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Mathematics
& Science for a
CHANGE

How to Design,
Implement, and Sustain
High-Quality Professional
Development

Foreword by Barbara Miller

Heinemann

DEDICATED TO TEACHERS™

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THE BIG PICTURE

Vision, Goals, and Working with Teachers

Part
I

In recent years, the publication of national standards in mathematics and science education has moved educators toward greater consensus about what students need to know and be able to do in these two content areas. The *Curriculum and Evaluation Standards for School Mathematics* and the *Principles and Standards for School Mathematics* published in 1989 and 2000, respectively, by the National Council of Teachers of Mathematics (NCTM) and the *National Science Education Standards* published by the National Research Council in 1996 created a vision for mathematics and science education that goes beyond memorization of facts, formulas, and vocabulary (NCTM 1989; NCTM 2000; NRC 1996).

These mathematics and science education standards call for classroom instruction that differs considerably from what many teachers learned during their preservice education—and from what they had previously been doing in their classrooms. (See Figure 1.) To move toward this new vision requires focusing intensely on assisting teachers as they change their ways of thinking and behaving in the classroom.

The first step is to lay the groundwork for the professional development that will be at the center of the improvement effort. This groundwork involves establishing a vision of high-quality mathematics and science instruction within the district; identifying needs; setting professional development goals; and

giving thoughtful attention and planning to working with teachers as professionals and key change agents.

According to the NCTM, mathematics instruction should align factual knowledge and procedural proficiency with conceptual knowledge. It should involve students in reflecting on their thinking and learning from their mistakes. It should also challenge students to learn increasingly more sophisticated mathematical ideas and should prepare them to apply their knowledge of mathematics to real-life settings.

A new vision of science instruction has also been developed—one that highlights the role of inquiry in science disciplines. According to the *National Science Education Standards*, as part of their science learning, students need to make observations; pose questions; examine information sources; plan and conduct investigations; review their current knowledge in light of experimental evidence; and use tools to gather and interpret data, propose explanations, and communicate results.

For more information on the mathematics and science education standards, see www.nctm.org/standards and www.nsta.org/standards.

Figure 1

Vision and Goal Setting

1

The fact that everyone wants to improve teaching and learning does not mean that everyone has the same view of high-quality mathematics and science instruction, nor that everyone has the same vision of how to go about the improvement efforts. Program leaders need to work to create a sense of “we’re all in this together,” not only at the beginning of any new initiative, but throughout the process.

Develop a Shared Vision with Top Administration Support

To create a successful, sustainable mathematics/science education improvement effort, programs need support from top district decision makers. This influential group has the power to establish policies and motivate school principals and teachers to dedicate their energies and resources to improving instruction in mathematics and science.

Everyone—the superintendent, members of the school board or local school council, and the leadership of teachers’ unions—must be approached and educated, so that there is a shared understanding of the program vision of high-quality mathematics and science instruction. Each leader should understand what effective instruction looks like and how

professional development helps classroom teachers learn to provide this kind of instruction.

EDUCATING ADMINISTRATORS

Program leaders should meet with district administrators early on to describe the vision for improvement. Explain how the program is in synch with district and state education goals, and present research supporting the effectiveness of the new approaches to mathematics and science education. Virtually all districts in the country are under pressure to improve student performance in mathematics, and increasingly in science, on state assessments. The assessments differ in each state, but many reflect the national mathematics and science education standards cited in Part One of this book. Point out these connections to superintendents and other district leaders, and build a case for the initiative, based on the premise that a new approach to mathematics and science education will be required if students are to meet the standards.

Following this “up front” work with district administrators, program leaders can contribute to regularly scheduled principal meetings or engage in one-on-one outreach to principals to promote the overall vision and goals of the initiative. Invite principals to visit classrooms and professional development events to observe program activities. Scheduling meetings to report on progress of the science or mathematics program is another approach to administrator engagement.

When key district administrators are engaged in initiatives over time, the efforts are more likely to move toward lasting change. Building a shared vision requires strategic planning, not only at the beginning of the initiative, but also as program activities and district needs evolve. (For more on this topic, see Chapter 9.)

□ **Building Administrator Support: A Team Approach**

To develop a vision of inquiry-based science instruction, some initiatives have sent district leadership teams to the National Science Resources Center Elementary Science Leadership Institute in Washington, D.C. While attending the institute, teams get together and begin drafting district plans for their science education program. ■

Remember That the Ultimate Goal of Professional Development Is to Improve Student Learning

Because time and resources for professional development are limited, it is essential that program leaders target priority needs within