Developing a Professional Development Program Model Based on Teachers' Needs

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Abstract

This paper presents a model of a teacher needs-based (TNB) professional development program. The TNB model formed the foundation of three externally funded professional development programs. The objectives of this model are to maximize the effects of a professional development program, and to help participants sustain their learning over the long term. The goals, content, main activities, and structure of the present professional development program were decided based on teachers' and administrators' inputs. The structure of this model was a combination of traditional and reform types. The main activities of the programs were hands-on activities, collaborative work, reflections, discussions, self-monitored practice, and providing an inservice program. The effects of the program are discussed in the Findings. This study suggests ways to enhance professional learning: including the participants as decision makers and consumers, recruiting participants from the same context, connecting professional learning and practice, and building a partnership between university, public schools, and local education agents.

The technical and simplistic view of teaching held in the 70s and 80s proposed that the goal of inservice teacher education be to increase teachers' knowledge by bringing in outside expertise. In the 90s, the focus of professional development widened to include not only teachers but also the organizations to which they belonged (Loucks-Horsley, 1995). In recent years, effective professional development experiences have been designed to help teachers build a new understanding of teaching and learning through direct experience with strategies that help students learn in new ways (Garet et al., 2001).

Developing a Professional Development Program (PDP)

In order to develop a successful PDP, program developers go through both standard procedural and specific contextual issues. Jones and his colleagues (1992) listed the common issues considered by PDP developers: individually guided teacher activities, feedback on new teaching practices, opportunities for teacher input and involvement in establishing a PDP, an inquiry approach for addressing teachers' pedagogical problems, and generating a knowledge base that facilitates effective teacher decision-making. The remarks made by Jones and his colleagues are critical to success, and yet they are directly related to teachers or can be controlled by teachers.

Other issues to be considered in designing a PDP deal with specific contextual situations. Some of these issues are to be faced by teacher educators rather than classroom teachers. For example, providing resources, establishing organizational culture and structures, ensuring equity, developing leadership, supporting the effective use of standards and frameworks through professional development, and evaluating a PDP. Then again, additional contextual factors exist that are generated by those other than classroom teachers or teacher educators: the physical environment, policies, the local history of professional development, and parents and the community. Therefore, a PDP must be developed and conducted by classroom teachers, teacher educators, administrators, and parents/community collaboratively.

Features of a Successful Professional Development Program (PDP)

Adopting Multiple Strategies

Like other teaching and learning processes, professional development cannot be handled by an isolated strategy. Each program uses a variety

of strategies in various combinations. The National Staff Development Council (Sparks & Loucks-Horsey, 1990) identified five different models of effective staff development for teachers: training, individually-guided staff development, observation/assessment, involvement in the development/improvement process, and inquiry. Many program organizations have simultaneously adopted several strategies from among these five strategies, and successful cases have been reported.

Organizational Features

With regard to the PDP structure, workshops, seminars, and conferences are considered the traditional form of activity types while reform types of a professional development program use study groups, networking, mentoring, coaching, and regular school day meetings that may occur during the process of classroom instruction or planning time. The advantages of the reform types of professional development are that teachers are able to make connections with classroom teaching that are easier to sustain over time. In addition, they may be more responsive to how teachers learn, have more influence on changing teaching practice, and be more responsive to tea-chers' needs and goals (Ball, 1996; Darling-Hammond, 1997; Desimone et al., 2002; Garet et al., 2001; Stile et al., 1996).

Longer Duration

It is also suggested that the duration of professional development is related to the depth of teacher change (Shields, et al., 1998), which includes the span of time over which the activity takes place, as well as the number of contact hours that participants spend in the activity. Longer activities are more likely to provide in-depth discussions of issues dealt with in the professional development program, helping to understand new strategies, as well as to allow teachers to try out new practices in their own classroom (Desimone et al., 2002; Garet et al., 2001; Speck, 2002).

Building a Teacher Community

The participants of professional development may be a collective group or individual teachers from many schools. However, it is reported that a PDP designed for groups of teachers from the same school, department, or grade level has several advantages. For example, the teachers have the opportunity to discuss concepts, skills, and problems encountered during the professional development. They can also integrate what they learn with other aspects of their instructional contexts such as common curriculum materials, course offerings, and assessment requirements. The teachers can "discuss students' needs across classes and grade levels, as well as sustain changes in practice over time" (Garet, 2001, p. 922). This cohesiveness helps teachers keep their enthusiasm about new knowledge and novel applications, as well as to have these take hold and endure (Belcastro et al., 1992; Langberg, 1989).

