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**Project-Based Learning Research: Annotated Bibliography**

**Barron, B. (2003).** [When smart groups fail (PDF)](http://www.academia.edu/2010823/When_smart_groups_fail). *The Journal of the Learning Sciences, 12*(3), 307–359. This study analyzed conversations of twelve sixth-grade groups of three in order to investigate how their collaborative interactions influenced problem-solving outcomes. The uptake of correct ideas by the group was correlated with partners' responsiveness to proposals. Less successful groups ignored or rejected correct proposals, whereas more successful groups discussed or accepted them. Conversations in less successful groups were less coherent; their proposals for solutions were disconnected from preceding discussion. These differences in groups' interactions extended to students' subsequent success on independent problem-solving tasks. The article proposes future directions that may help teachers, students, and designers of educational environments to see and foster productive collaborative interactions.

**Barron, B., & Darling-Hammond, L. (2008).** [*Teaching for meaningful learning: A review of research on inquiry-based and cooperative learning (PDF)*](http://www.edutopia.org/pdfs/edutopia-teaching-for-meaningful-learning.pdf). [Powerful Learning: What We Know About Teaching for Understanding](http://www.wiley.com/WileyCDA/WileyTitle/productCd-0470276673.html). San Francisco, CA: Jossey-Bass. A comprehensive review of research on inquiry-based-learning outcomes and best practices in project-based learning, problem-based learning, and design-based instruction. Barron and Darling-Hammond describe evidence-based approaches to support inquiry-based teaching in the classroom: (1) clear goals and guiding activities; (2) a variety of resources (e.g., museums, libraries, Internet, videos, lectures) and time for students to share, reflect, and apply resources, while debating over information discrepancies; (3) participation structures and classroom norms that increase the use of evidence and a culture of collaboration (i.e., framing debates as productive conflicts, using public performances); (4) formative assessments that provide opportunities for revision; and (5) summative assessments that are multidimensional and representative of professional practice. Ultimately, these practices will support students in evaluating their own work against standards (i.e., through revising and modifying work, redirecting energies, and taking initiative to promote their own progress).

**Black, P., & William, D. (1998).** [Assessment and classroom learning (Abstract)](http://www.tandfonline.com/doi/abs/10.1080/0969595980050102#.U6Mkmo1dWw4). *Assessment in Education: Principles, Policy & Practice, 5*(1). A review of the literature on classroom formative assessment indicates that frequent feedback yields substantial gains in student learning.

**Boss, S., Johanson, C., Arnold, S. D., Parker, W. C., Nguyen, D., Mosborg, S., Nolen, S., Valencia, S., Vye, N., & Bransford, J. (2011).** [The quest for deeper learning and engagement in advanced high school courses](http://scholarworks.gvsu.edu/cgi/viewcontent.cgi?article=1053&context=tfr). *The Foundation Review, 3*(3), 12-23. Starting in 2008, GLEF and a research team from the University of Washington have been working with Washington's Bellevue School District to develop and assess the impact of project-based learning approaches on upper-level AP courses in high school. This paper describes the approach and methods used by researchers to implement and study the impact of PBL in AP U.S. Government and Politics. In most cases, students in the PBL AP courses perform as well or better than students in traditional AP courses on the AP test.

**Chang, C. (2001).** [Comparing the impacts of problem-based computer-assisted instruction and the direct-interactive teaching method on student science achievement (Abstract)](http://eric.ed.gov/?id=EJ627155). *Journal of Science Education and Technology, 10*(2):147-53. Tenth-grade earth science students who received PBL earned higher scores on an achievement test than students who received traditional instruction.

**Cognition and Technology Group at Vanderbilt (1992).** [The Jasper series as an example of anchored instruction: Theory, program description and assessment data (PDF).](http://www.tandfonline.com/doi/abs/10.1207/s15326985ep2703_3) *Educational Psychologist, 27*(3): 291-315. A study of 700 students from 11 school districts in Tennessee found that students doing projects using videotaped problems over a three-week period performed better in a number of academic areas later in the school year. Students who had experience in the project work performed better in basic math, word problems, planning capabilities, and attitudes toward math.

