

Broadening Educational Access to Mathematics in Maine: Professional Development Approaches

Francis Eberle- Executive Director, Maine Mathematics and Science Alliance.
Cheryl Rose – Senior Mathematics Program Director, Maine Mathematics and Science Alliance.

Introduction

The Broadening Educational Access to Mathematics in Maine (BEAMM) project was a National Science Foundation funded Local System Change project for seven rural districts focusing on building grades K-8 teachers' mathematics understanding and curriculum implementation. The participating districts were identified in 1998 by the Maine Department of Education as not meeting Adequate Yearly Progress for three consecutive years based on low student performance in mathematics on the state assessment exam. The seven districts, with approximately 500 K-8 teachers and 13,000 students, are located across the state ranging in size from three to 9 grades K-8 schools with an average poverty level of 40%.

The BEAMM project was managed by the seven partnering districts, the Maine Mathematics and Science Alliance (MMSA) and mathematics faculty from Colby College. The goal of the BEAMM project was to increase student aspirations and performance in mathematics by providing professional development and high quality curriculum for all K-8 teachers of mathematics in the seven school districts. The specific objectives for the teachers in the BEAMM project were to:

- Understand mathematical ideas and pedagogy for long-term student learning and achievement.
- Create student-centered classrooms by using exemplary instruction, curriculum materials, and assessment practices.
- Reflect on practices and participate in collegial discussions about teaching and learning.
- Utilize and build mathematics knowledge and skills through professional development experiences for all the LEA's teachers.
- Develop teacher leaders for building local capacity.
- Provide support for the adoption and implementation of curriculum programs as a way to implement exemplary mathematics instruction.
- Institutionalize assessment, reflection, and improvement in instruction as a regular part of teacher activities.

Professional Development

BEAMM implemented a professional development model with multiple approaches for reaching all K-8 teachers who teach mathematics through opportunities for more than 100 hours of professional development. The challenges of working across seven districts with separate governance structures and policies, which are geographical dispersed and isolated due to distances from each other, was great. To address these conditions, several professional development formats were provided including; summer institutes, day long conferences, face-to-face meetings, district based study groups, teacher networks, electronic networks, and a

corps of teacher leaders to work within districts to support the implementing teachers. The mathematics content for the professional development was based on national and state standards and was reinforced through the selected exemplary curricula. The curricula implemented at each of the seven school districts emphasized high quality content, developmentally appropriate sequences of ideas, and pedagogy and assessment promoting greater mathematical understanding and opportunity for the students in the seven districts.

To support and sustain the various exemplary curriculum implementation efforts various networks were established. These networks were designed to be on-going and flexible to respond to questions and issues from teachers as a part of their regular work not something done just after school or in the summer. To facilitate the growth of the networks, the BEAMM districts committed to:

- (1) Providing cross grade face-to-face meetings for teachers;
- (2) Implementing exemplary mathematics curricula;
- (3) Creating and maintaining K-12 mathematics committees;
- (4) Releasing teachers for 5 days during the year to work on BEAMM activities;
- (5) Fostering single or cross grade study groups during the year; and
- (6) Enabling the building of mathematics expertise through teacher leaders.

The BEAMM partners all had representation on a project Advisory Board that guided and facilitated the project at the leadership levels. The Advisory Board met three to four times a year to review data on progress, develop and review district professional development plans, to share specific strategies and to develop a network of professionals doing the same work. The Advisory Board was very important to the coherence of the project across the districts.

Targeted Strategies

The sequence of teacher learning was to first build knowledge in mathematics and the use their selected curricula. Then the project provided additional content and content pedagogy support. The professional development activities focused primarily on gaining a deeper understanding of the instructional philosophy, mathematical content, and assessment features of a specific curriculum program. There was also professional development for teacher leaders and administrators that included the additional components of adult learning, the change process and facilitation skills. Changes were made in the second year from the original plans and the project began to offer separate parallel components for the different audiences of teachers, teacher leaders and administrators. It became apparent that we needed some differentiation of professional development and different levels of teacher audiences were identified not including the administrators. These levels were beginning, reflecting and refinement.