Matching Purpose and Strategies

The content focus of a professional development program may vary: subject matter content, teaching practice, goals for student learning, ways students learn particular subject matter, and so on. Many educators claim that professional development should focus on both knowledge of subject matter as well as understanding how children learn specific content (Desimone et al., 2002; Garet et al., 2001; Hiebert et al., 1996). In 1998, Loucks-Horsley and her colleagues presented specific strategies that correspond to what the primary purpose of the professional development model is meant to be. Their model has been adopted and modified by many educators designing PDPs. First, in order to build teacher knowledge, it is recommended that teachers engage in the kinds of learning that they are expected to practice with their students. Secondly, curriculum implementation and curriculum replacement units can be used as fundamental activities for practicing teaching. Thirdly, creating new instructional materials and strategies to meet the learning needs of students is a suggested activity for translating theory into practice. Lastly, in order to promote reflection, conducting action research, discussing case studies, examining student work (and thinking), and organizing study groups are considered exemplary strategies for a PDP.

Present Research: The Teacher Needs-Based Professional Development Program Model

The professional development model introduced in this paper is based on three externally funded projects for different grade groups: K–3, 4–6, and 5–8. These projects were designed to fulfil local teachers' needs, which reflected their personal deficiencies in content or pedagogical content knowledge, students' needs, and/or new state/local education policy. The primary goal of this *Teacher Needs-Based PDP* was to deepen the participating teachers' conceptual understanding of mathematics content knowledge and pedagogical content knowledge by exposing them to innovative and creative approaches that necessitate active participation in developing mathematics concepts.

The goals, content, main activities, and structure of the present professional development program were decided based on teachers' and administrators' inputs. In order to design the program, information was collected from the following: Interviews with teachers and administrators, a survey, Standardized test outcomes, and local schools' improvement plans. These programs were constantly evaluated and modified throughout the year. The detailed process of program implementation is discussed in the sequel.

This study sought ways to maximize the effects of a professional development program (PDP) on teaching practice and to help teachers sustain their learning over the long term. Especially, this article investigates the following:

- How to develop the various phases of an effective professional development program: Beginning, during, and after?
- To what extent did the Needs-Based professional development program affect the participants' practice?
- What lessons did we learn from the TNB model to guide future professional development efforts?

The Need for a Needs-Based Professional Development Program

"Just once I wish our staff development days could be used to meet some of my needs, there are so many areas where I need help" (Olivero, 1976, p. 194). This teacher's comment depicts a typical in-service meeting. Decreasing enrollments and a lack of teachers' motivation for staff development may be due to in-service having been designed to cater to the masses in the school district. Another cause may be the emphasis that administrators place on the latest hot topics, rather than attempting to individualize and personalize professional growth plans (Bradley, 1996; Olivero, 1976). There have been calls for a form of professional development that is responsive to the intrinsic needs of teachers to be more productive, to change perspective, and encourage teachers to improve (Belcastro & Isaacson, 1992; Bolin & McConnell-Falk, 1986). Taken together, professional growth is possible when a professional development program responds to teachers' personal needs.

Identification of Needs

It is suggested that teachers who teach young students "need to determine what students already know and what they still have to learn. Information from a wide variety of classroom assessment—classroom routines, conversations, written work, and observations--helps teachers plan meaningful tasks that offer support for students whose understandings are not yet complete and helps teachers challenge students who are ready to grapple with new problems and ideas" (NCTM, 2000, p. 77). In other words, teachers need to focus on areas of weak student performance, as well as their own understanding of mathematics concepts and pedagogical techniques to improve these areas of deficiency.

