In Focus ...Mathematics Curriculum Change in São Paulo, Brazil: A Model for Curriculum Development as a Continuous Process

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There is evidence that teachers, in general, do not implement ideas from curriculum reform movements in large scale in different countries (Rudduck, 1991; Burkhardt, Fraser, & Ridgway, 1990). Problems of curriculum implementation stem from the meanings that reform documents have for teachers. As Taba (1962) pointed out, curriculum change also involves teacher change. Research on teaching has demonstrated that teachers' confidence in changing their practice and the way teachers interpret and implement curriculum seem to be influenced by their knowledge and beliefs (Clark & Peterson, 1986). Teachers' knowledge and beliefs about mathematics, mathematics teaching and mathematics learning are strongly shaped by their previous experience as students of mathematics (e.g. Ball, 1988), and it is difficult to make significant changes in knowledge and beliefs in a short period of time (Schram, Wilcox, Lanier, & Lappan, 1988; Lappan, Fitzgerald, Phillips, Winter, Lanier, Madsen-Nason, Even, Lee, Smith, & Weinberg, 1988; Zilliox, 1990). Thus a continuous curriculum change process may be an opportunity for teachers to reflect on their practice, to interact and discuss the curriculum document ideas with others and, if teachers change and develop as a result of their participation in curriculum development, then the goals go beyond to get teachers implementing the ideas of an innovation, that is, the results have a greater impact than merely encouraging teachers to use specific methods.

The *Curriculum and Evaluation Standards for School Mathematics [Standards]* (NCTM, 1989) reflects the position of a national association in the United States, and it has been stimulating mathematics curriculum discussions in the country and abroad. Similarly, the state of São Paulo, Brazil, has been the leader of innovations related to curriculum development in Brazil. Brazilian mathematics curriculum documents such as *Proposta Curricular para o Ensino de Matemática para o 1° grau* (CENP, 1988a) and *Proposta Curricular para o Ensino de Matemática para o 2° grau* (CENP, 1988b) have similar emphases to those presented in the *Standards* and were published in São Paulo after much discussion, involving most of the teachers of the state of São Paulo in discussions of the proposed mathematics curriculum. D'Ambrosio (1991), analyzing the history of in-service education in São Paulo, concluded that it was mostly based on mathematical content, not on pedagogy before the *Proposta* documents. In contrast, the in-service education related to the *Proposta* reform was based on pedagogical content knowledge (Shulman, 1986) in addition to content knowledge.

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Analysis of the Proposta Documents from the Standards Perspective: Common Emphases and Differences

The *Proposta* and the *Standards* documents describe curriculum as more than a list of content. The *Standards* document defines *curriculum* as an operational plan for instruction that details what mathematics students need to know, how students are to achieve the identified curricular goals, what teachers are to do to help students develop their mathematical knowledge, and the context in which learning and teaching occur (NCTM, 1989, p. 1).

Although the Brazilian documents do not state a formal definition of *curriculum* they are based on the same ideas. The *Proposta* document for the 1-8 grade level states that

> A list of contents is not enough to characterize a curriculum. In mathematics, through many reform movements, such a list has not changed much. The big generator themes, numbers and geometry, have been the essential ones. However, such themes may be developed in different ways in different curricula, and it is the way in which these themes are discussed that characterizes a curriculum (CENP, 1988a, p. 11).

The *Proposta* documents emphasize mathematics as problem solving, communication, reasoning, and mathematical connections as do the *Standards*.

In both countries the documents discuss the purpose of having mathematics in the school curriculum and what it means to know mathematics. To know mathematics has been considered to equivalent to doing mathematics. The

documents call for discussions between the teacher and the students and among students in the classroom, emphasizing problem solving as an instructional practice. Teachers, as facilitators of learning, need to create an environment that encourages students to explore, test, discuss, and apply ideas to develop conceptual mathematical knowledge, the emphases being on mathematical ideas and conceptual knowledge rather than procedural knowledge of algorithms. The *Proposta* documents recommend extensive use of manipulatives at the 1-8 grade level, and the broad range of content includes plane and solid geometry, measurement, statistics, and probability. Estimation is also emphasized. The document acknowledges the need for students to know more than arithmetic, and it invokes Bruner's (1968) view of spiral curriculum to support this notion. Although the American document does not say anything about Bruner's view of spiral curriculum explicitly, it includes a similar discussion:

> An ideal 5-8 mathematics curriculum would expand students' knowledge of numbers, computation, estimation, measurement, geometry, statistics, probability, patterns and functions, and the fundamental concepts of algebra. The need for this kind of broadened curriculum is acute. An examination of textbook series shows the repetition of topics, approach, and level of presentation in grade after grade. A comparison of the tables of contents shows little change over grades 5-8 (NCTM, 1989, p. 65-66).

At the high school level, both the *Proposta* and the *Standards* documents, discuss what it means to have mathematics for all students. The objectives of schooling at the secondary level have been challenged. Some argue that secondary school serves to prepare students for life and work while others that it is to prepare for college. In São Paulo, the number of hours of mathematics to be taken in each high school grade (usually 3 grades) depends on the community where the school is located. Therefore, the curriculum document for this level presents suggestions of topics to be discussed as a function of the number of hours required and students' interests. Teachers can decide how deeply each content will be addressed. This is similar to the notion of the core curriculum presented in the *Standards*.

There are three significant differences between the *Proposta* documents and the Standards. First, the *Proposta* documents treat measurement as a link between the numbers and geometry themes when possible. Second, there is an emphasis on historical problems. Third, the use of technology is not addressed at all, even though students are supposed to be given opportunities to use calculators.