**Condliffe, B., Visher, M. G., Bangser, M. R., Drohojowska, S., & Saco, L. (2015).** [*Project-Based Learning: A Literature Review*](https://s3-us-west-1.amazonaws.com/ler/MDRC%2BPBL%2BLiterature%2BReview.pdf). MDRC. This literature review examines project-based learning research from 2000-2015. While many studies identify a positive relationship between PBL and student learning outcomes, an insufficient number use research methodologies that allow for causal inferences. The study authors. however, find that the design principles most commonly used in PBL align well with the goals of preparing students for deeper learning, higher-level thinking skills, and intra/interpersonal skills.

**Darling-Hammond, L. (1996).** [*What matters most: Teaching for America's future (PDF)*](http://nctaf.org/wp-content/uploads/WhatMattersMost.pdf)*.* New York, NY: National Commission on Teaching and America's Future. According to Darling-Hammond, teacher expertise has a direct correlation to high student achievement. "Students who have highly effective teachers three years in a row score as much as 50 percentile points higher on achievement tests than those who have ineffective teachers for three years in a row." The report offers a strategy for recruiting, preparing, and supporting excellent teachers in America's schools.

**Drake, K. N. & Long, D. (2009).** [Rebecca's in the dark: A comparative study of problem-based learning and direct instruction/experiential learning in two fourth-grade classrooms (Abstract)](http://eric.ed.gov/?id=EJ849707). *Journal of Elementary Science Education, 21*(1), p 1-16. Researchers at Elon University compared fourth graders receiving PBL in science with a corresponding group receiving the same teacher instruction in thematic form. The PBL curriculum involved figuring out a way to create electricity during a blackout, since blackouts had commonly affected the school's region. PBL students had fewer stereotypical images of scientists on a "draw-a-scientist" test and were able to generate more problem-solving strategies than students in the thematic group. Content knowledge learned was equivalent in both groups.

**Dweck, C. (2000).** [*Self-Theories: Their role in motivation, personality and development. Essays in social psychology*](http://www.psypress.com/books/details/9781841690247/)*.* Psychology Press/Taylor & Francis Group. Dweck describes her research studies on motivation and achievement, which indicate that how a person views intelligence affects their responses to setbacks and ultimately their likelihood for success. "Entity Theory" learners view intelligence as fixed, (i.e., people are born smart or not) and tend to avoid challenging situations that make them feel less intelligent. "Incremental learners" view intelligence as malleable, developed through effort, and tend to seek out challenging experiences that develop their skills and knowledge. "Incremental learners" showed significantly higher achievement levels than "entity theory" learners over the years they were studied by Dweck. Teachers can change students' mind-sets by valuing good learning over high achievement and by praising effort, resilience, and strategies that lead to success. Teachers should avoid praising "intelligence," "cleverness," or "talent," which defines intelligence in terms of attributes that are beyond the control of the learner. Teachers can celebrate and reward good learning by recognizing the "best mistake of the day," "best question of the day," and good group work. When children are focused on learning, as opposed to measuring themselves, failure is more likely to provoke continued effort, as opposed to a helpless response.

**Ertmer, P. A., & Simons, K. D. (2005).** [Scaffolding teachers' efforts to implement problem-based learning (PDF)](http://www.edci.purdue.edu/ertmer/docs/Ertmer-LC05.pdf). *International Journal of Learning, 12*(4), 319-328. Instructors frequently experience frustration due to the time and workload involved in PBL, difficulty transitioning students into more active roles, and assessing student learning. The authors describe specific ways to structure and simplify the PBL process, with tips on identifying the driving question, structuring students' research efforts, motivating students, creating a collaborative classroom atmosphere, and assessing students' learning with rubrics and class reflections.

**Finkelstein, N., Hanson, T., Huang, C. W., Hirschman, B., & Huang, M. (2010).** [Effects of problem-based economics on high school economics instruction](http://ies.ed.gov/ncee/edlabs/regions/west/pdf/REL_20104012.pdf) (PDF) (NCEE 2010-4110). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory West. This randomized-controlled experiment examined the effects of project-based economics curriculum developed by the [Buck Institute for Education](http://www.bie.org) on student learning and problem solving skills in a sample of 7,000 twelfth graders, taught by 76 teachers in 66 high schools. Teachers received either a 40-hour, five-day, professional-development course in the PBL economics curriculum, or participated in their regular annual professional-development activities. Results indicated that both students and teachers benefited from the PBL curriculum. PBL students outscored students who received traditional instruction on the standardized Test of Economic Literacy, and a test of applying economic concepts to solve real-world economic challenges. PBL teachers reported higher satisfaction with materials and methods.

