

# Pre and In-Service Education of Mathematics Teachers

Hooda, D. S.

Jaypee Institute of Engineering and Technology (JIET), A. B. Road, Raghogarh,  
Distt. Guna, M. P. 473226, India; Email: ds\_hooda@rediffmail.com

(Received July 21, 2009. Accepted December 15, 2009)

In the present paper we give a brief account of importance and necessity of pre and in-service education for professional development of mathematics teachers. We discuss some critical issues and new strategies for enhancing professional development. A few new strategies for professional learning are also explained. In the end some observations and suggestions are mentioned for implementation

*Keywords:* academic culture, new strategies, technology proficient, professional learning, professional development

*MESC Classification:* B50

*MSC2010 Classification:* 97B50

## 1. INTRODUCTION

“You can’t teach what you don’t know,” but too many of our mathematics teachers may be doing exactly that: they are teaching what they do not know. They are not well equipped with knowledge and skills of teaching mathematics. During my forty years’ teaching from school level to university I have gathered that mathematics learning depends how and by whom it is taught. The only way to achieve better mathematics education is to have better mathematics teachers who have the ability to conduct workshops, facilitate group discussions, and create professional development activities for colleagues in the school whilst acknowledging the school’s context and culture. This requires a radical reform; and for that, university departments must do a better job of teaching of their students (pre-service professional development), schools of education should start to emphasis on the importance of the knowledge of subject matter context and state that governments should embark on large scale and make systematic efforts to retrain the mathematics teachers already in the classrooms.

In the present paper we discuss about pre and in-service education leading to professional development of mathematics teachers. We also focus on critical issues for enhanc-

ing professional development and new strategies for professional learning.

## 2. PRE-SERVICE MATHEMATICS EDUCATION FOR TEACHERS

In fact there has been growing dissatisfaction with traditional approaches to teacher education. Educators have indicated that teacher education programs are not adequately preparing teachers for future conditions and needs of students. In recent years teacher's preparation is emerging as a critical factor limiting the contributions of new technologies to improved learning. Central and state governments and local agencies are investing heavily to equip schools with computers and modern communication networks. If our information technology investments are to pay off in improved education, these future teachers must be technology-proficient educators who should know how to use these modern learning tools to help students to meet high standards.

The following excerpt from the National Council of Teacher Education Technology and the New Professional Teacher: Preparing for the 21st Century Classroom illustrate the need for pre-service reform:

*“To what degree is higher education institutions meeting their responsibility for preparing tomorrow's classroom teachers? Bluntly, a majority of teacher preparation programs are falling far short of what needs to be done. Not using technology much in their own research and teaching, teacher education faculties have insufficient understanding of the demands on classroom teachers to incorporate technology into teaching. Many do not fully appreciate the impact technology is having on the way work is accomplished. They undervalue the significance of technology and treat it as merely another topic about which teachers should be informed. As a result, colleges and universities are making the mistake that was made by P-12 (Pre-Kindergarten – Grade 12) schools; they treat ‘technology’ as a special addition to the teacher education curriculum-requiring specially prepared faculty and specially equipped classrooms-but not a topic that needs to be incorporated across the entire teacher education program. Consequently, teachers-in-training are provided instruction in computer literacy and shown examples of computer software, but they rarely are required to apply technology in their courses and are denied role models of faculty employing technology in their own work.”*

The reasons for these deficiencies in mathematics teachers' education programs are identified as given below:

- a. Many programs of mathematics teachers' education lack the hardware and software essential to strong programs. These programs are often given low priority for special technology funding on their campuses and therefore are denied essential technology.
- b. Many teachers' education faculty lacks the knowledge and skill to incorporate technology into their teaching. Similar to P-12 teachers, they have not been provided the training they need to use technology successfully.