Classroom and Specialist Teachers

The professional development needs for classroom teachers and specialist teachers such as special education or title I teachers are different during the implementation of a curriculum. The move by teachers from the initial stage of just using the curriculum as it was intended to be used to a stage where teachers are able to refine and improve lessons within the curriculum. The different stages are similar to the CBAM stages of innovation (Hall and

Hord, 2001). The teachers needed to be able to first understand the new curriculum, then overcome the management issues at the same time following the learnings of their students. They needed to examine and experience what content the curriculum was trying to teach their students and how that fit with state and national standards. This stage was the most difficult as many of the long held beliefs about mathematics surfaced. A final stage developed after they fully accepted and understood the content, approach and philosophy of the curriculum program. We called the final stage the refinement stage where teachers saw content gaps in the curriculum and had implementation concerns which they believed could be improved. These stages and what the project did to address the different teachers needs are described in more detail below and are labeled; Level I: Beginning Stage of Implementation, Level II: Implementation with Reflection, and Level III: Implementation with Refinement.

Level I: Beginning Stage of Implementation

Here an implementation plan is in place to phase in a new curriculum program. Most teachers have seen overviews of the program and a small number of teachers have piloted portions in the classroom. Professional development initially includes helping teachers understand the content, organization, the instructional approach, and the assessment components during summer institutes. The professional development is continued during the school year focusing on learning issues of beginning implementation such as choosing a management system for grading/assessing, tracing a content strand through the grades, and experiencing the activities. Many issues that were discussed at the initial training are revisited with more in-depth questions and discussions. Level I trainings included 5 day summer institutes specific to the *Investigations*, *Everyday Mathematics*, *Math Trailblazers*, *Connected Mathematics*, and *MathThematics* programs.

Level II: Implementing with Reflection:

The majority of teachers at this level have participated in at least one full year of implementing the mathematics curriculum program. Professional development at this level is designed to focus on how the program is being taught in each classroom. Topics, goals, and outcomes included at this stage are pacing, instructional techniques, use of technology, student grouping, changes in assessment strategies, and looking at student work to discuss student understanding of a concept and to increase teacher understanding of providing feedback that enhances student learning. Two-three day summer workshops and during school sessions were designed for each of the specific programs that allowed teachers to look more closely at the program as a cohesive whole. Since day to day management is no longer a concern, activities were designed to focus on student learning by triangulating evidence aligned to program learning goals and to district and state expectations. These professional development sessions were held as district in-service days, grade level meetings, and study groups as well as cross-district regional workshops. Session activities included clarifying learning goals using standards and research, using common assessments to view multiple student approaches, and establishing standards-based assessment practices all specific to the program as chosen. Specific sessions, designed and facilitated by peer leaders, were also held for special educators at the stage.

Level III: Implementing with Refinement

The teachers at this level have been implementing the curriculum for several years, have participated in a variety of professional development activities at the initial and reflection stages, and are very comfortable with the instructional philosophy, mathematical content, and assessment features of the program. Professional development for teachers at this level of implementation is now focused on refinement of content and teaching processes. Strategies include institutionalizing assessment, reflection and improvement as a regular part of teacher activities by researching and discussing best practice, peer observations, looking at student work to identify growth in learning, misconceptions, and trends in student thinking, and continued enhancement of teacher content knowledge (beyond using activities from the program). Sessions were held as cross district regional workshop not necessarily tied to a specific program. The teachers studied standards and research on student learning to discuss learning paths of a topic, designed assessments to target learning goals, and developed strategies for differentiating instruction.

The teachers at this stage may have been using the curriculum or something similar before the project so they were at this stage at the beginning of the project. These are often the innovators or teachers who volunteer for professional development and have more experience with what are the current strategies for teaching mathematics.

Leadership Component

The BEAMM partnership required that each district build their internal capacity to carry out professional development activities for the length of the project and afterward. This was a sustainability strategy within the BEAMM project. To accomplish this, BEAMM provided leadership training for teachers and administrators from the seven school districts. The teachers were self-selected, nominated by their district and by the BEAMM Advisory Group. The teacher leadership training first included aspects to enhance the leaders' content and pedagogical knowledge, as well as a strand on presentation, adult learning, and working with various groups within the districts. They became leaders and facilitators in their districts professional development offered during the school year. For the most part, those involved in leadership remained in their roles during the 5 year project, although new leaders were included each year. New leaders were mentored through participation in the BEAMM advisory board and by attending leadership institutes designed and implemented by the developers of the chosen curriculum program. As leaders matured and were more reflective about the implementation process, new offerings were designed and offered to meet their needs. These sessions included topics such as; using standards and research to enhance group discussions, data and evaluation, and incorporating effective professional development strategies such as case discussions, Curriculum Topic Study (Keeley. 2005), and action research into the school day.