**Gallagher, S. A., & Stepien, W. J. (1996).** [Content acquisition in problem-based learning: Depth versus breadth in American studies (Abstract)](http://eric.ed.gov/?id=EJ527609). *Journal for the Education of the Gifted, 19*(3), 257-275. Secondary students using PBL in American studies did as well on multiple-choice tests as students who received a traditional model of instruction and showed a deeper understanding of content.

**Geier, R., Blumenfeld, P. C., Marx, R. W., Krajcik, J. S., Fishman, B., Soloway, E., & Clay-Chambers, J. (2008).** [Standardized test outcomes for students engaged in inquiry-based science curricula in the context of urban reform](http://bie.org/object/document/inquiry_based_science_in_an_urban_setting). *Journal of Research in Science Teaching, 45*(8), 922-939. Researchers from the University of Michigan, the University of Arizona, and Detroit Public Schools studied 5,000 students in grades seven and eight in 18 historically underserved middle schools who learned science with traditional instruction or the LeTUS inquiry-based science curriculum. Developed by the Center for Learning Technologies in Urban Schools, LeTUS consists of eight- to ten-week units such as What Is the Quality of Air in My Community? What Is the Water Like in My River? and Why Do I Need to Wear a Helmet When I Ride My Bike? and is aligned with professional-development activities (e.g., week-long summer institutes, monthly Saturday workshops, teacher discussion groups, online resources, and classroom support by graduate students and peer teachers). The inquiry-based science students scored higher on the high-stakes state assessment, and these gains lasted up to one and half years. The authors concluded that when the curriculum is highly specified, developed, and aligned with professional development and administrative support, the use of standards-based, inquiry-science curriculum can lead to standardized achievement test gains in historically underserved urban students.

**Gordon, P.R., Rogers, A.M., Comfort, M., Gavula, N., & McGee, B.P. (2001).** [A taste of problem-based learning increase achievement of urban minority middle-school students (Abstract)](http://eric.ed.gov/?id=EJ630429). *Educational Horizons, 79*(4), 171-175.

**Hattie, J. (2008).** [*Visible Learning: A synthesis of over 800 meta-analyses relating to achievement*](http://www.routledge.com/books/details/9780415476171/)*.* New York, NY: Routledge. Hattie points out that in education most things work, more or less. The questions are around those things that work best and therefore best repay the effort invested. Hattie analyzed a total of about 800 meta-analyses, encompassing 52,637 studies, 146,142 effect sizes, and millions of students (p. 15). According to Hattie, the simplest prescription for improving teaching is to provide "dollops of feedback." Providing students with feedback had the largest effect size on learning of any intervention studied.

**Halvorsen, A., Duke, N. K., Brugar, K. A., Block, M. K., Strachan, S. L., Berka, M. B., & Brown, J. M. (revised 2014).** [Narrowing the achievement gap in second-grade social studies and content area literacy: The promise of a project-based approach (PDF)](http://education.msu.edu/epc/library/papers/WP26.asp). *Theory and Research in Social Education*, 40, 198-229. Two project-based units in content literacy plus three of the five strands of the Michigan second-grade social studies curriculum (economics; civics and government; and public discourse, decision making, and citizen involvement) were taught to second-grade children in low-SES school settings in Michigan. The outcomes on standards-based social studies and content literacy assessments rendered statistically insignificant the achievement gap between second graders in very low-SES and very high-SES school districts.

**Hernandez-Ramos, P., & De La Paz, S. (2009).** [Learning history in middle school by designing multimedia in a project-based learning experience (Abstract)](http://eric.ed.gov/?id=EJ868627). *Journal of Research on Technology in Education, 42*(2), 151-173. Researchers from Santa Clara University and the University of Maryland compared learning outcomes for eighth graders who completed a six-week unit on early 19th-century U.S. history using traditional instructional methods versus project-based learning. In the PBL curriculum, groups of students created mini- documentaries, constructing an interpretation of a historical time period from the 1800s, with state standards as the basic required content guides, and public presentation. Results showed significant gains in content knowledge and historical-thinking skills for students engaged in the PBL curriculum as compared to students who received traditional instruction.