In order to determine the needs for teachers/students and identify areas of deficiency in the local mathematics curriculum, the following data were collected and analyzed: interviews with teachers and administrators, a 'Teacher Needs' assessment survey, Statewide Standardized Test outcomes, and the Continuous Improvement Plans (CIPs) of local schools. The initial stage of developing the Teacher Needs-Based professional development program consisted of interviewing teachers and administrators in local school districts. These interviews were conducted to gather data about the teachers' and students' needs, as

well as contextual factors of the local school districts. Secondly, diagnostic survey studies were conducted to understand the needs of local school teachers. Thirdly, outcomes of the state standardized tests were analyzed to investigate the needs of students in terms of their deficiency areas, weaknesses, and strengths. Lastly, the CIPs of local schools were examined to understand each school building's efforts/policy toward better mathematics education.

Items on the teacher surveys focused on identifying the following: mathematics strands or areas of greatest student deficiency; mathematics strands in which teachers felt uncomfortable; methods by which teachers can become more comfortable teaching mathematics; strategies for addressing student deficiencies, types and frequency of student assessment; and mathematics strands that received little attention. Responses to the survey indicated that teachers' perceptions about areas of deficiency did not always correlate with deficiencies identified through test data analysis. Results also indicated that while our State Proficiency Tests use rubrics to evaluate students' written responses, the majority of the teachers seldom required students to write in mathematics and rarely employed the use of rubrics as part of the evaluation process.

Teachers suggested several ways to address deficiencies: more mathematics professional development; greater access to effective hands-on activities, teaching strategies, and research-based best practices; increased alignment of curriculum to state and national standards; and more emphasis on the need for adoption of a new mathematics program. These suggestions were considered and adopted throughout the project planning process. In addition, the mathematics topics indicated in the Standardized Test data as weak content areas received special attention during the projects.

Foundation of the TNB Model

The NCTM *Standards* (2000) provide a new vision of the mathematics classroom: the role of teachers is to hear students' ideas, to let students construct their own meaning, and to assess students' progress in alternative ways. The only way to practice this new idea of teaching mathematics in the classroom is if teachers themselves learn/do mathematics differently. In order to introduce different and yet successful ways of doing mathematics, the projects sought to build on and extend professional development projects such as the Cognitively Guided Instruction Project (Fennema & Carpenter, 1992), the Active Learning Model (Smith, Johnson, & Johnson, 1991), and Academic Systems Mediated Learning with Interactive Mathematics (Metlizky, 1996).

Moreover, the project planning team members concurred with Stiff's (2000) statements, which address the need for a supportive working environment, development of content knowledge and pedagogical strategies, and high-quality teaching materials.

Structure of the TNB Model

The common goals of the three projects were to (1) increase the participants' understanding of Ohio's Mathematics Academic Content Standards and the National Standards; (2) apply models of mathematics teaching strategies that involve active participation of the learner; (3) increase the participants' knowledge and application of alternative means of assessment; and (4) increase the participants' knowledge and application of effective questioning, writing, and discussion skills as an integral part of mathematics learning.

This TNB model set forth with a workshop form for a whole year. Each participant received 6–8 graduate credits from the university. The number of total contact hours differed depending on the total credit hours that the grant offered. Participants were required to attend an introductory special workshop during the Winter Quarter; five (or six) full-day meetings (Thursdays and Saturdays) during the Spring Quarter; a one-week workshop during the Summer Quarter; and three (or four) meetings (Thursdays and Saturdays) during the Autumn Quarter. The workshops were conducted through discussions, collaborative group work, hands-on activities, problem-solving opportunities, reflections, and presentations by the participants. On-site assignments included readings in textbooks and additional reading materials, audio and videotaping of participant lessons, writing reflection papers on these taped

lessons, developing lesson plans, solving mathematics problems with invented ways, developing a sample alternative assessment tool with rubric, and keeping reflective journals or writing one-minute papers on each workshop session. Each session started by sharing ideas/issues that arose in the reflective journals and homework and ended by discussing what they have learned, what questions they have, and which math topics they want the instructors to cover more.

Building a Teacher Community

To help foster a teacher community, at least two or three teachers were recruited from the same school district. These groups of teachers were subsequently expected to act as the nuclei of professional development groups in their own schools and districts, sharing their experiences at regional conferences/seminars and by running workshops. As an application of instructional strategies, participants organized a five-hour professional development program or a parental involvement program (such as a Family Math Night) within their respective school districts that focused on learning mathematics. The professional development yields indirect benefits, increasing the project participants' leadership abilities and introducing effective teaching strategies to other teachers who did not participate in the project. The parental involvement activity such as a Family Math Night increased parents' awareness of the National and State Standards and assisted them in helping their children become mathematically literate.