- c. A majority of teachers' education department and colleges have not been able to invest in technical support required to maintain a high quality technology program.
- d. Some higher education faculties are out of touch with what is happening in schools. They have little understanding of the vast changes that are occurring in P-12 classrooms as a result of the introduction of technology and of how they must change their own instruction to stay abreast of changes in the schools.
- e. Teachers' education programs are driven by an academic culture that rewards and recognizes individuality among faculty.

School administrators, parents and students will expect all future teachers to be well-prepared, technology-proficient educators. To develop technology-proficient teachers requires pre-service education that may prepare prospective teachers and practicing teachers to reach high standards including 'skill in using a wide range of teaching strategies and technologies'.

In order to address these issues it is imperative that higher education take a leading role in brokering statewide collaboration, developing pre-service educational training and disseminating information to all stakeholders. To prepare for the commitment needs to develop technology-proficient teachers of the next millennium.

### 3. IN-SERVICE EDUCATION FOR MATHEMATICS TEACHERS

For 21st century, professional development of mathematics teachers must address several challenges, such as the need to educate an increasingly diverse student population, the change required by new goals for schooling, and the necessity for teachers and other educators to function well and to create new organizations as needed. Thus in-service education is a critical ingredient of mathematics education reform. Effective professional development experiences are designed to help teachers build new understanding of teaching and learning through direct experiences with strategies that help students learn in new ways. Many educators and organizations have endeavored to clarify the characteristics of effective professional development in mathematics education (Clarke, 1994; Loucks-Horsley, Hewson, Love & Stile, 1998; National Staff Development Council, 1995a; 1995b; 1995c).

We enlist the principles that shape effective in-service education for mathematics teachers:

- (i) Professional development experiences are driven by a well-defined image of effective classroom learning and teaching. The opportunities are provided to the

teachers to build their knowledge and skills.

- (ii) New strategies are modeled that teachers will use with their students.
- (iii) Teachers are supported to serve in leadership roles.
- (iv) Links are provided to other parts of education system.

A decade ago, Jones *et al.* (1992) discussed major concerns regarding the need for professional development programs, which are as given below:

- a. Actively promote “individually guided” teacher activities;
- b. Generate the conditions for significant follow-through and feedback on new teaching practices;
- c. Provide opportunities for teacher input and involvement in establishing and developing the professional development program;
- d. Support an inquiry approach for addressing teachers’ pedagogical problems; and generate a knowledge base for effective teacher decision-making.

Although these concerns are still critical to success, several new issues should be considered when designing in-service education programs. These include: ensuring equity, building professional culture, developing leadership, building capacity for professional learning, scaling up, generating public support, supporting the effective use of standards and framework through professional development, and evaluating professional development.

It is important for educators to understand that professional development cannot be pre-specified in a standard format; the environment in which program is implemented is valuable. Designers need to consider contextual factors as they plan programs. Factors such as students, teachers, the physical environment, policies, resources, organizational culture, organizational structures, and the local history of professional development, along with parents and community, must be considered when developing new programs.

#### 4. NEW STRATEGIES FOR PROFESSIONAL LEARNING.

Professional development does not occur as an isolated strategy. Every program uses a variety of strategies in various combinations. There are five different models of effective staff development/improvement for teachers which can be used singularly or in combinations. These have been identified: training, guiding staff individually, observation/assessment, involvement in development process and inquiry.

Loucks-Horsley, Hewson, Love & Stile (1998) discussed specific professional development strategies (learning experiences) with different purposes indicated by Brown & Smith (1997). Several different institutions or organizations adopted these strategies

correspondent to the professional development models. For the primary purpose of building teacher's knowledge, recommended strategies are: engaging in the kinds of learning that teachers are expected to practice with their students; participating in workshops, summer or winter institutes, courses, and seminars; interacting in person or through electronic means with other teachers to discuss topics of common interest; and using various kinds of technology to learn content and pedagogy.

