CHAPTER 5

Professional Development

"Professional development for teachers should be analogous to professional development for other professionals. Becoming an effective science teacher is a continuous process that stretches from preservice experiences in undergraduate years to the end of a professional career."

NSES, P. 55

Chapter 5

Professional Development & Systemic Reform

The *Minnesota Science Framework* bridges the *National Science Education Standards (NSES)* and the *Minnesota Graduation Standards (MGS)*. The vision of the *Framework* is one in which all students engage in scientific inquiry to achieve understanding of and ability in science, and are able to use their science learnings in classrooms and in everyday affairs. This vision requires support from all parts of the science education system, not just classrooms. It recognizes that teachers are central to achieving the vision but that they cannot do it alone.

" Reforming science education requires substantive changes in how science is taught, which requires equally substantive change in professional development practices at all levels."

NSES p. 5

Reform that affects student outcomes cannot occur unless there are changes in other subsystems as well—assessment, science program, science education policy, and the professional development of teachers of science from the time teachers enter college and throughout their professional career. Previous reform efforts have usually focused on one element: curriculum. Systemic reform is about making simultaneous change in all elements of the educational system. The idea is to establish and achieve ambitious expectations, as well as improve opportunities for all students to achieve these expectations. Systemic reform refers to deep changes, perhaps best thought of as cultural changes at all levels that will ultimately lead to fundamental change throughout the system (Fullan & Stiegelbauer, 1991).

Teaching to this new vision of science education is an extraordinarily complex and uncertain activity. Cooney (1992) captures this by noting that the teaching standards "call for a manner of teaching in which ideas are not packages to be accumulated but terrain to be explored." Ball (1996) points out that our knowledge about students is incomplete, and that there is an inherent tension between teaching worthwhile content while at the same time honoring the ideas of students and teaching in ways that are responsive to students. These observations require that we think differently about professional development for teachers.

The NSES provide criteria for making judgments about science teaching and a continuous process of professional development, from preservice experiences throughout a teaching career. This chapter, grounded in the NSES, provides direction for teachers and others who design and deliver professional development.

Towards Standards-Based Professional Development

The air is filled with new phrases these days. One of them is the hyphenated phrase *standards-based*. There are repeated references to standards-based curriculum, standards-based teaching, standards-based professional development, standards-based science education, and the list goes on. What each of these means is far more uncertain and problematic than the easy assent that is so pervasive in our discussions about school reform. As Deborah Ball (1997) has observed, the "it" envisioned is elusive and the standards "documents are far from programs for practice." Even though the ideas in the standards documents will come to be better defined and understood and therefore more useful, Ball (1996) also notes that, "the more the ideas are concretely articulated, the more disagreements are likely to emerge." For the purposes of this *Framework*, standards-based professional development is understood as professional development that is purposefully aligned with the MGS for students and the NSES *Teaching and Professional Development Standards*. Together, these describe how teachers learn science, learn to teach science, and become lifelong learners and the conditions for quality professional development.

A Seamless Web of Professional Development

National Science Education Standards Professional Development Standards

- learning essential science content through the perspectives and methods of inquiry
- learning to teach science
- learning skills for lifelong learning
- indicators of quality professional development programs

The NSES and the MGS are based on the idea that understanding is a result of active construction by the learner. In order to make sense of information, learners must relate information to what they know, accommodate the learning if it is not compatible with previously held ideas, and use the new information in a variety of ways so that it becomes connected to their knowledge structures rather than remaining as isolated and useless as learning science factoids. In a similar manner, the professional development of teachers, preservice and in-service, needs to reflect the fact that educators construct their understanding, too. Teachers should learn science in ways similar to the ways they are expected to teach it. That is, through inquiry. A developmental perspective on how adults learn has implications for professional development. Professional development programs must take into account where teachers are on a continuum of change and knowledge, as well as changes in teachers' needs that occur over time.

Becoming and developing as a teacher is a journey consisting of a variety of encounters that lead to growth. Recognizing this, the NSES are purposeful in blurring the distinction between the needs of prospective teachers and practicing teachers while allowing that some of these needs are different. The reason for this seamlessness is that becoming and remaining an accomplished science teacher is a lifelong process. There are always practices to be improved, skills to be learned, and changes in knowledge and technology with which to keep current.

