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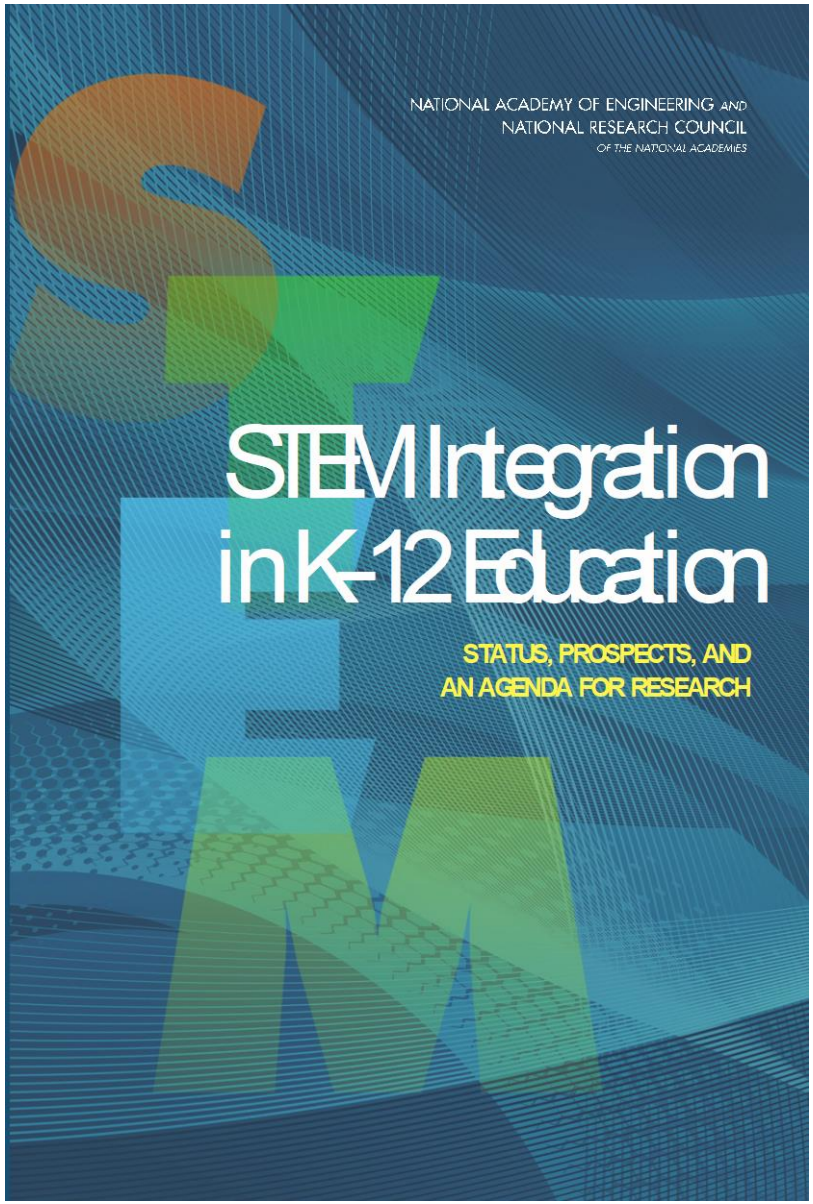
STEM Integration in K-12 Education

Heidi Schweingruber



Study Objectives

1. Identify and characterize existing approaches to K-12 integrated STEM education in formal and informal settings.

2. Review evidence for impact on various student outcomes of interest.

3. Determine a set of priority research questions to advance understanding of integrated STEM education.

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Align with how STEM is practiced in today's world

Framework for STEM Integration in K – 12 Education

GOALS

For Students

- STEM literacy
- 21st century competencies
- STEM workforce readiness
- Interest and engagement
- Making connections

For Educators

- Increased STEM content knowledge
- Increased pedagogical content knowledge

OUTCOMES

For Students

- Learning and achievement
- 21st century competencies
- STEM course taking, educational persistence, and graduation rates
- STEM-related employment
- STEM interest
- Development of STEM identity
- Ability to make connections among STEM disciplines

For Educators

- Changes in practice
- Increased STEM content and pedagogical content knowledge

Integrated STEM Education

NATURE AND SCOPE OF INTEGRATION

- Type of STEM connections
- Disciplinary emphasis
- Duration, size, and complexity of initiative

IMPLEMENTATION

- Instructional design
- Educator supports
- Adjustments to the learning environment

Commonly Used Approaches

- Problem-based
- Project-based
- Design-based

Common features:

- Student centeredness
- Small-group work
- Teachers as facilitators or guides
- Problems/projects/design as the focus and stimulus for learning

Potential of Integrated STEM

- Enhance learning in each of the disciplines
- Help students understand connections between the disciplines
- Increase interest in STEM

To achieve these outcomes, learning experiences need to be designed with the desired outcomes in mind.