Evaluation of the TNB Model

The effects of a PDP can be assessed in the areas of teacher knowledge and skills, as well as teaching practice. According to a survey study by the U.S. Department of Education, teachers that participated in an efficient PDP report that their knowledge and skills were enhanced in the areas of curriculum, instructional methods, approaches to assessment, use of instructional technology, strategies for teaching diverse student populations, and the depth of knowledge of mathematics (Desimone et al., 2002; Garet et al., 2001). The teachers also indicated changes in their teaching practices in the domains of mathematics curriculum content, cognitive challenge of mathematics classroom activities, instructional methods employed, types of mix of assessment used to evaluate students, ways technology is used in instruction, and approaches taken towards student diversity. All these areas were taken into consideration in our project evaluation process.

The TNB Model was evaluated by participants, instructors, curriculum supervisors, and the project evaluator. The following tools were used to evaluate the effectiveness of the program:

- Survey studies and interviews: Pre- and post-study questionnaires were used to evaluate the overall project impact on participants' teaching. Follow-up interviews were conducted with several teachers.
- Concept maps: Concept maps were used to compare participants' entering and exit knowledge, beliefs, and attitudes toward teaching mathematics.
- Participants' assignments, including reflective journals, were reviewed to prepare the following sessions and to fulfill participants' needs.
- Site visits: The project team visited participants' classrooms and workshops/seminars conducted by participants to evaluate the project contribution to participants' teaching.
- Reflecting on practice: Participants recorded their own teaching in audio and/or videotapes for self-monitoring and self-evaluation of their own lessons. Participants exchanged audiotapes and/or videotapes (recorded their lessons) and provided comments on the teaching performance and classroom management of others.

Evaluation by project participants and instructors was an ongoing process. Communication through journal entries and informal conversations meant to exchange ideas were crucial factors in developing an effective/efficient program. Each session was designed to supplement participants' needs and areas of weakness, which had been identified by the instructors and/or expressed by

the participants. In addition, instructors held meetings before/after each session to reflect on the session, as well as to review participants' journals. Instructors visited all the participants' classrooms to observe their teaching, as well as to offer consultation. These visits provided instructors with information about the teaching situation/status of each participant, which helped the instructors understand the teachers' immediate needs. The curriculum supervisors, instructors, and the project evaluator visited participants' classrooms before, during, and after the project. These communications with teachers and site visits helped us assess the project's contribution to the teachers' teaching and its impact on their school buildings.

Findings: Effects of the Needs-Based Program

Table 1 is a summary of the professional development program that includes the role of systematic aids for project goals and observed outcomes. Through classroom discussions, interviews and written documents, such as journals and a follow-up survey, the participants and the project staff reported the effects of the TNB professional development program.

Table 1
Connecting the Project Goals, Systematic Aids, and Observed Outcomes

Project Goals	Provided Systematic Aids	Observed Outcomes
• Increase the participants' levels of understanding of Ohio's Mathematics Academic Content Standards	• Introductory workshop: Standards (state and national), General issues in mathematics education, Reform curricula, and Assessment • Hands-on activities from the regular workshop sessions • Sharing ideas and resources • Discussions after each activity • Class presentations • Developing inquiry-based lessons with children's literature and traditional textbooks • Sharing curriculum materials	• Participants clarified their beliefs about mathematics teaching and learning by explaining the need to change such beliefs in the light of current research, best practices, and the future needs of society. • Participants demonstrated conceptual understanding in mathematics by choosing developmentally appropriate mathematics experiences for their students. • Participants evaluated best practices to determine their effectiveness in meeting State and National Standards.
• Apply models of mathematics teaching strategies that involve active participation of the learner	• Hands-on activities from the workshop sessions • Collaborative group work • Class presentations • Reflection papers • Reflections on practice (video-taped lessons and audio-taped lessons) • Sharing curriculum materials	• Participants demonstrated teaching strategies, which could engage students in active participatory mathematics learning. • Participants appropriately used commercially and/or teacher developed curricular materials, including manipulatives, software, web-based course tools, and Internet sites.