**Hung, W. (2008).** [The 9-step problem design process for problem-based learning: Application of the 3C3R model](http://www.sciencedirect.com/science/article/pii/S1747938X08000444). *Educational Research Review, 4*(2) 118-141. The design of problems is crucial for the effectiveness of PBL. Ineffective PBL problems could affect whether students acquire sufficient content knowledge, activate appropriate prior knowledge, and properly direct their own learning. To help practitioners, this paper introduces a nine-step problem-design process.

**Johnson, D.W., & Johnson, R. T., 2009.** [An educational psychology success story: Social interdependence theory and cooperative learning (Abstract)](http://edr.sagepub.com/content/38/5/365.abstract). *Educational Researcher, 38*(5), 365- 379. This article provides a qualitative review of findings from more than 1,200 research studies conducted in the past 11 decades on cooperative, competitive, and individualistic efforts. The authors describe the findings and implications of this vast body of research for educators. For small groups working together over a class period to several weeks, the authors recommend (1) structuring group work, (2) explaining the task and positive interdependence, (3) monitoring students' learning and intervening to provide assistance and increase interpersonal group skills, and (4) evaluating students' learning and helping students process how well their group is doing.

**Johnson, D. W., Johnson, R. T., & Stanne, M. E. (2000).** [*Cooperative learning methods: A meta-analysis (PDF)*](https://www.researchgate.net/publication/220040324_Cooperative_Learning_Methods_A_Meta-Analysis)*.* Minneapolis, MN: University of Minnesota Press.

**Kolodner, J. L., Camp, P. J., Crismond, D., Fasse, B., Gray, J., Holbrook, J., Puntambekar, S., & Ryan, M. (2003).** [Problem-based learning meets case-based reasoning in the middle-school science classroom: Putting Learning by Design into practice (PDF)](https://stemedhub.org/resources/800/download/Kolodner_etal_2003_PBL_Meets_Cased-Based_Reasoning.pdf). *Journal of the Learning Sciences,12*(4), 495- 547. Researchers at Georgia Institute of Technology studied 240 middle school students who learned science in groups of four via Learning by Design (LBD) or traditional methods with matched teachers. LBD students learned science content as well as or better than comparison students, and these gains were often largest among the most socioeconomically disadvantaged students. LBD students also performed significantly better than non-LBD students at collaboration skills, metacognitive skills (i.e., checking work), and science skills (i.e., designing fair tests, justifying with evidence, and explaining). [Visit this Web page for further information on LBD](http://www.cc.gatech.edu/projects/lbd/home.html).

**Krajcik, J. S., Blumenfeld, P. C., Marx, R.W., & Soloway, E. (1994).** [A collaborative model for helping middle grade science teachers learn project-based instruction (Abstract)](http://eric.ed.gov/?id=EJ484004). *The Elementary School Journal 94*(5): 483-497. The authors describe the essential elements for project-based learning, and how middle school teachers learned to teach with project-based learning through collaboration, classroom enactment, and reflection.

**Lee, O., Buxton, C., Lewis, S., & LeRoy, K. (2006).** [Science inquiry and student diversity: Enhanced abilities and continuing difficulties after an instructional intervention (Abstract)](http://onlinelibrary.wiley.com/doi/10.1002/tea.20141/abstract). *Journal of Research in Science Teaching 43*(7): 607-636. Inquiry-science intervention; measured impact of an urban instructional intervention in grades 3-5 using matched pre- and post-tests found substantial learning gains and a cumulative effect as students participate over several years.

**Liu, M., Hsieh, P., Cho, Y. J., & Schallert, D. L. (2006).** [Middle school students' self-efficacy, attitudes, and achievement in a problem-based learning environment (PDF)](http://alienrescue.edb.utexas.edu/researchpapers/LiuHsiehChoSchallert_2006.pdf). *Journal of Interactive Learning Research. 17*(3). 225-242.

