IES Institute of Education Sciences

Project-Based Inquiry Science™

WHAT WORKS CLEARINGHOUSE™
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Intervention Report | Primary Science Topic Area

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This What Works Clearinghouse (WWC) report, part of the WWC's Primary Science topic area, examines research on the effects of *Project-Based Inquiry Science*™ on science achievement of students in grades 6-8. No studies of *Project-Based Inquiry Science*™ that fall within the scope of the Primary Science review protocol meet WWC standards. Because no studies meet WWC standards, the WWC is unable to draw any conclusions at this time about the effectiveness of *Project-Based Inquiry Science*™ on science achievement.

Intervention Description[1]

Large numbers of U.S. students lack proficiency in science, and students from different ethnic and socioeconomic groups show disparities in science achievement.[2] Science knowledge and skills are important for both academic and workplace success, and a variety of interventions have been developed to improve student science achievement.

Project-Based Inquiry Science™ is a science curriculum for students in grades 6–8 with approximately 13 independent instructional units, each covering a topic in life science, earth science, or physical science. In each 8- to 10-week unit, teachers first orient students to a "big question" or "big challenge" that frames the unit, such as how to improve air quality in the local community, and then guide students through a series of activities to answer a set of scripted smaller questions on the path to answering the big question (such as "What is air?", "What are pollutants, and how do they get in air?", and "How can air quality be improved?"). Students collaborate in small groups to identify relevant concepts, conduct hands-on explorations or investigations, read relevant informational texts, reflect on what they have learned, and apply new knowledge toward answering the big question. In periodic whole-class discussions, students update a project board (a large poster or other visual display) on which they track progress toward answering the guiding question. Each unit culminates with small-group presentations to the whole class in which students propose, justify, and evaluate potential answers to the big question or solution to the challenge. For each unit, the curriculum includes student editions, activity kits, and resources for teachers that include teacher guides, online videos, professional development resources, unit walkthroughs, access to a professional learning community, and a rubric to assess the fidelity of implementation.

Research Summary[3]

The WWC identified seven studies that investigated the effectiveness of *Project-Based Inquiry Science*™:

- Three studies do not meet WWC standards.
- Four studies are ineligible for review.

Because no studies of *Project-Based Inquiry Science*™ meet WWC standards, the WWC is unable to draw any conclusions about the effectiveness of *Project-Based Inquiry Science*™ on science achievement. The seven studies reviewed for this report are listed in the References section.

References

Studies that do not meet WWC group design standards

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. *Journal of Research in Science Teaching, 45*(8), 922–939. Retrieved from https://eric.ed.gov/?id=EJ813446 The study does not meet WWC group design standards because equivalence of the analytic intervention and comparison groups is necessary and not demonstrated.

Additional source:

Geier, R. R. (2005). *Student achievement outcomes in a scaling urban standards-based science reform* (Doctoral dissertation). Available from ProQuest Dissertations and Theses. (UMI No. 3163801)

Harris, C. J., Penuel, W. R., D'Angelo, C. M., DeBarger, A. H., Gallagher, L. P., Kennedy, C. A., … Krajcik, J. S. (2015). Impact of project-based curriculum materials on student learning in science: Results of a randomized controlled trial. *Journal of Research in Science Teaching, 52*(10), 1362–1385. Retrieved from https://eric.ed.gov/?id=EJ1078859 The study does not meet WWC group design standards because equivalence of the analytic intervention and comparison groups is necessary and not demonstrated.

Additional source:

Harris, C. J., Penuel, W. R., DeBarger, A. H., D'Angelo, C., & Gallagher, L.P. (2014). *Curriculum materials make a difference for next generation science learning: Results from year 1 of a randomized controlled trial.* Menlo Park, CA: SRI Education.

Kolodner, J. L., Gray, J., & Fasse, B. B. (2003). Promoting transfer through case-based reasoning: Rituals and practices in Learning by Design™ classrooms. *Cognitive Science Quarterly, 3,* 119–170. The study does not meet WWC group design standards because it does not establish the reliability of the eligible outcomes.

Additional source:

Holbrook, J. K., Gray, J., Fasse, B., Camp, P., & Kolodner, J. (2001). *Assessment and evaluation of the Learning by Design™; Physical Science Unit, 1999-2000: A document in progress.* Atlanta: Georgia Institute of Technology, College of Computing. Retrieved from https://www.cc.gatech.edu/projects/lbd/htmlpubs/progress.html

Studies that are ineligible for review using the Primary Science review protocol

Fortus, D., Sutherland Adams, L., Krajcik, J., & Reiser, B. (2015). Assessing the role of curriculum coherence in student learning about energy. *Journal of Research in Science Teaching, 52*(10), 1408–1425. Retrieved from https://eric.ed.gov/?id=EJ1078854 The study is ineligible for review because it does not include an outcome eligible for review under the Primary Science review protocol (Version 4.0).

Harrer, B. W., Flood, V. J., & Wittmann, M. C. (2013). Students talk about energy in project-based inquiry science. *AIP Conference Proceedings, 1513*(1), 162–165. The study is ineligible for review because it does not use a study design eligible for review under the WWC's group design standards, regression discontinuity design standards, or pilot single-case design standards, as described in the WWC Standards Handbook (Version 4.0).

Krajcik, J. S., Marx, R. W., Blumenfeld, P. C., Soloway, E., Fishman, B. J., & Middleton, M. (2000). Inquiry based science supported by technology: Achievement among urban middle school students. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA. Retrieved from https://eric.ed.gov/?id=ED443676 The study is ineligible for review because it does not use a study design eligible for review under the WWC's group design standards, regression discontinuity design standards, or pilot single-case design standards, as described in the WWC Standards Handbook (Version 4.0).

Krajcik, J. S., McNeill, K. L., & Reiser, B. J. (2008). Learning-goals-driven design model: Developing curriculum materials that align with national standards and incorporate project-based pedagogy. *Science Education, 92*(1), 1–32. Retrieved from https://eric.ed.gov/?id=EJ781739 The study is ineligible for review because it does not use a study design eligible for review under the WWC's group design standards, regression discontinuity design standards, or pilot single-case design standards, as described in the WWC Standards Handbook (Version 4.0).

Endnotes

[1] The descriptive information for this intervention comes from the program's websites (http://activatelearning.com/project-based-inquiry-science/ and http://www.pbiscyberpd.org/). The What Works Clearinghouse (WWC) requests developers review the intervention description sections for accuracy from their perspective. The WWC provided the developer with the intervention description in May 2019; however, the WWC did not receive a response. Further verification of the accuracy of the descriptive information for this intervention is beyond the scope of this review.

[2] See Appendix Table 1-4, "Students in grades 4, 8, and 12 scoring at or above the main NAEP's proficient level in science for their grade, by student grade and characteristics: 2009-15," in: National Science Foundation (2018). *Science and Engineering Indicators, 2018*. Arlington, VA: Author. Available at https://nsf.gov/statistics/2018/nsb20181/assets/481/tables/at01-04.pdf

[3] The literature search reflects documents publicly available by April 2019. Because several *Project-Based Inquiry Science*™ units were developed as part of the *Learning By Design* project (Kolodner et al., 2003) and *The Center for Learning Technologies in Urban Schools (LeTUS) Program* (Geier et al., 2008), studies of these versions of the intervention were included in this review. Reviews of the studies in this report used the standards from the WWC Procedures and Standards Handbooks (version 4.0) and the Primary Science review protocol (version 4.0). The evidence presented in this report is based on available research. Findings and conclusions could change as new research becomes available.

Recommended Citation

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