(table continues)

Table 1 (continued)

Project Goals	Provided Systematic Aids	Observed Outcomes
• Increase the participants' knowledge and application of rubrics and alternative means of assessment	• Reflections on practice (video-taped lessons and audio-taped lessons) ‣ Clinical interviews with students and a report on the interviews ‣ Analyzing students' work/thinking ‣ Hands-on activities from the workshop sessions ‣ Discussions during the workshop	• Participants used videotapes of their own teaching in mathematics classes to reflect on and improve their instructional practices. • Project participants developed a sample alternative assessment tool that demonstrates students' understanding of mathematics concepts (e.g., clinical interviews, learning logs, systematic observations, annotated class lists, and portfolios). • Participants monitored student performance in mathematics by applying rubrics and keeping records of alternative assessment results.
• Increase the participants' knowledge and application of effective questioning, writing, and discussion skills as an integral part of mathematics learning	• Designing and providing Family Math Night or an inservice program in participant's own school building • Hands-on activities from the workshop sessions • Reflective journals • Reflections on practice (video-taped lessons and audio-taped lessons) • Sharing ideas and resources • Discussions during the workshop	• The participants provided evidence of effective questioning, writing, and discussion skills by posing "what if" questions, connecting mathematics to other subjects, and applying mathematical skills in a real life context. • Project participants conducted inservice workshops/seminars for their colleagues that demonstrate effective teaching strategies, as well as the ability to utilize questioning, writing, and discussion skills in their school districts.

Change in attitudes and beliefs about teaching mathematics: The teachers reported that they are not afraid of introducing innovative ways of solving mathematics problems anymore. It was observed that they were trying to adapt new/invented pedagogical strategies and alternative ways to assess their students' understanding/learning.

- Becoming more knowledgeable practitioners: The teachers started to investigate and modify the teacher resources based on the students' level and the objectives of the lesson. The participants became better able to find necessary information through various resources: internet, references, and experts.
- Being a reflective practitioner: The participants also reported that participating in this project helped them to become more reflective practitioners. The teachers noticed that they ask themselves 'why' and 'how' questions more often. By the end of the program, the teachers' concerns were not limited by personal matters or short-term solutions, but were able to set their sights on long-term goal.
- Creating a student-centered classroom: It was observed that the participants were trying to create a student-centered classroom. The teachers reported that they allocated more time for students to think about a problem, come up with their own solutions, and discuss why their solutions

work or why they do not work. However, it was still noticed that the teachers were threatened by the amount of concepts to cover in a short time period.

- Aligning with the Standards: It was also observed that participants took time to determine if their teaching goals and approaches met the standards recommended by NCTM and the State of Ohio, which was also one of the project goals.

Implications

What lessons did we learn to guide future professional development efforts? The primary goal of this study was to find ways to maximize the effects of a professional development program (PDP) on teaching practice and to help teachers sustain their learning over the long term. The TNB model considered all the barriers and facilitators in teachers' sustained implementation of new practices. This PDP model is applicable not only with mathematics teachers, but also with any professional educators. The following suggestions provide professional educators with insights into designing a professional development program.

Including the Participants as Decision Makers and Consumers

To determine what our participant teachers expected from the PDP, our project development teams found the data collected from the diagnostic survey to be beneficial. Teachers' desires varied and reminded us that planning a PDP should start with the ends (outcomes) in mind and that teachers should be encouraged to be involved in the planning process.

Some PDPs are often criticized because the activities are disconnected from one another. It is reported that activities are more effective in improving teachers' learning if they form a coherent part of a wider set of opportunities for teacher learning and development. In order to establish coherence among professional development activities, a PDP must be developed based on what participants need and what they already know. Also, it is better to focus on units and do one or two units per class. Needless to say, the professional development designer's challenge is to assemble a combination of learning activities that best meet the teacher's needs, goals and context.

Therefore, in order to develop an effective PDP, the project goals must respond to the potential project participants' needs and expectations of a program. Taken together, the program participants should be considered as partners throughout the process—planning their own learning experiences, implementing practices, providing feedback, and evaluating the program (Abbott, et al., 1999; Bradley, 1996; Fuchs & Fuchs, 1998).