The NSES addresses professional development for in-service and preservice teachers in two chapters, "Science Teaching Standards" and "Standards for Professional Development for Teachers of Science." The standards for science teaching describe what teachers of science at all grade levels should understand and be able to do. The standards for professional development provide criteria for making judgments about the quality of professional development opportunities that teachers of science will need to implement the MGS and the NSES.

Preservice Teacher Education

Many state and national organizations have issued standards for mathematics and science teacher education. These documents provide a new picture of students, teachers and teacher education. The criteria that standards provide for making judgments about preservice programs can be used to engage teacher education faculty in discussions about effective preservice professional development programs, as well as to provide direction for them in terms of practices, policy and program development.

Transforming Teacher Education: A Minnesota Framework for Mathematics and Science (Simpson and Wallace, undated) provides a vision for the education of prospective Minnesota science and mathematics teachers: "Beginning mathematics and science teachers will be prepared to teach according to the vision of present and future national standards, and they will be prepared to continue learning new content and new ways of teaching throughout their professional lives." This vision reflects voluntary national standards and is informed by current reform efforts in Minnesota, namely changes in teacher licensure and the MGS. The structure for the achievement of this vision for Minnesota teacher education institutions is organized as follows:

1 Knowing mathematics and science

2 Knowing pedagogy in mathematics and science

3 Knowing students as learners of mathematics and science

4 Establishing an environment for learning mathematics and science

5 Developing as a teacher in mathematics and science

Each of these sections summarizes and synthesizes standards for what beginning teachers should know and be able to do, and describes experiences that enable them to develop their knowledge and skills. These are followed by a description of the roles and responsibilities of faculty in helping teachers develop their knowledge and skills and the characteristics of institutions which ground beginning teachers in an understanding of science and in a theoretical framework of how learners construct meaningful knowledge.

Effective Professional Development

Systemic reform calls for new forms of professional development. According to Dennis Sparks (1996), reform "will fail unless…accompanied by" professional development. The goal of professional development for teachers is increased student learning. This goal, which is consistent with the central purpose of systemic reform, is the key finding from a recent survey of more than 800 teachers by The National Foundation for the Improvement of Education (1997). The reason teachers participate in staff development opportunities is to improve student learning.

A wide range of professional development experiences are required to create and implement inquiry-based science programs. Loucks-Horsley (1996) notes that "educators need to know about the *Standards*; they need to know the *Standards*; they need to act upon the *Standards* as they influence the science learning of young people." This way of differentiating professional development needs is a reminder that reform documents such as this *Framework* are not intended or designed to be implemented directly, but serve as a guide—a framework—for the design of programs. "Knowing about, knowing, and acting upon the *Standards"* are complex tasks that, when taken together, underscore the need for high-quality preservice and in-service education throughout a teacher's professional lifetime. In the same spirit and intent as the content standards for learning, teachers will learn to investigate classroom practices through inquiry and use the results to make informed decisions about changes in curriculum, instruction, and assessment.

Effective professional development includes opportunities for teachers to:

- Learn subject matter in ways that reflect the complexity and spirit of the Standards.
- Learn content-specific as well as generic instructional skills.
- Use professional development standards in planning and conducting staff development activities.

Such criteria minimize one-shot, one-teacher-at-a-time, expert driven workshops in addition to changing their geography. Professional development experiences and opportunities are more likely to be held locally, closer to teachers' schools and classrooms.

Strategies for Professional Development

1. Immersion in Inquiry into Science & Mathematics
2. Immersion in the World of Science & Mathematics
3. Curriculum Implementation
4. Curriculum Replacement Units
5. Curriculum Development & Adaptation
6. Workshops, Institutes, Courses, Seminars
7. Action Research
8. Case Discussions
9. Study Groups
10. Examining Student Work and Student Thinking and Scoring Assessments
11. Coaching & Mentoring
12. Partnerships With Scientists & Mathematicians in Business, Industry and Universities
13. Professional Networks
14. Developing Professional Developers
15. Technology for Professional Learning