The Mathematics Curriculum Change Process

The emphases of mathematics teaching in São Paulo at the time in which the *Proposta* documents appeared were: 1) Preoccupation with skill training, procedural knowledge, memorization, repetition and imitation; 2) priority given to algebra, reduction of geometry and, in some cases, elimination of geometry; and 3) excessive formalistic way of treating mathematics. In general, the teaching of mathematics was not in correspondence with student's development, needs and interests (CENP, 1988a). In order to change that situation, isolated groups of teachers in the state started getting together to discuss the emphases of the previous curriculum document and the relationship between that document and teachers' practices in classrooms. These discussions led to the conclusion that there was a mismatch between the previous curriculum document's suggestions for mathematics teaching and teachers' practice. Further, most of the teachers were not familiar with the curriculum they were to be teaching, so they relied heavily on textbooks. Also, the previous mathematics curriculum had been written by three people, analyzed and modified by a group of thirty people only, and disseminated in a complicated model in 1976.

As a result of the discussions by groups of teachers and the government's desire to involve most of the teachers in the state in curriculum development, the *Proposta* documents were developed with the intent of producing a process of continuous curriculum change. Also, the discussion of the mathematics curriculum was inserted in a broader curriculum change process for all areas of study in the state. The curriculum drafts documents were written by a group of teachers with the assistance of university professors. These teachers were on leave from teaching and such a group (state mathematics staff) had already existed in the state educational system. Writing the curriculum documents was an additional task for them. The mathematics group was composed by 10 people. Three university professors served as consultants. A strategy of discussing curriculum materials with teachers using discussion leaders had existed in few regions of the state since 1976. In 1984 all regions of the state were stimulated to have its mathematics discussion leader who was a mathematics teacher on leave from teaching. The model of curriculum change described below is more closely related to the discussion of the *Proposta* document for the 1-8 grade level because most of the initial efforts occurred at that level.

The 1986 *Proposta* draft document (1-8) was built from previous instructional materials and was discussed by most of the teachers and professionals in education in the state of São Paulo in a systematic way. The objective of the curriculum change process was to involve most of

the teachers and professionals in education in the discussion of what mathematics should be taught, why it should be taught, and how it should be taught. Teacher participation in the discussion of the *Proposta* document draft was an essential condition for change (CENP, 1988a). This process of discussion happened in the following way:

Phase 1:

1) Critique of the previous curriculum document by a group of 23 people including some mathematics teachers, some discussion leaders, some members of the state mathematics staff, and some university professors (1985);

2) discussion of the draft of the *Proposta* document with about 100 discussion leaders from all regions of the state and some university professors in the capital of the state (early 1986); and

3) modification of the draft (early 1986);

Phase 2:

1) discussion of the second draft in each region of the state with a group of 20 people in average, including elementary teachers, mathematics teachers, principles, and supervisors, coordinated by the discussion leader (late 1986); and

2) modification of the second draft (late 1986);

Phase 3:

1) discussion of the third draft in each region of the state with all teachers and professionals in education (1987); and

2) modification of the third draft.

In the last phase all teachers and professionals in education were required to participate in discussions of the curriculum draft. The document emphasized the continuous process of discussion that should follow its publication through the teachers' feedback of their practice based on ideas and activities proposed in the curriculum document.

Following the first discussion of the draft document in the capital of the state involving discussion leaders, each teacher was responsible for organizing meetings in his/her region and sending reports to the state mathematics staff. The discussion of what mathematics should be taught, why it should be taught, and how it should be taught, including the discussion of curriculum materials, has been facilitated by discussion leaders. One objective of having such discussion facilitated by discussion leaders was to disseminate the ideas of the curriculum document to all professionals in education in the state. A more important objective was the promotion of active participation of small groups of people. In this sense, different strategies for in-service education have been tried in different regions of the state.

Discussion

Reports of successful implementation of in-service programs (Fullan, 1992; McLaughlin, 1990; Lovitt, Stephens, Clarke, & Romberg, 1990) have demonstrated that for in-service education to foster teacher change, it is essential that teachers consider the meaning of change and demonstrate commitment to the program. Also, teachers are more likely to change and continue to use new ideas when there are ongoing interactions among them during the program implementation and when there is a continuous two-way negotiation and mutual pressure and support between the schools and the system. Active initiation and participation, pressure and support, changes in behavior and beliefs, and the problem of ownership, identified by Fullan (1992) were present in the curriculum change process in São Paulo, Brazil. The change process has provided institutionalized continuous assistance and support from the state through discussion leaders. Fostering a sense of ownership was a progressive process, and it evolved as some teachers showed leadership and willingness to help the discussion leaders organize meetings and workshops based on their practice related to the curriculum document ideas. The lack of skilled leadership appeared to be a constraint to successful discussions in some regions of the state, but, overall, important leadership for the mathematics education community was developed in the state and in the country.

The mathematics curriculum change process described above was a reflexive one. As Olson (1985) characterizes reflexive change, it reflects "the development of critical awareness" (p. 301). The complexity of the problem is captured by the statement of a group of recognized scholars in mathematics education:

> It must be acknowledged also that educators are faced with a most daunting challenge for their goals can *never* be attained. Just when 'success' is in sight, new targets will be set. Criticisms of educational systems continue, often with increasing severity, but little credit is given to educators for the enormous advances made in the last half-century (Howson & Wilson, 1986, p. 93).

Teacher education and teacher change are matters of lifelong learning. The discussions involved in the continuous curriculum change process in São Paulo, Brazil, has provided an opportunity for teacher reflection, change, and development. Also, important leadership for the mathematics education community in the state and in the country was developed.

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