It is suggested to create new instructional materials and strategies to meet the learning needs of students. For the best effect of these strategies we require voluntary participation, clear expectation, an established procedure, content knowledge, and district or school administration support. Strategies related to teaching practice include curriculum implementation, curriculum replacement units, working with experienced teacher to improve teaching and learning through a variety of activities.

We can use action research, case discuss, examining students work, and study groups as the strategies for the promoting reflection. To achieve desirable outcomes when using these strategies, access to research resources, time, administrative support and atmosphere conducive to experimentation and opportunities to share the results of their research, should be taken in view.

## 5. SOME OBSERVATIONS AND SUGGESTIONS

In the broader terms there are two kinds of in-service professional development: enrichment and remediation. The first is devoted to enlarging the mathematical knowledge of teachers who are already at ease with the mathematical demands in the classroom. The goal is to inspire them to even higher levels of achievement, while, the object of the second is to ensure, as far as possible, that the teachers achieve an adequate understanding of standard classroom mathematics. However, I am of the view that the major need for many teachers who attend in-service professional development programs is for more robust mathematics background, so the first order correction has to be about mathematics.

Actually, in-service education in mathematics is quite different from ordinary teaching and is essentially a race against time: how to do something in a mere three or four weeks' workshop or summer institute could overcome teachers' non-learning or inactiveness for many years? Thus for in-service education for mathematics teachers, time is the greatest constraint. It is an admitted fact that there is no universal agreement on special features of in-service education; however, the following is a minimal list of my suggestions for enrichment of in-service education for mathematics teachers:

- Professional learning should be taken as and relevant to student learning.

- Keep the mathematics simple and relevant to K–12 (Kindergarten – Grade 12).
- Schools must stop counting hours or programs that a teacher participates in professional development, and start measuring what happens as result of their participation.
- For successful professional development, efforts should be made to use a judicious mixture of lecturing and discovery method.
- Professional development initiative in mathematics should have an appropriate level of challenge and support; provide demonstrations to teach and to learn; provide time for reflection; evaluate the effectiveness and impact of the activities.
- Planning in-service education should start with keeping outcomes in view and encourage teachers to participate in the planning process.
- For the purpose of teaching meaningful mathematical presentation in in-service education programs should be framed to needs of teachers of different grade levels like elementary, middle, high or senior secondary schools.
- There should be year-round follow-up programs to monitor the teachers' progress.
- There should be a combination of learning activities that can meet the specific goals and context.
- Teachers should be paid for participation in in-service professional development programs.
- In-service educational programs should be viewed as a critical component of reform. It should be linked to aims and clear goals for students as well as assessment, pre-service teachers' education, school leadership, resources, and staffing.

## REFERENCES

- Brown, C. A. & Smith, M. S. (1997). Supporting the development of mathematical pedagogy. *The Mathematics Teacher* 90(2), 138–143. ERIC EJ538323
- Clarke, D. (1994). Ten key principles for research for the professional development of mathematics teachers. In: D. B. Aichele & F. Coxford (Eds.), *Professional Development for teachers of mathematics: 1994 yearbook* (pp. 37–48). Reston, VA: National Council of Teachers of Mathematics.
- 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 (pp. 107–113). Normal, IL: Illinois State University.
- 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.  
ME 1998d.02411

National Staff Development Council (1995a). *Standards for Staff Development: Elementary School Edition, Study Guide*. Oxford, OH: Author. ERIC ED451581 Available from:

<http://www.eric.ed.gov/ERICWebPortal/contentdelivery/servlet/ERICServlet?accno=ED451581>

\_\_\_\_\_ (1995b). *Standards for Staff Development: Middle Level Edition, Study Guide*. Oxford, OH:

Author. ERIC ED451582 Available from:

<http://www.eric.ed.gov/ERICWebPortal/contentdelivery/servlet/ERICServlet?accno=ED451582>

\_\_\_\_\_ (1995c). *Standards for staff development: High school*. Oxford, OH: Author.