**Lou, Y., Abrami, P.C., Spence, J. C., Poulsen, C., Chambers, B., & d’Apollonia, S. (1996).** [Within-class grouping: A meta-analysis (Abstract)](http://rer.sagepub.com/content/66/4/423.abstract). *Review of Educational Research, 66*(4), 423-458. Lou et al. summarized studies comparing grouping versus no grouping, and homogeneous versus heterogeneous grouping, at the primary, secondary, and post-secondary levels. Overall, results showed a slight advantage of grouping as compared to non-grouping in promoting student learning, with large variability in the effect sizes. The gains from within-class grouping were greater in math and science than in reading, language arts, and other subject areas. Low-, medium-, and high-ability students all seemed to benefit from being taught in small groups. Low-ability students performed better in heterogeneous as opposed to homogeneous groups (mean effect size=0.60), medium-ability students performed better in homogeneous groups (mean effect size=0.51), and high-ability students performed equally well in either type of group (mean effect size=0.09).

**Lynch, S., Kuipers, J., Pyke, C., & Szesze, M. (2005).** [Examining the effects of a highly rated science curriculum unit on diverse students: Results from a planning grant (PDF)](http://home.gwu.edu/~kuipers/JARST04.pdf). *Journal of Research in Science Teaching, 42*(8): 912-946. Standards-based, inquiry-based science curriculum in ten urban middle schools had a positive effect on achievement.

**Maxwell, N., Mergendoller, J. R., & Bellisimo, Y. (2005).** [Problem-based learning and high school macroeconomics: A comparative study of instructional methods](http://econpapers.repec.org/article/jeejournl/v_3a36_3ay_3a2005_3ai_3a4_3ap_3a315-331.htm). *The Journal of Economic Education, 36*(4), 315-331. Researchers at California State University, East Bay; the [Buck Institute for Education](http://www.bie.org); and the College of Marin analyzed data from 252 economics students at 11 high schools, while controlling for individual characteristics, such as verbal ability. PBL modestly increased learning of macroeconomics at the high school level as compared with traditional classes. Findings suggest that problem-based instruction can improve student learning if instructors are well trained in both the PBL technique and economics.

**Mergendoller, J. R., Maxwell, N. L., & Bellisimo, Y. (2006).** [The effectiveness of problem-based instruction: A comparative study of instructional methods and student characteristics](http://docs.lib.purdue.edu/ijpbl/vol1/iss2/5). *Interdisciplinary Journal of Problem-based Learning, 1*(2). Five veteran teachers at four high schools taught macroeconomics using PBL with one or more classes and traditional lecture format in another class. Results from 246 students in 11 classes who completed a pre- and post-test showed that PBL was more effective than traditional instruction in teaching macroeconomics concepts

**Mergendoller, J. R., & Thomas, J. W. (2005).** [Managing project-based learning: Principles from the field (PDF)](http://bie.org/images/uploads/general/f6d0b4a5d9e37c0e0317acb7942d27b0.pdf). Based on the [Buck Institute for Education](http://www.bie.org)'s extensive fieldwork in schools seeking to implement PBL methods, the authors report seven themes and 18 sub-themes systematically derived from 12 teacher interviews. Useful tips from veteran PBL teachers are organized around themes such as Getting Started, Creating a Culture of Self-Management, Managing Student Groups, Technology, and Assessment/Evaluation. Teachers emphasized time management (setting the number of days and then building in a 20 percent overrun), flexibility (being prepared to give alternative instruction to reinforce subject matter versus knowing when to maintain a deadline), and priming (starting project dialogue and setting expectations early).

**National Clearinghouse for Comprehensive School Reform. (2004).** [*Putting the pieces together: Lessons from comprehensive school reform research* (PDF)](http://www.uky.edu/~gmswan3/609/Cairncross_Mannion_2001.pdf). Washington, DC. The strongest models that are not direct instruction included Success For All; Highly Promising Evidence of Effectiveness. Models in this category are those that had positive and statistically significant results from comparison or third-party comparison studies but did not have research bases that were as broad and generalizable as those of the models that met the highest standard.