Building level administrators were invited to attend the initial and ongoing professional development sessions provided to the teachers. This provided them with a sense of the project's goals. Some sessions were designed around the specific roles and responsibilities such as the EDC's *Lenses on Learning* program and additional sessions on classroom observation and evaluation techniques of a standards-based classroom. Due to the high level of building administrator turnover, *Lenses on Learning* modules were offered during each of the last three year of the project. Administrators also came to the Advisory Board meetings

and although these meetings were not professional development in the traditional sense, they provided great learning opportunities for the participants. The issues discussed were relevant to implementation of mathematics instructional strategies and programs, data use and professional development plan development. Each Advisory Board meeting provided an opportunity for district teams to share strategies and sometimes problem solve across district the challenges they were experiencing.

Impact on Teacher Thinking and Practices

All of the NSF funded Local System Change projects participated in a core evaluation program which included a survey developed by Horizons Research, Inc. The self-reported teachers’ data from this survey shows statistically significant increases in the composite scores for pedagogical preparedness, content preparedness, investigative culture, investigative practices, collegiality and resource availability from the beginning to the end of the project. See Table 1

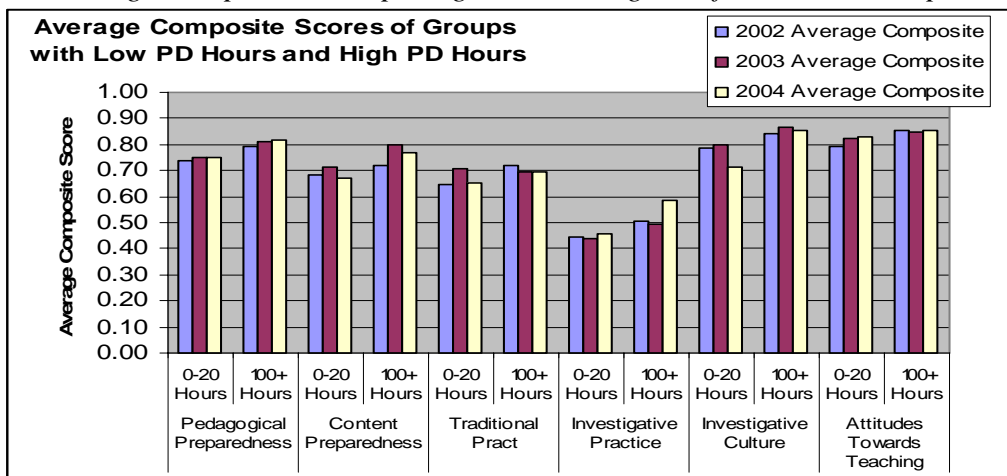
Table 1: Horizon Teacher Survey Composites

Teacher Composite Means	1999	2004
2. Attitudes Toward Teaching	85.91	84.18
3. Pedagogical Preparedness	71.53	78.99*
4. Content Preparedness	65.3	73.90*
5. Traditional Teaching Practices	67.15	68.58
6. Investigative Culture	74.93	82.79*
7. Investigative Practices	44.53	47.00*
8. Collegiality	68.81	73.56*
10. Effect of Resource Availability	61	65.92*

Teachers reported that they were better prepared to teach and were exhibiting a higher level of investigative culture and practices in their classrooms. These two areas are positive results as reported by the teachers on their reactions to five year participation in the BEAMM project.

At the same time, for each of the last three years, a comparison was made of the average composite scores of teachers who have participated in less than 20 hours of professional development to those who have participated in more than 100 hours of professional development. The composite scores are all higher for the 100 + hours group of teachers as compared to the 0-20 hours groups. The most striking change is in the area of Investigative Practice (See Graph 1). In some cases such as in traditional practice, and attitudes towards teaching the composite scores within the 100 + hours group was not as high in the third year as it was in the first.

Graph 1: Average Composites Comparing Low and High Professional Development Hours



Challenges of BEAMM

The challenges of incorporating multiple levels of professional development included the ever present concerns for time, resources, and location. Each of these areas could be addressed in how we approached them, but the most challenging aspect of BEAMM that actually led to our multiple strategies to professional development, was the turn over of people at all levels of the system. We were aware that there would be mobility of the teachers and administrators in the BEAMM districts. However, the amount of movement that occurred was surprising, particularly among the administrators. The mobility of the teachers averaged about 30% while the administrators had between 68 to 100% turnover rate depending on the type of administrator. The education system as a whole was in constant motion of people moving in and out. The Table 2 shows the position and percent of turnover in the BEAMM project.