Recruiting Teachers from the Same Context

The demand for professional development opportunities for certain grade groups was greater than what we were able to supply. This unbalance between demand and supply required serious discussion regarding the recruiting process of participants. As mentioned earlier, to increase the impact of the project, our project staff decided to recruit three or four teachers (one in each grade) per school, and to give priority to the schools that had a team of teachers with a strong commitment to the project. The advantage of this recruiting process was that teachers from the same building came to the program with an existing support group and the team would have a strong potential influence on the mathematics curriculum in their school system. In addition, having participants from the same school districts made possible to balance between meeting the needs of individual teachers and advancing the organizational goals of their schools and districts (Bradley, 1996).

Connecting Professional Learning and Professional Practice

Another issue that arose during the project was the teachers' expressed preference for summer classes over classes during the school year. They were, however, aware that such a schedule would deprive them of the opportunity to immediately incorporate their ideas into the classroom. Researchers have reported that one of the most formidable barriers in implementing new practices is the lack of time to implement a program (Abbott et al., 1999; Klingner et al., 2003). In order to connect professional learning and practice,

schools should stop just counting the hours or programs that a teacher participates in professional development. In addition, schools should provide participants with more time to grow, begin to measure what happens as a result of their participation, and provide teachers with follow-up to professional development, such as opportunities for practice in the classroom.

Building a Partnership Between University, Public Schools, and Local Education Agents

The fiscal agent (the university), several Education Service Centers (ESCs), the Regional Professional Development Center (RPDC), public schools, and the participant teachers had been working for several months toward the common goal of the project. Needless to say, this collaborative structure enhanced the project, and was an essential factor in building a teacher needs-based PDP. The participants' commitment to the program became much stronger and persistent when their ESC curriculum supervisor and principal supported them.

For the teachers, participating in the decision making process of a professional development program can be a vehicle for pursuing further professional development in a collaborative relationship with administrators (Belcastro et al., 1992; Conoley, 1989). Another advantage of conducting a PDP based on partnership is that the various areas of the participants' expertise complemented each other. For example, some of the planning partners had been involved in research-based reform curricula such as Connected Math, Discovery Math, Investigations (TERC), and Everyday Mathematics. Some of the partnering districts have mapped Ohio's curriculum standards to their school-based curriculum, and these partners started to take a leadership role in working with other districts to complete this objective. Furthermore, considering that "inadequate support from administrators" and "a lack of fit between the practice and other methods mandated by the school district" are known barriers to scaling up practice (Klingner, et al, 2003, p. 413), building a partnership between the professional development program provider and the administrators is one way of overcoming barriers.

Other Challenges

Professional development must address several challenges. First, the need to educate an increasingly diverse student population should be considered and understood along with the principal issue of the PDP that it must be relevant to student learning. Secondly, professional educators should be aware of the need to change as required by new goals, as well as the necessity for teachers and other professional educators to create new organizations as needed. In other words, higher education faculty (teacher educators) must realize that while the PDP is a critical component of reform, it cannot carry the reform movement alone. The PDP must be linked to those same clear goals for students as well as to school leadership, resources, staffing, and the needs of the national/state/local education community. Also, "top-down support for bottom-up reform" (Darling-Hammond et al., 1995) is needed.

Overall, for the best outcomes, a PDP should have an appropriate level of challenge and support, provide activities demonstrating new ways to teach and learn, build internal capacity, use a team approach, provide time for reflection, and evaluate the effectiveness and impact of the activities.

References

Abbott, M., Walton, C., Tapia, Y., & Greenwood, C. R. (1999). Research to practice: A "blueprint" for closing the gap in local schools. *Exceptional Children, 65*, 339–352.

Ball, D. L. (1996). Teacher learning and the mathematics reforms: What we think we know and what we need to learn. *Phi Delta Kappan, 77*, 500–508.

Belcastro, F. P., & Isaacson, D. K. (1992). Professional development: Problems and solutions. *Journal of Instructional Psychology, 19*(3), 143–147.

Bolin, F., & McConnell-Falk, J. (Eds.). (1986). Teacher renewal: Professional issues, personal choices. New York: Columbia Teachers College Press.

Bradley, A. (1996). Teachers as learners. *Teacher Magazine, 7*(9), 31–36.

