Pursuing Best Practices in STEM Education: The Peril and Promise of Active Learning

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The need for quality STEM (science, technology, engineering, and math) education has never been greater, but educators face lingering questions about how students most effectively learn these subjects. Although a promising instructional technique known as “active learning” has become more pervasive in undergraduate STEM education, this approach to education is ill-defined and the characteristics of effective active learning remain elusive.

In the latest issue of Psychological Science in the Public Interest (PSPI), teams of researchers across many disciplines synthesized recent findings on STEM learning to provide a focused description of active learning and offer guidance on current practice and future research.

Read summary and full text of latest PSPI: “The Curious Construct of Active Learning.”

“Because of the vagaries of the term ‘active learning,’ my colleagues and I wanted to provide a

coherent and actionable concept of active learning that incorporates a wide array of research disciplines," said Doug Lombardi, a researcher at the University of Maryland, College Park, and first author on the paper. "Our goal was to provide a clear picture of active learning and offer guidance on research and practice."

What is active learning?

Many educators have suggested that active-learning strategies, which include a variety of hands-on learning techniques and focus on student engagement, are highly effective for undergraduate STEM education. They also appear to provide more equitable outcomes for students from underrepresented groups in STEM fields.

In past research, active learning has commonly been used as a vague umbrella term to represent an alternative to the traditional lecture in which students sit passively and listen to their instructor while taking notes. Multiple activities have been described as active learning, including participation in flipped classrooms (in which students read or watch educational material outside of class and use class time to engage in interactive activities), use of clickers or other student response systems, and engagement with computerized conversational agents.

The authors approached this study with several questions in mind: What are effective learning processes in undergraduate STEM, and what role does active learning play in these processes? Do certain active-learning strategies optimize learning in some situations but not others? Is lecturing—the predominant teaching strategy in undergraduate STEM instruction—inherently flawed, or are there some circumstances in which students can actively learn during lectures?

Outcomes and goals

The authors hope that their new report will transcend traditional academic silos by encouraging cross-disciplinary science involving researchers from educational and cognitive psychology and education in several STEM fields.

Read related content in the APS's Studying and Learning Research Topic.

Lombardi and his coauthors present a framework for active learning that they believe will be a useful tool for researchers and instructors who want to deepen students' STEM learning. If future research can help educators better understand how to increase students' agency during the instructional process, it will open STEM to more students, particularly those who have been disempowered and underrepresented via traditional modes of instruction.

"The cornerstone of this work is the idea that learners should be active agents during instruction to optimize inclusive and effective learning of complex STEM topics and practices," Lombardi said.

Feedback on this article? Email apsobserver@psychologicalscience.org or scroll down to comment.

Reference

Lombardi, D., Shipley, T., Astronomy Team, Biology Team, Chemistry Team, Engineering Team, Geography Team, Geoscience Team, & Physics Team. (2021). “The curious construct of active learning. Psychological Science in the Public Interest. Advance online publication. https://doi.org/10.1177/1529100620973974