Loucks-Horsley et al, 1997

Professional Development Programs

Loucks-Horsley (1996) points out that professional learning experiences can and must take a variety of forms. This is something that we have not always appreciated or understood. Professional development is still too often thought of in terms of workshops or summer institutes that are generally single experiences. Most of these programs are designed without the collaboration of participants. Often their purpose is to introduce teachers to new curriculum programs or classroom teaching strategies. Many have been organized as independent training programs and are unconnected to other parts of the science program. Loucks-Horsley (1996) describes four general models of professional development. In brief, they are:

• **Individually Guided Staff Development.** This model may be summarized in four steps. First, the teacher identifies something that s/he is interested in or needs to learn. Second, the teacher develops a plan with outcomes. Third, the teacher participates in the learning activity, e.g., a workshop, reading, seminar, visit with a colleague or to another school, or some other experience. Fourth, the teacher summarizes and evaluates the experience. This may include a written report and/or a session with a supervisor or other colleagues.

• **Observation and Assessment.** Examples of this model are peer coaching and clinical supervision. The teacher and observer determine what should be observed, the methods to be used, and discuss the observations with the intent of identifying what the teacher does well and what areas the teacher may want to work on.

• **Involvement in a Development or Improvement Process.** The goal is the improvement of instruction, curriculum or assessment. The process usually involves a team of teachers and the learning occurs in a variety of ways. It may include reading, discussion, writing, training and/or a workshop. The result can be a plan for continuous improvement or a product such as a new curriculum unit/units or an assessment system.

• **Inquiry.** This is an action research approach and may involve a single teacher or a group of teachers in a collective inquiry. Inquiry involves identifying a problem or a researchable question, developing a plan to systematically collect data, analyzing the data, summarizing the results, and using the results to make informed classroom decisions designed to improve student learning.

In a current analysis of effective professional development, Loucks-Horsley, Hewson, Love and Styles identify and describe fifteen different strategies for professional learning that can be combined in unique ways to address particular needs for a given teacher population. These are listed in the sidebar.

Professional Development that Addresses Teachers' Concerns

Change is a key feature of learning, and research has shown that as teachers change their practices over time, they experience predictable stages in how they feel and think about change and how knowledgeable they are in using the change they are learning. The Concerns-Based Adoption Model (CBAM) (Loucks-Horsley & Stiegelbauer, 1991) is a developmental model that has broad application to teachers undergoing change, e.g., in the implementation of a standards-based, inquiry-oriented, science curriculum program.

Stages of Concern: Typical Expressions of Concern about the Innovation

Stages of Concern		Expression of Concern
6	Refocusing	I have better ideas about something that would work even better
5	Collaboration	I am concerned about relating what I am doing with what other instructors are doing
4	Consequence	How is my use affecting students?
3	Management	I seem to be spending all my time getting material ready
2	Personal	How will using it affect me?
1	Information	I would like to know more about it
0	Awareness	I am not concerned about it (the innovation)

Hord, Rutherford, Huling-Austin & Hall, 1987

Seven stages of concern have been identified: awareness, informational, personal, management, consequence, collaboration, and refocusing. In the early stages, teachers' questions are personal (I am not concerned about it. I would like to know more about it. What is it? How will this affect me?). As these issues and questions are resolved, the questions tend to become more task oriented (How can I manage this in my classroom? Are there ways to be more efficient? Are there better ways to organize this program? What do I need to do to…?). When these questions are answered, teachers are more likely to ask questions about effects (How is this change working for my students? Are they understanding major concepts? How can I make this work better?).

These stages must be taken into account in planning for and carrying out professional development. For example, if teachers are at the awareness stage and the workshop focus is on how to do inquiry, many will be frustrated and the atmosphere ripe for blaming. The CBAM model also calls attention to the importance of time. Research on this model has shown that it takes at least three years for initial concerns to be resolved and for the middle set of concerns to emerge. This underlines the importance of providing continuing support and reinforcement throughout this period, both of which are necessary if a change is to be successfully implemented. This includes opportunities to meet with others engaged in the same process, coaching, and mutual problem solving. Interestingly, even when the difficult parts of change are over and the new learning practice has become routine practice, teachers do not raise questions about student learning. The new emphasis on the links between assessment and student understanding, as well as instruction, requires that the effects of the change be considered. As has been pointed out, this must be a priority. Teachers who have mastered a new program or teaching strategy are in a good position to address issues of student learning.