Table 2: BEAMM Educator 5 Year Mobility

BEAMM Districts	Reg. Ed Teachers	Spec Ed. Teachers	Administrators						
			District	Superintendents		Curriculum Coordinator/ Assist Superintendent		Principals/ Assistant Principals	
				#	Turn Over	#	Turn Over	#	Turn Over
	% Turnover	% Turnover							
Sanford	32.08	42.86	Sanford	1	1	1	0	10	6
U96	26.09	36.67	Union 96	1	1	1	1	4	3
SAD 34	24.53	53.85	SAD 34	1	1	1	1	6	3
SAD 60	21.84	41.67	SAD 60	1	1	1	1	7	5
SAD 63	31.91	25	SAD 63	1	1	1	1	3	0
U90	29.59	39.58	Union 90	1	1	1	1	5	6
U106	38.57	35.71	Union 106	1	2	x	x	3	3
Average	29.23%	39.33			114%		100%		68%

The professional development model and approaches taken were design to provide support for this type of change by addressing the various phases of teaching experience, knowledge of mathematics, role in the school and how to maintain coherence from one year to another. The three levels of professional development addressed the classroom teachers' experience in teaching and knowledge of mathematics, were more practice based (Mundry, 2005) and addressed the specific needs of teachers. The teacher leaders and administrators were engaged in BEAMM through the targeted support and focus on implementation issues. The Advisory Board helped support the teacher leaders and administrators in understanding the goals of the project, its strategies and feedback process for learning about and sustaining the improvement in mathematics. The idea that leadership is embedded at all levels of the system is important and recognized by others (Lambert, 1998, Fullan, 2001, and Mundry 2005).

Another challenge of BEAMM was the collection and use of data by the BEAMM districts. An initial audit within schools provided information that there needed to be a greater local ownership for assessing growth in the areas of curriculum, instruction, and assessment in addition to improved student performance. This information was used to design appropriate professional development opportunities to move the staff through the described three levels of

implementation. What was missing was an ongoing attention by districts to the data they were collecting and receiving. This included the analysis of the data and then including the results of the analysis in future planning. For example, some districts were challenged by disaggregating student performance data by school and subgroups to target professional development support for particular teachers. The process of review and planning was used in the Advisory Board, but several of the districts still had difficulty in developing an internal process for reviewing and applying the results of their data.

Conclusion

We experienced many successes in BEAMM; successes in raising student achievement, successes in engaging large numbers of teachers in many hours of professional development in mathematics, and successes in engaging administrators in becoming a part of the process of mathematics improvement. However, if we ask the question, if we knew what we know now what we would have done differently in BEAMM our answer to this question transcends the positive concrete results. We would have incorporated the multiple component professional development strategy for teachers, teacher leaders, and administrators from the start, with the caveat that those sessions are focused on mathematics, embedded in the practices of the teachers or administrators, coherent and held often and consistently. The content of the mathematics has to be strong but grounded in the standards and research on teaching and learning of mathematics. This practice based view is critical to helping teachers bridge their beliefs, practice and new techniques and approaches they are asked to incorporate. These are identified by others as qualities of effective professional development, Garret, Porter Desimone, Birmen and Suk Yoon (2001) and Weiss, Pasley, Smith, Bandilower and Heck (2003). Within that professional development there is recognition that the audience of teachers in any professional development experience may range from new teachers, career changer teachers, innovator teachers, and experienced teachers. We now call our approach differentiated professional development.

All levels of the system have to actively involve the multiple audiences simultaneously because district wide change is complex. Gamoran has identified; time to interact, curricular and professional development support, internal and external expertise, facilitating teacher learning, supporting teacher autonomy, teacher leadership to have resources in the hands of teachers and to build linkages across the system (2005). This idea of a rich involved collaborative professional development that is designed to meet many different needs is critical and it would be helpful to have this explicitly made clear in the beginning of any district improvement effort. This is no small task, but the idea of one size fits all for professional development needs to evolve the way that same concept has for meeting the needs of all students. To realize that all teachers do not bring the same knowledge, cultural backgrounds and experiences to a professional development experience is a great step forward to making the modifications and adjustments that are needed to meeting all teachers' needs.

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