Chapter 36
STEM Learning in Middle Grades by Technology–Mediated Integration of Science and Mathematics:
Results of Project SMILE

Pradeep Maxwell Dass
Northern Arizona University, USA

John T. Spagnolo
Appalachian State University, USA

ABSTRACT

In an attempt to foster inquiry-oriented learning in middle grades (grades 6 – 8), a technology medi-ated pedagogy integrating science and mathematics was promoted through Project SMILE (Science and Mathematics Integration for Literacy Enhancement). It involved in-service teachers in professional learning and classroom implementation over a period of two academic years, with the explicit goal of enhancing teachers' ability to foster more authentic inquiry in their classes. This chapter describes the design of Project SMILE in the context of recent reform efforts in science and mathematics education, along with the theoretical underpinnings for the design. Project activities, followed by the research meth-odology employed to investigate the impact on both teachers and students are described next. Finally, research results and their implications are discussed with an eye toward the usefulness of integrating science and mathematics and involving specific technological tools to foster greater inquiry-oriented learning in school science and mathematics.

INTRODUCTION

Understanding of and ability to perform inquiry and solve problems are critical components of developing scientific and mathematical literacy as promoted by most national reform efforts in science and mathematics education in the recent past. Yet, in most cases, the extent of student opportunity to engage in inquiry and problem solving in science and mathematics classes is restricted to one or few "units" designed to teach inquiry and problem solving, rather than be integrated throughout the curriculum. Middle grades represent a kind of "turning point" in students academic career where important foundational components of science and mathematics literacy get established, leading students to either develop a strong interest in these subjects, followed by the desire to pursue them further; or a lack of confidence, which if left unaddressed, could lead to unrealized potential in science and mathematics futures. These realizations lead to the following questions:

- Can integrating science and mathematics instruction around real world issues, problems, etc., result in greater inquiry and problem solving that is embedded in the 'content' of curricular topics, rather than be taught separately for its own sake?
- What modern technological tools can be leveraged to effectively integrate science and mathematics?
- Can a technology mediated, integrated approach lead to better foundations of scientific and mathematical literacy in middle grades students?

These questions were investigated through Project SMILE (*S*cience and *M*athematics *I*ntegration for *Li*teracy *E*nhancement), a professional development project designed to enhance in-service teachers' ability to embed inquiry and problem solving throughout the curriculum in middle grades science and mathematics classes by integrating the two disciplines. Indeed, the ultimate outcome, which formed the basis for Project SMILE, was that teachers will learn to implement inquiry and problem solving as the standard tool for teaching and learning all curricular topics in science and mathematics. The integration of science and mathematics instruction was mediated through the use of a specific technological tool—the InspireData software—that enables collection, visualization and analysis of data seamlessly. Participating teachers experienced and designed instructional modules addressing topics mandated in the state science and mathematics curricula, setting them in the context of real life situations, problems, questions, etc., following a Science-Mathematics-Technology-Society (SMTS) pedagogical approach, and involving the use of InspireData for integrating science and mathematics topics in the modules. They taught these instructional modules in their respective classes and examined its impact on various aspects of student learning. Emulating the Iowa Chautauqua Program's (ICP) model of professional development, Project SMILE engaged teachers in three-week summer institutes for three consecutive years, involved them electronically in academic year professional learning and communication (virtual learning communities, video conferencing, etc.), and teaching of their self-designed instructional modules integrating science and mathematics during two school years.

The main goal of the project was to enhance teachers' ability to teach the entire science and mathematics curricula through an inquiry-oriented approach so that their students get opportunities to engage in authentic inquiry and problem solving on a regular basis as they learn the "content" of science and mathematics. Teacher enhancement toward this goal was examined through a combination of qualitative and quantitative methods. The objectives of this chapter are to provide a rationale and description

18 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/stem-learning-in-middle-grades-by-technology-mediated-integration-of-science-and-mathematics/169035

Related Content

Lin Gao: Empowering Chinese Female Coaches with a Platform Economy
Lin Gao (2022). *Women Community Leaders and Their Impact as Global Changemakers (pp. 52-58).*
www.irma-international.org/chapter/lin-gao/303975

Does the Organizational Change Induced by the Pre-Implementation of an IS Proceed as a Planned Process?
Amira Sghari, Jamil Chaabouniand Serge Baile (2021). *Encyclopedia of Organizational Knowledge, Administration, and Technology (pp. 219-232).*
www.irma-international.org/chapter/does-the-organizational-change-induced-by-the-pre-implementation-of-an-is-proceed-as-a-planned-process/263540

Peace Leadership Education: Stories of Growth, Training, and Development
Rabab Atwi, Whitney McIntyre Miller, Annmary S. Abdou, Miznah O. Alomair, Nicholas J. Irwin, Lisa Hilt, Negeen Lotfi, sylvia murrayand Gabrielle Richmond (2022). *Evolution of Peace Leadership and Practical Implications (pp. 101-123).*
www.irma-international.org/chapter/peace-leadership-education/303465

Artificial Intelligence as an Enabler for Developing Business Systems
N. Raghavendra Rao (2021). *Encyclopedia of Organizational Knowledge, Administration, and Technology (pp. 421-432).*
www.irma-international.org/chapter/artificial-intelligence-as-an-enabler-for-developing-business-systems/263555

Overview of Workforce Development in Education
Julie Neal (2018). *The Role of Advisory Committees in Biomedical Education and Workforce Development: Emerging Research and Opportunities (pp. 1-27).*
www.irma-international.org/chapter/overview-of-workforce-development-in-education/192239