STEM EDUCATION

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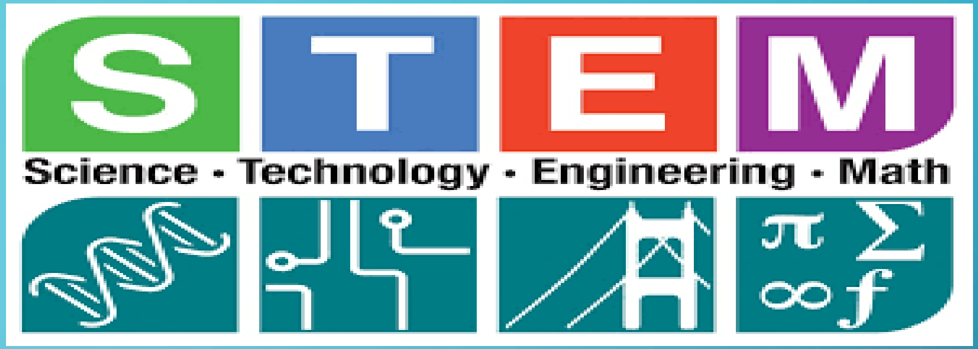
WHAT IS STEM EDUCATION?



STEM is a curriculum based on the idea of educating students in four specific disciplines — science, technology, engineering and mathematics — in an interdisciplinary and applied approach.

Rather than teach the four disciplines as separate and discrete subjects, STEM integrates them into a cohesive learning paradigm based on real-world applications.

RELEVANCE

Education for students in science, technology, engineering, and mathematics (STEM) has received increasing attention over the past decade with calls both for greater emphasis on these fields and for improvements in the quality of curricula and instruction. In response, numerous new instructional materials, programs, and specialized schools are emerging.

As a kind of transcending traditional education mode, STEM education can narrow the gap between the existing knowledge and skills of the students and the vocational knowledge and skills, and enhance the students' employment competitiveness.

The study is concentrated on research associated with the potential impact of integrated STEM education in two areas:

- learning and achievement
- interest and identity

Looking across studies, the mixing of STEM concepts and practices has the promise to steer to increase conceptual learning within the disciplines. However, the positive impact on learning appears to differ for science and arithmetic, with less evidence of a positive impact on mathematics outcomes, supported current assessments for those subject areas, which could not fully capture integrated learning in STEM.

Taken together, the findings from research have implications for the planning of integrated STEM education initiatives. Three key implications are:

1. Integration should be made explicit. Observations in a number of STEM settings show that integration across representations and materials, as well as over the arc of multi-day units, is not spontaneously made by students and therefore cannot be assumed to take place. This highlights the importance of designing integrated experiences that provide intentional and explicit support for students to build knowledge and skill both within the disciplines and across disciplines. In many integrated STEM experiences, such supports are missing or only implicitly embedded within the classroom activities or the CAD software, measurement instruments, and computational tools used in the classroom.

2. Students' knowledge in individual disciplines must be supported. Connecting ideas across disciplines is challenging when students have little or no understanding of the relevant ideas in the individual disciplines. Also, students do not always or naturally use their disciplinary knowledge in integrated contexts.

Students will thus need support to elicit the relevant scientific or mathematical ideas in an engineering or technological design context, to connect those ideas productively, and to reorganize their own ideas in ways that come to reflect normative, scientific ideas and practices.

3. More integration is not necessarily better. The potential benefits and challenges of making connections across the STEM subjects suggest the importance of a measured, strategic approach to implementing integrated STEM education that accounts for the potential tradeoffs in cognition and learning.

Analyses of the educational moves made by the teachers and interactions between the teachers and students suggest that a key mechanism of integrated STEM education is cohesion of central concepts across:

- Mathematics
- Science representations
- Engineering objects
- Design and construction activities
- Social structures within the classroom

It is clear from the research that STEM connections which will appear obvious to teachers, curriculum developers, and disciplinary experts often don't seem to be obvious to novice learners. At times, teachers themselves might not apprehend the connections. For either reason, integration of STEM concepts and transfer of learning to new contexts might not be spontaneously made by students and can't be assumed to require place just because certain concepts and practices are introduced at the identical time or place. Put in a different way, deep, lasting, and transferable learning through integrative experiences will rarely be automatic for many students and a few teachers.

Analysis of the research and examination of specific programs led to special findings about three aspects of integrated STEM education:

- the interplay between integrated and disciplinary learning;
- the cognitive pluses and minuses related to connection making;
- the role that context seems to play in supporting integrated STEM learning.

CONCLUSION

It is important to produce learning opportunities that make students feel competent and provides them opportunities to precise that competence. Learning experiences that allow flexibility and selection for students which make connections to the important world also are important. Project- and problem-based experiences seem to be especially effective in supporting the event of interest and identity, suggesting that integrated STEM experiences is powerful tools for building students' interest and identity in STEM fields.

In sum, integrated STEM can provide opportunities for students to productively engage in STEM in ways in which spark their interest and transform their identity. But the research base is sparse, particularly on the topic of designing integrated STEM experiences to intentionally support interest and identity.

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