**Newmann, F. M., & Wehlage, G. G. (1995).** [*Successful school restructuring: A report to the public and educators*](http://www.wcer.wisc.edu/archive/cors/Successful_School_Restruct.html)*.* A five-year study by the University of Wisconsin's Center on Organization and Restructuring of Schools found that structural school reform only works when (1) students are engaged in activities that build on prior knowledge and allow them to apply that knowledge to new situations, (2) students use disciplined inquiry, and (3) school activities have value beyond school. Even innovative school improvements, such as portfolio assessment and shared decision making, are less effective without accompanying meaningful student assignments based on deep inquiry. Researchers analyzed data from more than 1,500 elementary schools, middle schools, and high schools and conducted field studies in 44 schools in 16 states between 1990 and 1995.

**Oakley, B., Felder, R. M., Brent, R., & Eljajj, I. (2004).** [Turning student groups into effective teams (PDF)](http://www4.ncsu.edu/unity/lockers/users/f/felder/public/Papers/Oakley-paper%28JSCL%29.pdf). *Journal of Student Centered Learning, 2*(1), 9-31. A concise guide with worksheets to help teachers effectively structure group work. Section VI presents a summary of the major themes.

**Parker, W. C., Lo, J., Yeo, A. J., Valencia, S. W., Nguyen, D., Abbott, R. D., Nolen, S. B., Bransford, J. D., & Vye, N. J. (2013).** [Beyond breadth-speed-test: Toward deeper knowing and engagement in an advanced placement course](http://dx.doi.org/10.3102/0002831213504237). *American Educational Research Journal, 50*(6), 1424-1459. This study is the second-year follow-up to Parker et al.’s 2011 analysis of the *Knowledge in Action* project. While student performance on AP test scores remained high in the project-based learning group compared to the traditional AP group, performance on the Complex Scenario Test was less consistent.

**Parker, W., Mosberg, S., Bransford, J., Vye, N., Wilderson, J., & Abbott, R. (2011).** [Rethinking advanced high school coursework: Tackling the depth/breadth tension in the AP U.S. Government and Politics course](http://www.tandfonline.com/doi/abs/10.1080/00220272.2011.584561). *Journal of Curriculum Studies, 43*(4), 533-559. Researchers from the University of Washington, the Bellevue Schools Foundation, and The George Lucas Educational Foundation conducted a multiyear study to test a rigorous project-based learning approach to teaching Advanced Placement (AP) U.S. Government and Politics. Three hundred fourteen students from Washington's Bellevue School District were randomly assigned to a traditional course or project-based learning course on AP U.S. Government and Politics (AP+). The PBL course included five project cycles: (1) role- playing a United Nations task force advising a new nation on the various forms and features of democracy, (2) proposing a public policy and actions to improve society, (3) role-playing legislators in the U.S. Congress, (4) role-playing party campaign strategists in an election, and (5) role-playing a Supreme Court case. The PBL students performed as well as or better than traditionally taught students on the AP test and better on a complex scenario test, which measures strategies for realistically monitoring and influencing public policy. [More information on the project is available on Edutopia](http://www.edutopia.org/knowledge-in-action-PBL-research).

**Schneider, R., Krajcik, J., Marx, R.W., & Soloway, E. (2002).** [Student learning in project-based science classrooms (Abstract).](http://onlinelibrary.wiley.com/doi/10.1002/tea.10029/abstract) *Journal of Research in Science Teaching. 39*(5), 410-422.

**Slavin, R. (1991).** [Synthesis of research of cooperative learning (PDF)](http://www.ascd.org/ascd/pdf/journals/ed_lead/el_199102_slavin.pdf). *Educational Leadership 48*(5), 71-82. For enhancing student achievement, the most successful cooperative learning approaches have incorporated two key elements: group goals and individual accountability. Consistently, cooperative-learning effects have been found on outcomes such as self-esteem, intergroup relations, acceptance of academically handicapped students, attitudes toward school, and ability to work cooperatively.

**Slavin, R. (1996).** [Research on cooperative learning: What we know, and what we need to know (Abstract)](http://eric.ed.gov/?id=EJ526831). *Contemporary Educational Psychology 21,* 43-69. In this article, Slavin presents two essential components that are necessary for effective group work.

**Springer, L., Stanne, M. E., & Donovan, S. (1999).** [Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis (Abstract)](http://rer.sagepub.com/content/69/1/21.short). Madison, WI: National Institute for Science Education.

