

Implementation and Evaluation of Problem Solving in Elementary Mathematics

Ron Cammaert
Alberta Education

This paper is an initial evaluation of the implementation of a curriculum model in elementary mathematics in the province of Alberta. The paper also examines the possible reasons for success or failure of that implementation in various jurisdictions in southern Alberta.

Implementation Model

A revised elementary mathematics program was implemented in Alberta in September 1982. Revisions to the 1977 program were seen to be minor in nature (Alberta Education, 1982). The 1982 program placed a greater emphasis on problem solving to reflect recommendations made by the National Council of Teachers of Mathematics and information gathered from school systems and provincial testing.

To assist school jurisdictions and teachers with implementation of the revised program, a curriculum guide was developed and distributed to each school in the province. A series of one-day workshops dealing with the problem solving component of the program were sponsored by Alberta Education. Two teachers from each jurisdiction were sent to this workshop with the expectation that they would, in turn, conduct workshops for the teachers in the various schools within their systems.

To further assist implementation of the problem solving component, a monograph entitled "Let Problem Solv-

ing Be the Focus for the 1980s" was published by Alberta Education in September 1983. One copy of this monograph was sent to each jurisdiction central office and school in the province. Additional copies could be ordered as needed.

Evaluation Procedures

Interviews were conducted with the superintendent or delegate responsible for curriculum in each of the jurisdictions in southern Alberta. To obtain responses from teachers, a questionnaire was prepared and distributed to approximately 30 percent of the teachers. One hundred and seventy-two questionnaires were returned. Comments on observations made during 11 school evaluation visits over the 1983-84 and 1984-85 school years were also included.

Survey Results

Results obtained from interviews with superintendents, questionnaires completed by teachers, and classroom observation seem to be fairly consistent. All three sources tend to give the picture of an initial effort and of some awareness being developed by teachers, but not a great deal of "institutionalization" of the change on the part of teachers. Almost half of the teachers responding to the poll indicated that they had not received

inservice, and of those who had attended inservice workshops, twice as many indicated dissatisfaction with the inservice than indicated satisfaction. It would seem that the inservice delivery system did not meet the needs of the teachers.

Most teachers reported having a copy of "Let Problem Solving Be the Focus for the 1980s." Unfortunately, they were not asked to rate the effectiveness of the document.

The majority of teachers indicated that they teach problem solving, feel comfortable with the model, and allocate time to the instruction of problem solving. One of the problems connected to a discussion of this concept is that there are several interpretations a teacher may give to the words "problem solving." The concept is very different from traditional word problems found in most textbooks, but "problem solving" can refer to both. When a teacher indicates comfort with the concept, there is no way of knowing if the teacher is referring to the old or new version. Based on interviews with superintendents, classroom observations, and given the fact that almost half of the teachers reported that they had not been given inservice orientation, one would be skeptical that the majority of teachers actually do teach problem solving in the manner being discussed.

Teacher comments were reflected in statements made by superintendents. Both groups desire more inservice assistance and feel that more resources should be made available.

Discussion of the Implementation Model

In Alberta, the development of provincial programs is centralized, but includes broad consultation. Centralized development is favored for economic efficiency and to ensure structured uniformity. In this particular case, the need for change was

recognized at the provincial level as a result of a thrust in mathematics education in North America. The National Council of Teachers of Mathematics, among other groups in mathematics education, has identified the teaching of problem solving as highly important in the curriculum of our classrooms. This perception comes from analysis of the needs of society. It is desirable to have people who are able to solve ever-increasing complicated problems.

However, the extent to which an innovation meets local needs, as perceived by school personnel, is related to successful implementation (Fullan and Pomfert, 1977). The uniqueness of the local environment, the need for local fiscal control, the need for increased local public participation, and recent developments in management theories are cited as reasons for local school involvement.

Inservice orientation was designed to persuade teachers of the need for change. Personnel from the University of Alberta attempted to make teachers aware of the model adopted by Alberta Education. References were made to materials that teachers could access, and some strategies for problem solving were given. The major emphasis was to have teachers become committed to pursue the idea on their own. Little, if any, follow-up was planned or occurred.

Generally, curriculum development plans receive more attention from Alberta Education than do implementation plans (Alberta Education, 1980). Provincial responsibility for curriculum implementation in the past decade or so has mainly been with regional office consultants in the Program Delivery Division. It is the perception of Alberta Education that each school jurisdiction should have its own local implementation plan for new or revised curricula in keeping with the intent of the provincial thrust (Alberta Education, 1985). In the final analysis, it is the classroom teacher who bears

the majority of the responsibility for curriculum implementation, with support coming from system supervisors, professional association resources, or consultative assistance from the universities in Alberta or from Alberta Education.