Consideration of developmental models such as CBAM leads to designs that take into account time, settings, learning experiences, instructional expertise, the needs of participants for information and assistance, and changes that occur in participants over time.

" The teacher is a reflective practitioner who continually evaluates the effects of his/her choices and actions on others (students, parents, and other professionals in the learning community) and who actively seeks out opportunities to grow professionally."

INTASC p. 27

Professional Development Planning

Teachers face a smorgasbord of professional development opportunities every year. It is possible to sample many experiences that address a variety of personal and professional needs. These experiences are often random, discrete events, unconnected to each other and only tangentially connected to improved student learning. Planning for one's professional development provides a blueprint for purposefully aligned short and long term professional development that supports student attainment of standards.

Developing a coherent professional development plan is a different way of thinking and doing professional development from past practice. One major difference is the role that teachers play in their own education. It involves a tension between personal needs and the needs of one's professional community within the school, district, and/or department. The assumption that learning to teach science is something that teachers do rather than something that is done to them, changes the expectations and outcomes of professional development. Teachers have a major responsibility in their continuous improvement as professionals. Rather than merely being the targets of professional development activities, teachers help shape the process by deciding the scope and content of their own professional development. As members of a collaborative professional community, teachers reflect on professional development learnings, use what they have learned with students, and evaluate it based on classroom experience.

Reflection on practice has the potential to be a powerful educator because it promotes an analytic approach to one's own teaching. There are a great variety of reflective practices, such as collecting systematic data on the effects of a curriculum innovation on student performance, using a daily journal to gather information about professional practice, using a mentor or a supervisor to work together as observer and observed to develop a better understanding of instruction, using video technology to gather information about the nature of practice, working with a colleague to develop criteria for judging and interpreting student work and then applying these, etc. Hidden in these thumbnail sketches are strategies and techniques that must be learned, practiced and refined through use. These can be learned through reading, discussions with an experienced reflective practitioner, and in formal and informal learning settings.

An issue of interest in professional development is the nature of the relationship among the science, mathematics and professional development communities. Do these communities have a shared understanding of what effective professional development experiences look like? The Professional Development Project of the National Institute for Science Education (Loucks-Horsley, Stiles & Hewson, 1996) examined mathematics, science and professional development standards and found that there is a shared vision of professional development. This vision consists of seven principles and twenty-eight components that have been derived from best practices in the design of professional development. The principles and their respective components are summarized on page 5-9.

Minnesota law requires every school district to develop and implement a process for professional development planning. This includes the establishment of a representative staff development committee, the majority of which are teachers representing various grade levels, subject areas and special education. Also represented on the committee are school administrators, non-teaching staff and parents. School districts are required to report to the Minnesota Department of Children, Families & Learning the results of and expenditures related to district professional development. The

Principles of Effective Professional Development in Mathematics & Science

Loucks-Horsley et al. (1996)

Professional development experiences:

1 are driven by a clear, well defined image of effective classroom teaching and learning that includes

- a commitment to the idea that all children can and should learn science,
- a sensitivity to diversity of individuals, cultures, languages, races and gender,
- inquiry-based learning, student investigation and application of knowledge,
- a commitment to constructivism as a belief and action system not only on how people come to know but as the basis for how teachers learn themselves, one that allows participants to experience the restructuring of beliefs,
- more is less, i.e., in-depth study,
- collaborative work, and
- clear outcomes and the use of a variety of appropriate assessments, i.e., an assessment system rather than single assessments.

2 provide teachers with the opportunities to develop knowledge and skills and broaden their teaching approaches so they can create better learning opportunities for students that include:

- learning experiences that engage teachers in deep understanding of major concepts and pedagogy,
- strengthening teacher's pedagogical content knowledge (PCK) (cf. Chapter 2), and
- enabling teachers to make informed content decisions as well as integrating a set of meaningful learning experiences into a course of study.

3 use instructional methods to promote learning for adults which mirror the methods to be used with students that include:

- attending to and building on teachers' current science knowledge, skills, and attitudes,
- providing teachers with experiences and time to construct their understanding of concepts,
- being engaged in the same types of learning experiences that help students learn best,
- providing time to develop, practice, and reflect upon new knowledge and learning strategies,
- planning and designing for structured, ongoing support and feedback, and
- making the learning experiences explicit by tying them together through a comprehensive plan so that the goals, strategies, experiences, and follow-up become a whole.

