonly experienced when implementing new initiatives	Harris et al., 2014
6	Sixth grade LeTUS (Center for Learning Technologies in Urban Schools) project, How Do Machines Help Me Build Big Things? LeTUS includes PBL curriculum materials that build from district, state, and national standards to support the development of integrated science understandings for middle school students, designed by University of Michigan researchers and Detroit Public Schools. Together with Detroit, LeTUS has developed five middle-school project-based science units: a sixth grade project on mechanical advantage; seventh grade projects on air quality, water quality, and communicable diseases; and an eighth grade project on force and motion. The project was taught four repeated times.	Overall learning outcomes improved across the science learning goals and inquiry process of Big Things, even with increased participation in the project by including greater numbers of teachers and students. Students showed improvement in their understanding not only at a recall, descriptive level but also showed an increased ability to apply information to new situations and draw relationships between concepts.	2,500	Schools in low-SES neighborhoods, representative of the district with: African American = 91%, FRLP = 70%, and 85% of the statewide standardized eighth grade science assessment reports are below grade level	Detroit, Michigan	Not randomized Measures are curriculum-based; no use of standardized test scores	Rivet & Krajcik, 2004
6, 7	Investigating and Questioning our World through Science and Technology (IQWST) is a middle school science curriculum in physics & chemistry built on five key aspects of coherence: learning goal coherence; intra-unit coherence between content learning goals, scientific practices, and curricular activities; inter-unit coherence supporting multidisciplinary connections and dependencies; coherence between professional development and curriculum materials to support classroom enactment; and coherence between science literacy expectations and general literacy skills.	Physics: Overall, the results show significant improvement in all the learning goals (e.g., Light can be reflected, transmitted, or absorbed when it reaches matter. The absorption of light can make things happen.) and in students' understanding and ability to use models. Chemistry: The results provide evidence of students improving their understanding of the learning goals (e.g., Students use the particle model to explain states of matter and phase changes.).	308	Unidentified	Michigan	No comparison group	Shwartz et al., 2008
6, 7, 8	PBL middle school LetUS science curriculum materials collaboratively developed by the University of Michigan and Detroit Public Schools with professional development: summer institutes, monthly work sessions, teacher discussion groups, and with some classroom support.	Students made statistically significant gains on measures of scientific content knowledge and process skills.	8,000	Detroit Public Schools: African American = 91%, Latino = 4%, White = 1%	Detroit, Michigan	Attrition Principal turnover Teacher turnover Technology challenges Non-random selection of schools, teachers, and students for the intervention	Marx et al., 2004

SCIENCE (CONT.)

GRADE LEVEL	PBL INTERVENTION	FINDINGS	STUDENTS	DEMOGRAPHICS	SETTING	LIMITATIONS	AUTHOR, YEAR
7-8	LeTUS curricular units developed by the Center for Learning Technologies in Urban Schools (LeTUS) at the University of Michigan with week-long summer institutes, monthly Saturday workshops, teacher discussion groups, online resources, and limited classroom support by graduate students and peer teachers.	Students who participated in the LeTUS units significantly out-performed non-participants on the state standardized tests. Higher scores were achieved in all three science content areas (earth, physical, and life science) and both science process skill groups (constructing and reflecting).	19,365	Detroit Public Schools: Total students = 160,000, African American = 91%, Latino = 5%, diverse ethnic mix = 4%, FRLP = 69%	Detroit, Michigan	Non-random selection of schools, teachers, and students	Geier et al., 2008
Middle School	Investigating and Questioning Our World Through Science and Technology (IQWST) curriculum units with one week of professional development in the summer and monthly Saturday workshops to support implementation.	On average, students showed gains from the pre- to post-test scores. The study shows considerable learning with significant variation across teachers.	1,234	A: Urban Public School in Midwest: Majority of students were African American from lower or lower-middle class families; B: Independent Schools in Midwest: Majority of students were Caucasian from middle to upper-middle income families; C: Urban Public Schools in Midwest: 49.8% African American, 38% Hispanic, 8.8% Caucasian, and 3.2% Asian; D: Urban Public Schools in Midwest: 44% African American, 10% Hispanic, 42% Caucasian, and 4%; E: Rural Public Schools in South: Diverse schools with a majority of African American	Midwest & Southern USA	Lack of data completion Student absenteeism Lack of alignment between self-efficacy definition and measure (i.e., comfort level with curriculum) Use of survey data to measure teacher enactment of PBL	Fogleman et al., 2011
10-11	The Foundations of Science (FOS) curriculum framework was based upon Project Based Science (PBS) pedagogy, which is built around five features: investigation of a real life question or problem; student development of a series of artifacts, or products, that address the question or problem; student engagement in investigations; collaborative inquiry; and use of cognitive tools. Teachers were provided multiple opportunities to participate in a variety of LeTUS professional development settings during each year of enactment, including a summer institute, Saturday workshops, after-school study groups, and one-on-one classroom instructional support.	Project Based Science (PBS) students outscored the national sample on 44% of National Assessment of Education Progress (NAEP) test items. Even when compared to groups that traditionally score higher on achievement tests (middle class and white students), on average the PBS students, including minorities, outscored the national sample on almost half of the items. PBS students also scored significantly higher on a larger percentage of the earth science items, then physical science followed by life science in all comparisons.	142	Students in a small alternative high school who represented a range of racial, academic, and socioeconomic characteristics that correspond to district demographics, although the majority of students were white and middle-to upper middle-class.	Michigan	No comparison group	Schneider et al., 2002

