SCHOOL SCIENCE AND MATHEMATICS

Research to Practice Article

Addressing Science Learning through Science Notebooks and Discussion

Based on the published SSM Journal Research Manuscript:
The Indiana Science Initiative: Lessons from a Classroom Observation Study

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Overview

"The Indiana Science Initiative [ISI]: Lessons from a Classroom Observation Study" details findings from a qualitative study of a systemic, model-based effort (Smithsonian Science Education Center, 2015) to reform K-8 science education in Indiana. The ISI seeks to improve science education through the use of inquiry-based pedagogies and reform-based science modules enhanced with literacy education. The ISI also provides professional development in the areas of scaffolded-guided inquiry (e.g. Krajcik, Blumenfeld, Marx, & Soloway, 2000) and literacy enhancement via science notebooks. This study focused on five teachers of grades 3 through 6 from three different schools who were observed and interviewed as they taught lessons using the ISI-provided modules. Observation data was analyzed with a modified version of the Science Teacher Inquiry Rubric (Bodzin & Beerer, 2003) which measures alignment with inquiry-based instruction.

Research Questions

This study was conducted to examine teacher practice and perceptions in the context of an initiative that combines professional development with reform-oriented science modules in order to investigate the following questions: 1) How do teachers who have participated in the ISI professional development incorporate the essential features of inquiry into their science instruction while using the ISI-provided curricular modules?; and 2) What do teachers perceive to be the influences that support and challenge their ability to incorporate the essential features of inquiry as they implement the modules?

Discussion of Findings

Key findings were identified in how participating teachers incorporated the essential features of inquiry (National Research Council, 2000) into science instruction. Analysis of observation data found that each feature was observed at some point during the study to varying degrees. Teachers were most effective in implementing the data collection features such as posing questions, establishing procedures, and collecting and analyzing data. Conversely, the features associated with formulating, evaluating, and connecting explanations and conclusions to larger concepts were observed with less frequency.

Interview data indicated that participants understood the features and benefits of scaffolded-

guided inquiry and attempted to implement it. Teachers also expressed an increased awareness of the importance of going beyond data collection in science instruction. However, in observations they demonstrated limited ability to do so. These findings suggest teachers had the most difficulty with implementation of post-data collection features, where scientific thought processes at the core of inquiry may be found. Teacher interviews provided further insight for the observational data by examining what they perceived as challenging influences on their ability to incorporate the features of inquiry. Some challenges included time management, uncertainty about how to facilitate science instruction, perceptions of students' abilities or behavior, and teacher discomfort with the content of the modules.

Another key finding from the interview data was teachers' perceptions of the use of science notebooking as a support for literacy education. They reported continuing to use the notebooks in the absence of ISI-provided modules. Teachers also reported specific benefits from using the science notebooks, which may prove useful as starting points in addressing the lack of reflective, evaluative, and explanatory features in teacher instruction. For example, teachers reported that they were better able to help students connect science to their own lives and experiences, and they credited the notebooks with increasing students' communication skills.

In summary, this study's findings indicate that programs like ISI may be useful in increasing teachers' understandings of what constitutes inquiry-based instruction, but have limited ability to impact classroom practices as a result of various implementation challenges. Teachers showed a strong tendency to incorporate the features of inquiry related to data collection, while eschewing the post-data collection features that focus on connecting material to larger science concepts, formulating explanations, and evaluating evidence-based conclusions.

Implications for Practice and Suggested Resources

Educators and professional development providers can draw two lessons from this study when planning learning experiences for students or teachers. First, the importance of "science talk" must be recognized as a critical component in implementing scaffolded-guided inquiry in the classroom. In the ISI study teachers rarely provided students with opportunities to develop understandings through the formulation and evaluation of conclusions or by connecting material to larger science concepts. Engaging in science talk in these areas can be crucial to student success in science. Following this study, the ISI professional development team changed the program in order to focus more time on science talk and strategic talk moves (Michaels, Shouse, & Schweingruber, 2008; Zembal-Saul, McNeill, & Hershberger, 2013). Resources like the *Talk Science Primer* (Michaels & O'Connor, 2012) help teachers focus on the importance of science talk for student learning and offer strategies to address communication, justification, and evaluation of evidence-based conclusions.

Second, the use of science notebooks was an essential strategy for success in the ISI. Teachers reported that the notebooks supported students' abilities to communicate, make connections between science concepts, and relate science to the real world. Teachers used notebooks without the ISI modules because they perceived that notebooking developed students' skills in writing and literacy. Educators should be aware that notebooks can provide a starting point for incorporating inquiry-based instruction in the classroom, particularly in regard to helping students ask and investigate scientific questions. The ISI professional development has subsequently added Fulton and Campbell (2014) and Fulwiler (2007) as resources to help teachers incorporate literacy strategies in science instruction. Similar to other findings (e.g. Jones & Eick, 2007), linking science and literacy through the integration of science notebooks can be a critical tool in the implementation of inquiry-based pedagogies and reform-based curricular materials.

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