Darling-Hammond, L. (1997). *The right to learn: A*

blueprint for creating schools that work. San Francisco: Jossey-Bass.

Darling-Hammond, L., & McLaughlin, M. W. (1995). Policies that support professional development in an era of reform. *Phi Delta Kappan, 76*, 597–604.

Desimone, L. M., Porter, A. C., Garet, M. S., Yoon, K., & Birman, B. F. (2002). Effects of professional development on teachers' instruction: Results from a three-year longitudinal study. *Educational Evaluation and Policy Analysis, 24*, 81–112.

Fennema, E., & Carpenter, T. P. (1992). Cognitively Guided Instruction: Building on the knowledge of students and teachers. In W. Sacada (Ed.), *Researching educational reform: the case of school mathematics in the United States* (p. 457-470). Special issues of *International Journal of Educational Research*. Elmsford, NY: Pergamon Press.

Fuchs, D., & Fuchs, L. S. (1998). Researchers and teachers working together to adapt instruction for diverse learners. *Learning Disabilities Research & Practice, 13*(3), 126–137.

Garet, M. S., Poter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal, 38*, 915–945.

Grant, S. G., Peterson, P. L., & Shojgreen-Downer, A. (1996). Learning to teach mathematics in the context of systemic reform. *American Educational Research Journal, 33*, 502–541.

Hiebert, J., Carpenter, T. P., Fennema, E., Fuson, K., Human, P., Murray, H., Olivier, A., & Wearne, D. (1996). Problem solving as a basis for reform in curriculum and instruction: The case of mathematics. *Educational Researcher, 25*(4), 12–21.

Joint Council of the State Board of Education and the Ohio Board of Resents. (2001). *Academic Content Standards: K-12 Mathematics*. Columbus, OH: Ohio Board of Education.

Jones, G. A., Swafford, J. O., & Thornton, C. (1992). An integrated model for the professional development of middle school mathematics teachers. In J. A. Dossey, G. Jones, A. E. Dossey, & M. Parmantie (Eds.), *Preservice and inservice teacher education: The papers of working group 6 from ICME-7, Quebec City, Quebec, Canada, August 18–22, 1992*. Normal, IL: Illinois State University.

Klingner, J. K., Ahwee, S., Pilonieta, P., & Menendez, R. (2003). Barriers and facilitators in scaling up research-based practices. *Exceptional Children, 69*, 411–429.

Langberg, A. (1989). Key issues for teacher empowerment. *Holistic Education Review, 2*(1), 40–42.

Loucks-Horsley, S. (1995). Professional development and the learner centered school. *Theory Into Practice, 34*, 265–271.

Loucks-Horsley, S., Hewson, P. W., Love, N., & Stiles, K. E. (1998). *Designing professional development for teachers of science and mathematics*. Thousand Oaks, CA: Corwin Press.

Metlizky, L. (1996). *Medicated learning with academic systems at California State Polytechnic University, Pomona.* Pomona, CA: California State Polytechnic University, Pomona.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston. VA: Author.

Olivero, J. L. (1976). Helping teachers grow professionally. *Educational Leadership, 34*, 194–200.

Shields, P. M., Marsh, J. A., & Adelman, N. E. (1998). *Evaluation of NSF's Statewide Systemic Initiatives (SSI) Program: The SSIs' impacts on classroom practice.* Menlo Park, CA: SRI.

Smith, K. A., Johnson, D. W., & Johnson, R. T. (1991). *Active learning: Cooperation in the college classroom*. Edina, MN: Interaction Book Company.

Sparks, D. (1994). A paradigm shift in staff development. *Education Week, 42*.

Sparks, D., & Loucks-Horsey, S. (1990). *Five models of staff development*. Oxford, OH: National Staff Development Council.

Speck, M. (2002). Balanced and year-round professional development: Time and learning. *Catalyst for Change, 32*(1), 17–19.

Stiff, L. J. (2000). *National Council of Teachers of Mathematics News Bulletin*. Reston. VA: National Council of Teachers of Mathematics.

Stiles, K., Loucks-Horsley, S., & Hewson, P. (1996). Principles of effective professional development for mathematics and science education: A synthesis of standards. In *NISE Brief* (Vol. 1). Madison. WI: National Institutes for Science Education.