



Key Points

The key elements of instruction that support and facilitate conceptual change in students' thinking are:

- The teacher designs her curriculum with students' ideas in mind.
- The teacher includes parallel strands in the curriculum.
- The teacher makes her curricular expectations known to the students in a variety of ways.
- The teacher uses instructional strategies that support students' exploration of their own and others' ideas.
- The teacher allows sufficient time for students to engage fully in the social and conceptual practices that she believes are necessary for students to learn science concepts well.

Learning Goals in an Exemplary Science Teacher's Practice and Social Factors in Teaching for Conceptual Change

By Michael Beeth and Peter Hewson

Introduction

Over the course of the past 8 years, the conversations (both spoken and written) of many elementary school students in the classroom of Sister M. Gertrude Hennessey have captured the attention of science educators, scientists, and cognitive psychologists. Research conducted in this classroom has documented student learning attributed to these conversations in the professional literature and at professional meetings. There are many unique aspects of learning that these students exhibit during their conversations with one another and their teacher. The extraordinary performance of these students inevitably raises the question: How does Sister Gertrude do it? What are significant components of her instruction that support the student outcomes reported in the studies just indicated?

One approach to answering these questions has been to synthesize a set of teaching and curricular guidelines that can inform teaching for conceptual change. Our goal is to provide the details that can help us understand how this teacher facilitates conceptual change learning. We are interested in whether the learning that takes place in Sister's classroom is the product of a unique and singular environment, or whether the instructional principles she uses, once incorporated into the practices of other teachers, might result in similar student outcomes.

Analysis of Instruction

Sister Gertrude's instruction is marked by her desire to engage students in activities that allow them to talk about their developing science ideas in increasingly powerful ways. At the heart of her instruction are seven learning goals she presented to students at the beginning of each academic year:

- (1) Can you state your own ideas?
- (2) Can you talk about why you are attracted to your ideas?
- (3) Are your ideas consistent?
- (4) Do you realize the limitations of your ideas and the possibility they might need to change?
- (5) Can you try to explain your ideas using physical models?
- (6) Can you explain the difference between understanding an idea and believing in an idea?
- (7) Can you apply intelligible and plausible to your own ideas?

Thus, for students in this classroom, the overall goals of learning are to constantly examine the status of ideas, first their own and then those of

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others; explore the reasons that support any idea; compare their current understandings to similar ideas in the scientific community; and to choose between competing ideas on well-reasoned grounds. In effect, the teacher used her learning goals to establish a pattern of discourse that she felt was similar in many respects to those of the scientific community.

Collectively, Sister Gertrude's seven learning goals established the conditions under which students in this classroom learned science. Presented early in each school year, these goals sent a very clear message to the students that the curriculum in this science class would focus on the students' developing ideas, and that they would be expected to speak about their ideas in various ways. Each of the goals, if achieved, would give the learner awareness of and control over his or her thoughts about the science content he or she studies. Although none of the learning goals addresses science content specifically, together they provide students with insights into both the individual and social construction of scientific knowledge.

Conclusions

The question we posed when we began our study was: what is the nature of Sister Gertrude's practice that leads to student outcomes such as these? We present our answer to this question by summarizing the key elements of Sister Gertrude's instruction. The key elements of instruction that support and facilitate conceptual change in students' thinking are:

- 1) *The teacher designs her curriculum with students' ideas in mind.* She takes it as her responsibility to clarify the spaces—physically, conceptually, and socially—in which her students will be working.
- 2) *The teacher includes parallel strands in the curriculum.* She focuses her instruction on her students' conceptions of science, their views of learning, and their ability to apply some aspects of scientific epistemology, and intends that students' learning outcomes will include changes in all three.
- 3) *The teacher makes her curricular expectations known to the students in a variety of ways.* Sister Gertrude's expectations are communicated to the students through explicit references during instruction, through the provision of carefully chosen hands-on experiences, in response to input from her students and other sources, and through constant modeling of the activities and practices inherent in her learning goals.

- 4) *The teacher uses instructional strategies that support students' exploration of their own and others' ideas.* Students explore their own and others' ideas through individual, small-group, and whole-class activities. She does not intervene with respect to science content until the students have "gone as far as they can go" in discussing their ideas.
- 5) *The teacher allows sufficient time for students to engage fully in the social and conceptual practices that she believes are necessary for students to learn science concepts well.* Establishing an overall classroom discourse community that shares some of the cognitive and social practices used in the scientific community is essential to Sister's instruction. Once established, these practices help her students achieve learning outcomes that are truly extraordinary.