The Effect of Teachers' Sociological Understanding of Science (SUS) on Curricular Innovation

Christine M. Cunningham
Cornell University

Abstract

Science education reform initiatives advocate incorporating more accurate portrayals of science in the high school classroom that attend to science in its larger social context. However, conveying such understandings will require teachers to possess new knowledge about how science is practised. This paper reports research that investigated the effect of teachers' sociological understanding of science (SUS) on their design and implementation of curriculum innovations. It concludes that teachers' SUS level strongly influences their ability to innovate; knowledge about science is necessary, but not sufficient, for sociologically informed curricula.

Theoretical Framework

Science reform initiatives call for school science to include more accurate portrayals of science that attend to science in its larger social context (American Association for the Advancement of Science, 1993; National Research Council, 1996). They recommend that teachers develop and teach interdisciplinary, open-ended activities which are attentive to local needs. The initiatives clearly communicate that school science must teach more than scientific facts to prepare students to function in a world that depends increasingly on science and technology—school science should also engage students in the processes and practices of science, communicate understandings about the nature of science and scientific knowledge, better equip students to understand the strengths and limitations of science, and introduce students to the interactions between science and society. Clearly, innovations such as these ask teachers to go beyond teaching science content and will require educators to draw upon new types of knowledge—knowledge about science. Given the current focus of most science classrooms and science teacher education programs on science content (knowledge of science), the increased teacher knowledge base that will be needed for the initiatives could present one stumbling block for reform (Carlsen, Cunningham, & Lowmaster, 1995).

Educational researchers working in the teacher-knowledge domain have described a variety of types of teacher knowledge, such as subject matter knowledge, general pedagogical knowledge, pedagogical content knowledge, and knowledge of context, and have explored their effects on classroom practice (Grossman, 1990; Hashweh, 1987; Lee, 1995; Shulman, 1987; Wilson, Shulman, & Richert, 1987). The present study builds upon previous research about teacher knowledge to attend specifically to the new directions charted by science reform initiatives. Effectively translating the recommendations of the reform standards into classroom practices will require teachers to possess new types of knowledge about science. To describe these new understandings, a new form of teacher knowledge has been defined—sociological understanding of science (Cunningham, 1995). Sociological understanding of science includes aspects of both subject-matter and pedagogical-content knowledge. It describes teachers' understandings about the practice and construction of scientific knowledge and the interactions between science and society. Sociological understanding of science encompasses two types of understandings: macrosociological and microsociological. Macrosociological understandings consider the
relationship and interactions of science in its societal context. This approach addresses the influence of external social, political, religious, economic, and cultural factors on science, and how, in turn, science affects society. Microsociological understandings focus on knowledge about the practice of science at the laboratory bench, how a scientific fact is constructed, and how social and personal concerns and beliefs permeate scientific decisions. It includes issues such as replication attempts in science, what counts as evidence, peer review, and negotiation among the scientific community.

In recent years, science educators have become increasingly concerned with infusing sociological understandings of science into school science curriculum. Scholars knowledgeable about science studies have begun to work with science teachers to develop, implement, and research curricula that encourage science lessons to more accurately represent the practice of science and its interactions with society. Researchers have articulated the need to teach science designed to help all student become scientifically informed citizens; convey the contingencies, messiness, and social components of science; and emphasise the creative, open-ended nature of scientific problem-solving (Atkinson & Delamont, 1977; Collins & Pinch, 1993; Duschl, 1990; Gough, 1992b; Kelly, Carlsen, & Cunningham, 1993; Millar, 1989; Millar & Wynne, 1988). Additionally, scholars have advocated school science projects that are socially responsible; are situated in a local context; explore relationships between science and the larger community; are open-ended; and encourage students to generate their own questions, develop experiments to address these, and then gather and interpret their data (Eisenhart, Finkel, & Marion, 1996; Gough, 1992a; Helms, in press; Roth & McGinn, 1997).

The research reported in this article offers another example of an innovative science curriculum project designed to encourage curricular content and pedagogical techniques that resonate with understandings in science and technology studies. In particular, the research aimed to investigate a belief that the level of teacher knowledge about sociological facets of science influences teachers' ability and willingness to develop and implement innovative lessons that are consistent with new science education frameworks and standards. This article reports the results of a research project that investigated the role that teachers' sociological understanding of science plays in promoting or deterring the design and implementation of curricular innovations.

Methods and Data Sources

This study was part of a larger project that examined the effect of teachers' sociological understanding of science (SUS) on both their everyday classroom practices and curriculum innovations. The research was a case study of six biology teachers—two each with strong, moderate, and weak SUS—who participated in an inservice program that investigated issues and methods related to water quality and watershed dynamics. As part of Cornell University's Institute on Science and Environment for Teachers (ISET), the teachers, who came in multidisciplinary science teams, developed a school-specific curriculum project that focused on a local water resource or problem, integrated the school sciences, and explored science in its social context. Our goal was to promote teacher-based innovation that was consistent with science reform initiatives and that conveyed information about the sociological aspects of science. During the school year, periodic follow-up workshops, school site visits, and a computer network helped maintain contact between participants and staff.