**Strobel, J., & van Barneveld, A. (2009).** [When is PBL more effective? A meta-synthesis of meta-analyses comparing PBL to conventional classrooms (Abstract)](http://docs.lib.purdue.edu/ijpbl/vol3/iss1/4). *The Interdisciplinary Journal of Problem-Based Learning, 3*(1). Researchers from Purdue University and Concordia University synthesized eight meta- analyses of PBL studies spanning 40 years in order to evaluate the effectiveness of problem- based learning and the conditions under which PBL is most effective. The meta-analyses included medical students and adult learners in postsecondary settings. PBL was more effective than traditional instruction for long-term retention, skill development, and satisfaction of students and teachers. Traditional approaches, on the other hand, were more effective for improving performance on standardized exams, considered by the researchers as a measure of short-term retention.

**Terenzini, P. T., Cabrera, A. F., Colbeck, C. L., Parente, J. M., & Bjorkland, S. A. (2001).** [Collaborative learning vs. lecture/discussion: Students' reported learning gains (PDF)](http://barnard.edu/sites/default/files/inline/collaborative_learning_vs_lecture-discussion_student_reported_learning_gains.pdf). *Journal of Engineering Education, 90*(1), 123-130.

**Thomas, J. W. (2000).** [A review of research on project-based learning (PDF)](http://www.bobpearlman.org/BestPractices/PBL_Research.pdf). This review defines PBL as involving projects that are complex tasks, which typically results in a realistic product, event, or presentation, which is central to the curriculum, and which is organized around a driving question that leads to central principles or concepts of a discipline. PBL is student driven and constructive, involving inquiry, investigation, knowledge building, and resolution. PBL students are responsible for making choices and designing and managing their work, and they experience gains in factual learning that are equivalent or superior to those experienced by students engaged in traditional learning.

**Walker, A. & Leary, H. (2009).** [A problem-based learning meta analysis: Differences across problem types, implementation types, disciplines, and assessment levels](http://docs.lib.purdue.edu/ijpbl/vol3/iss1/3/) (Abstract). *Interdisciplinary Journal of Problem-based Learning, 3*(1): 12-43. In a meta-analysis of 82 studies, 201 outcomes favored problem-based learning over traditional instructional methods. The authors review a typology of 11 problem types proposed by Jonassen (2000), which range from highly structured problems (focused on an accurate and efficient path to an optimal solution), to "ill-structured" problems (which do not necessarily have solutions and which prioritize evaluation of evidence and reasoning). The typology includes: logical problems, algorithmic problems, story problems (which are algorithmic problems with a story wrapper), "rule- using" problems, decision-making problems (e.g., cost-benefit analysis), troubleshooting (systematically diagnosing a fault, eliminating a problem space), "diagnosis-solution" problems (characteristic of medical school, which involve small groups understanding the problem, researching different possible causes, generating hypotheses, performing diagnostic tests, and monitoring a treatment to restore a goal state), strategic-performance, case analysis (characteristic of law or business school, which involve adapting tactics to support an overall strategy and reflecting on authentic situations), design problems, and dilemmas (such as global warming, which are complex and involve competing values, and which may have no solutions). Strategic-performance and design problems were deemed most effective in producing positive PBL outcomes.

**Wieseman, K. C., & Cadwell, D. (2005).** [Local history and problem-based learning (Abstract)](http://eric.ed.gov/?id=EJ720484). *Social Studies and the Young Learner, 18*(1), 11-14. Fourth graders collaboratively researched primary and secondary resources in a unit about human communities and the history of the local area. The use of PBL was associated with student excitement, inductive reasoning, and collaboration as students researched reasons and themes for human migration. The discussion and critical thinking involved in the PBL unit developed student knowledge about local human communities and local history.

**Zimmerman, B. (2002).** [Becoming a self-regulated learner: An overview (PDF)](http://www.tandfonline.com/doi/abs/10.1207/s15430421tip4102_2?journalCode=htip20). *Theory into Practice 41*(2), 64-70. Self-directed learners are more likely to succeed academically and view their futures optimistically.

**Additional PBL Research Resources**

The [Buck Institute for Education](http://www.bie.org) is a great resource for all kinds of information about project-based learning.

If you're interested in earlier studies on the efficacy of PBL, Edutopia published an article in 2001 with summaries of a variety of reports, "[Studies Validate Project-Based Learning](http://www.edutopia.org/research-validates-project-based-learning)."