Design of Integrated STEM

- Make integration explicit.
- Attend to students' disciplinary knowledge.
- Pay attention to social aspects of learning.
- Consider how to support the development of interest.

Make Integration Explicit

- Simply presenting a real-world context does not mean students will see the disciplinary connections.
- Teachers/facilitators need to explicitly draw students' attention to the connections.

Examples:

- between different forms of representation;
- from one context to another

Attending to Students' Disciplinary Knowledge

- Students need disciplinary knowledge in order to use it in the context of integration.
- Students may not recognize when to use knowledge they already have.
- Students may not revise their understanding based on integrated experiences.

Implementing STEM Integration

- Standards (and Curricula)
- Assessment
- Educator Expertise
- Policies -- organization of courses, time devoted to instruction, certification of teachers, etc.

Research Recommendations

R1. Research is best when it includes:

- –Rich description of intervention
- –Alignment of study design and outcome measures with goals of intervention
- –Control groups

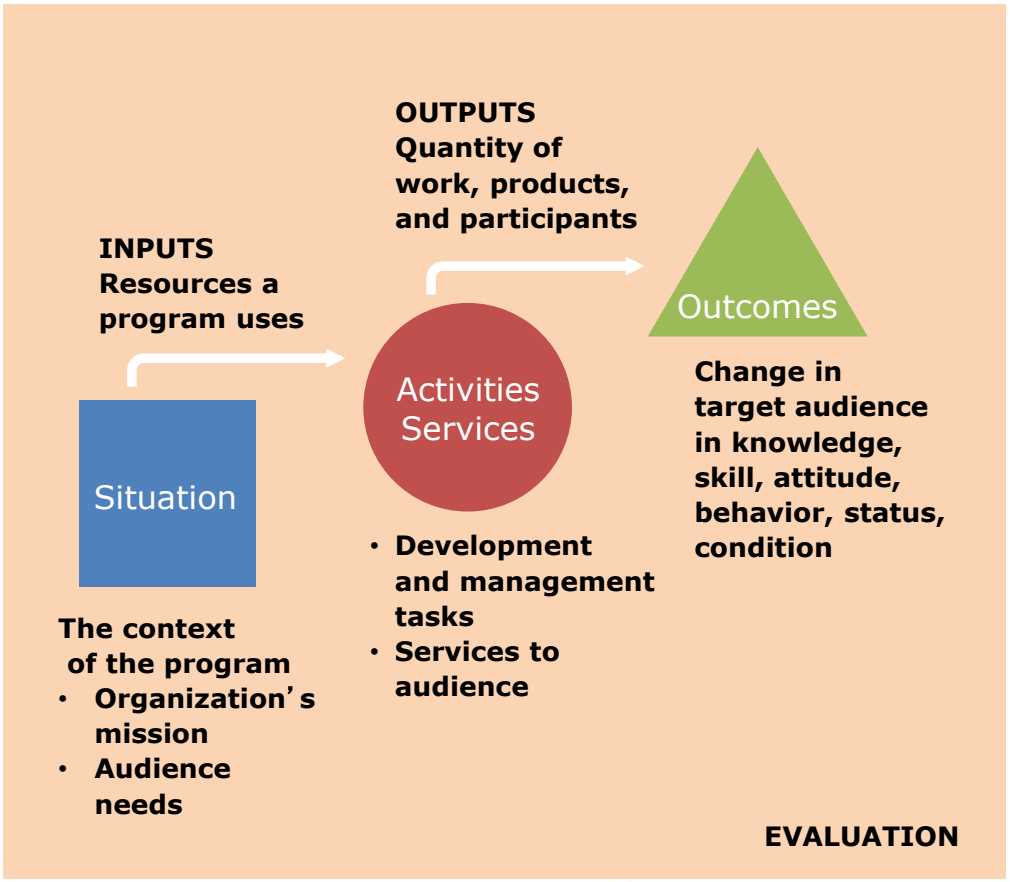
R2. The field — educators, program developers, researchers — could benefit greatly from a common framework for both description of the intervention and, when appropriate for the research strategy.

Outcomes Recommendations

R3. Avoid the "integrated STEM is good for everything" strategy. Delineate impact on achievement, interest, identity, persistence, etc.

R4. Examine long-term impacts on interest and identity for diverse audiences.

Design and Implementation Recommendations



R5. Delineate a logic model for your integrated STEM intervention.

R6. Be explicit about teaching and learning goals.

R7. Understand learning goals and learning progressions.

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