IES Institute of Education Sciences

Full Option Science System™ (FOSS)

Intervention Report | Primary Science Topic Area

WHAT WORKS CLEARINGHOUSE™
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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 *Full Option Science System™ (FOSS)* on science achievement for students in kindergarten through grade 8. No studies of *FOSS* 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 *FOSS* 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 achievement in science.

FOSS is a science curriculum for students in kindergarten to grade 8 with content in physical science, earth science, and life science. The curriculum consists of a series of 8- to 9-week modules in kindergarten to grade 5, and 9- or 18-week courses in grades 6 to 8. Students conduct a series of investigations during each module or course in which they:

- Examine a focus question that guides instruction and learning.
- Work in small groups on hands-on activities to explore phenomena in the natural or designed world (for example, measuring the mass of materials before and after mixing them; observing what happens after mixing baking soda and vinegar; going outdoors to see which naturally occurring materials form a solution in water).
- Document observations, organize data, and generate explanations using words and drawings in science notebooks.
- Read informational science text in a *FOSS* Science Resources book.
- Discuss relevant science and engineering concepts and practices.
- In grades 6 through 8, students also complete required online activities.

The *FOSS* assessment system includes both formative assessments embedded throughout instruction and summative assessments administered at the beginning and end of the course or module and after completing each investigation. *FOSS* provides teachers written and online instructor toolkits, course preparation videos, guides to implementing each investigation, teaching slides, course teaching notes, assessments, and assessment coding guides.

Research Summary[3]

The WWC identified ten studies that investigated the effectiveness of *FOSS*:

- One study does not meet WWC standards.
- Nine studies are ineligible for review.

Because no studies of *FOSS* meet WWC standards, the WWC is unable to draw any conclusions about the effectiveness or ineffectiveness of *FOSS* on science achievement. The ten studies reviewed for this report are listed in the References section.

References

Study that does not meet WWC group design standards

Powell, K., & Wells, M. (2002). The effectiveness of three experiential teaching approaches on student science learning in fifth-grade public school classrooms. *Journal of Environmental Education, 33*(2), 33-38. Retrieved from https://eric.ed.gov/?id=EJ648067. The study does not meet WWC group design standards because it does not establish the reliability of the eligible outcomes.

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

Amaral, O. M., Garrison, L., & Klentschy, M. (2002). Helping English learners increase achievement through inquiry-based science instruction. *Bilingual Research Journal, 26*(2), 213–239. Retrieved from https://eric.ed.gov/?id=EJ652666. 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).

Cromley, J. G., Weisberg, S. M., Dai, T., Newcombe, N. S., Schunn, C. D., Massey, C., & Merlino, F. J. (2016). Improving middle school science using diagrammatic reasoning. *Science Education, 100*(6), 1184–1213.

Retrieved from https://eric.ed.gov/?id=EJ1116992. 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).

Field, T., Bernal, E. M., & Goertz, J. (2001). How gifted/talented students perceive FOSS science program. *Understanding Our Gifted, 13*(2), 3–5. Retrieved from https://eric.ed.gov/?id=EJ624786. 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).

Frederick, L. R., & Shaw Jr., E. L. (1999, November). *Effects of science manipulatives on achievement, attitudes, and journal writing of elementary students revisited.* Annual Meeting of the Mid-South Educational Research Association, Point Clear, AL. Retrieved from https://eric.ed.gov/?id=ED436410. 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).

Giglio, K. R. F. (2014). *How elementary teachers' beliefs about the nature of science mediate implementing prescribed science curricula in their classrooms* (Doctoral dissertation). ProQuest Dissertations and Theses. (UMI No. 3648962). 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).

Plevyak, L. H., & Mayfield, A. (2006). Water within their world. *Taproot Journal, 16*(1), 4–8. 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).

Shaw, T. (2006). What do we get to do today? The middle school Full Option Science System program. In R. E. Yager (Ed.), *Exemplary science in grades 5-8: Standards-based success stories* (pp. 181–194). Arlington, VA: National Science Teachers Association. 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).

Valadez, J., & Freve, Y. (2001). *The effect of inquiry-based science teaching on standardized reading scores.* Fresno, CA: Fresno Unified School District-Urban Systemic Program. 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).

Zimmerman, R., Maker, C., Gomez-Arizaga, M., & Pease, R. (2011). The use of concept maps in facilitating problem solving in earth science. *Gifted Education International, 27*(3), 274–287. 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 website (https://www.fossweb.com/). 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 August 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. 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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