SCIENCE (CONT.)

GRADE LEVEL	PBL INTERVENTION	FINDINGS	STUDENTS	DEMOGRAPHICS	SETTING	LIMITATIONS	AUTHOR, YEAR
11, 12	“The Machine Control” high school curriculum, developed in 1989 and implemented in 1990 as part of the technological education reform in Israel, consisting of six different projects. The curriculum focuses on the development of systemic thinking, the acquisition of design knowledge and skills, the acquisition of scientific and mathematical background for the design of control systems, and the ability to implement control processes in typical technological systems.	Significant increase in formal knowledge as measured by standardized matriculation exams and an expansion in the scope of technological knowledge acquired and implemented. PBL students considerably expanded their technological knowledge base and improved their technological skills.	120	Unidentified	Israel	Not matched comparison group Six different projects used	Miduser & Betzer, 2007



MATHEMATICS

GRADE LEVEL	PBL INTERVENTION	FINDINGS	STUDENTS	DEMOGRAPHICS	SETTING	LIMITATIONS	AUTHOR, YEAR
8, 9	Projects used were student-defined and authentic in that students selected their own variables, crafted their own research questions, and collected and analyzed their own data sets. Students usually conducted these projects in groups of three. Students were given four weeks to prepare projects. At the end of this period, each group presented their projects in class. Each group made a presentation about 15-20 minutes.	Students in PBL statistics class showed significant gains in knowledge of statistical literacy as compared to students in the control group (no PBL)	70	Unidentified	Turkey	No random assignment of students, teachers and schools Minimal description of PBL intervention Small sample size	Koparan, T. and Guven, B., 2015
9, 10, 11	Instead of relying on textbooks, teachers had students work on open-ended questions. Teachers introduced students to a project or theme, which students explored, using their own ideas and mathematical knowledge. Projects were usually extremely open, amounting to a little more than a challenging statement. Students were given unusual degree of choice in math lessons.	Students in PBL performed as well as or better than traditional school students on items of rote knowledge. Three times as many students in PBL score the highest possible score on the national exam (General Certificate of Secondary Education (GCSE)) More PBL students passed the national exam than students in traditional classes. PBL students did not have greater knowledge of math facts, procedure, and rules, BUT were better able to make more use of math in different situations	300	Traditional school: Working class = 68%, Ethnic minority =17%; PBL school: Working class = 79% working class, ethnic minority = 11%	United Kingdom	No random assignment of students, teachers and schools PBL intervention varied across classrooms and students	Boaler, 1997



ENGLISH LANGUAGE ARTS

GRADE LEVEL	PBL INTERVENTION	FINDINGS	STUDENTS	DEMOGRAPHICS	SETTING	LIMITATIONS	AUTHOR, YEAR
2	Four PBL units focused on economics, geography, history & civics and government, designed to address nearly all state social studies standards and all literacy standards. Projects were done over an extended period of time and focused on a real problem or opportunity in the world.	The PBL group showed statistically significant higher growth in informational reading, but not in writing. [See Duke et al., 2017 in Social Studies section above.]	684	High -poverty, low performing districts with at least 65% of the student population qualified for free or reduced-priced lunch (2) below state average student performance on state exams. FRLP = 65% to 100% (mean 80.350%); White = 40.337%; Black/ African American = 32.975%; Multi-racial = 15.491%; Asian = 5.368%; Hispanic/Latino = 4.448%	Midwest USA	Lack of consistency in number of lessons across control and intervention groups Researcher-developed measures	Duke et al., 2017

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