4 build or strengthen the learning community of science teachers that include:

- promotion of and help with collegiality and collaborative professional exchanges,
- encouragement of risk taking in instruction (stretching their limits) and opportunities for classroom experimentation (action research), and
- the view of professional development as a lifelong process that is part of professional norms and culture.

5 prepare and support teachers to serve in leadership roles that include:

- participating in planning professional development experiences for themselves and others,
- acting as agents of change for systemic reform,
- promoting a shared purpose of science education and using it to ensure that learning experiences are congruent with it, and
- supporting colleagues.

6 consciously provide links to other parts of the educational system that include:

- being planful about school/district professional development activities, e.g., matching appropriate professional development with a new curriculum,
- aligning learning activities with curriculum, frameworks and assessment, and
- establishing active support within the school, district, and community for professional development.

7 make use of continuous assessment that includes:

- making short-term adjustments based on the satisfaction and engagement of participants, and
- in the long-term, evaluating the effectiveness of the program on teacher effectiveness, student learning, leadership, and the community.

district staff development plan must include staff development outcomes, the means to achieve the outcomes, and the procedures for evaluating progress at each school site toward meeting those outcomes.

Such plans represent a dynamic equilibrium. The cycle of learning, practice of what has been learned, reflection on the new practice, and evaluation of the value of that learning can promote the improvement of teaching. However, the likelihood of this occurring is greatly increased when professional development is done planfully, otherwise the experiences are likely to be chosen at random or based on convenience rather than with an eye to the long range outcome of improving student learning and understanding. While a causal relationship between professional development plans and increases in student understanding may be difficult to establish, it is useful to develop such plans with the view of improving student achievement.

A Guide for Planning

A commitment to planning for professional development ensures that personal and professional growth is coherent and is focused on improvement of children's learning. The following process, which is aligned with Minnesota staff development legislation, is designed to assist teachers in writing and developing personal professional development plans. This process, or a variation on the process, may be done alone or with colleagues. Your school district may have a professional development planning process for teachers or someone who can help you develop a plan. Typically such plans include the names of team members; relevant department/school/district goals; student goals; your goals; how the goals will be attained; resources needed; and indicators of progress. They are often signed by supervisors and relevant colleagues and sometimes integrated into a review process.

1. Set a Foundation

Use Chapter Three of the Minnesota Science Framework to review, revise and/or establish curriculum content standards for students. Establish building and/or department improvement goals that are related to student achievement of the standards.

2. Self Assessment

Use Chapters Two, Three and Four to assess your teaching practice (what you want students to accomplish) and determine professional development needs and strengths (what you want to learn or learn how to do, in order to help students achieve and be successful in science).

3. Determine Goals

Develop personal professional development goals related to your self assessment and the standards set in the first step. As a general rule-of-thumb, goals are personal, positive, stated in simple terms, written with a deadline, realistic, taken seriously, and usually achieved one or two at a time.

4. Develop Strategies & Resources

Determine the resources (people, course, workshop, coaching, equipment, etc.) and support needed to accomplish these goals. Chapter Six can be used to find sources for appropriate professional development. Chapter Five can be used to provide direction on the breadth and quality of your professional development plan.

5. Evaluation

Establish indicators for determining whether you are "getting there." Is your professional development plan meeting your needs? The needs of your department/school/district? What's working? What's not working? Why and/or why not? How do you know? What is needed to get better? Were timeline checkpoints met? How does a colleague evaluate your progress?

6. Set Your Plan

While professional development plans address professional growth needs, particularly intellectual growth, they are also constructed on current strengths. Your professional development plan is likely to include a variety of short term and long term experiences. Overall, the plan should be coherent. Short term experiences are typically ones that are 15 hours or less. Examples of these include faculty meetings, awareness conferences, guest speakers, field trips, professional conferences and directed workshops. Long term professional development may extend over weeks or even years. It has the potential to lead to the development of deep and lasting effects on teaching. Long term professional development experiences include peer coaching, mentoring, professional portfolios, journaling, action research and intensive study, including study groups, that include extended follow-up opportunities. Include a timeline with checkpoints along the way for evaluating your progress.

Resources

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