There were no formal plans made for evaluation, nor for monitoring of the process. Some jurisdictions monitored the implementation on an informal basis, and regional office personnel evaluated the process as part of their school evaluation program.

The unit of change, as perceived by Alberta Education and school jurisdictions, was the school system. There is considerable research evidence to support the view that the individual school is the unit of change that is most successful in bringing about curricular improvement. A major finding of the studies conducted by John I. Goodlad and the Rand Change Agency Study indicate the need for local involvement and the reality of local control of education despite the influence of forces operating at the state and national levels (Goodlad, 1975; Berman and McLaughlin, 1975). Unless conditions for change exist at the school building and in the individual class, no change will occur (Neal, Bailey, and Ross, 1981).

Alberta Education includes teachers in provincial committees when curriculum changes are being planned. Teacher responses to the questionnaire indicated the desire to develop materials at the local level. No such action occurred in this zone. Investigators in the Rand study found that successful change resulted when mutual adaptation occurred, that is, when both the innovative practice and the local school organization were changed (Berman and McLaughlin, 1975).

Responses from teachers indicated that having representatives from each school system attend a training session, so that there would be "experts" in each jurisdiction, failed to serve its purpose. The day-long session was

not seen as intense enough to allow most people to sufficiently develop the knowledge base and training techniques necessary for them to feel comfortable with this role in their jurisdictions. The people selected to attend the workshop had varying degrees of experience with the model, varying degrees of ability to conduct inservice orientations, and varying degrees of commitment to the model. Some teachers were not aware of what their role would be upon returning to their school system. The selected personnel were given no training on how to provide coaching within their systems, and there was little or no provision for this in most jurisdictions.

When Lippitt and his associates surveyed teachers to determine what they believed were the forces facilitating innovation of teaching practice, they found that the availability of help from consultants was considered very important (Lippitt, 1967). Teachers indicated that the innovator needs to work through the new ideas with the teachers to solve problems at the practical level, rather than simply conduct a one-shot information session (Tanner and Tanner, 1980).

The commitment of central office personnel was one of the most significant variables in determining the success of curriculum implementation in a system. Where curriculum projects have been successful, one of the most significant elements is that the personnel involved were deeply committed to the project. Activities to inform principals were not part of the implementation plan. Principals became aware only if they happened to attend in-system presentations, were informally contacted by regional office personnel, undertook professional reading on their own, or were apprised at the system administrators' forum.

Curriculum development must have the support and backing of school administration (Zenger and Zenger, 1984). In developing commitment, the

first stage is to make certain all those affected understand the change and the reasons for the change. As indicated earlier, a little more than half of the teachers reported attending one inservice session. Central office personnel developed their understanding in a different setting, and principals may or may not have received any information regarding the change.

If teachers are to fully implement the problem solving model within their teaching, they must shift from a content orientation to a process one. It is likely that this disparity between the values and objectives of teachers and the planned innovation would cause difficulty in developing commitment in teachers. Problem solving reflects a "discipline" approach to curriculum rather than a "subject" orientation. One of the criticisms of "discipline" organization is that insufficient inservice assistance is given. If the values and goals in a particular change project match those of project participants, then commitment is more likely to occur (Leithwood and Fullen, 1984; Neill, 1982; Kienappel, 1984).

The fact that the innovation was not seen as major by the province could also account for the difficulty in developing the commitment of school personnel, since they have been charged with a large number of pressing and major changes in the school environment. No more than one or two areas of the curriculum should be studied or changed at one time (Zenger and Zenger, 1984).

Summary

At this time, the innovation has not been internalized by a majority of teachers in southern Alberta. However, the innovation has been picked up by some teachers, and one needs to keep in mind that the implementation process is still continuing. The provincial mathematics achievement tests

at Grades 3 and 6 will reflect this emphasis in the curriculum, and some educators feel that this will help teachers develop the awareness required. In order to enhance the likelihood of successful implementation of a curriculum change, it may be necessary for educators to use some of the results of current research and modify the implementation model now used.

Ron Cammaert is the mathematics consultant for Alberta Education, Lethbridge Regional Office. Mr. Cammaert is past president of MCATA, having served as president for two years. He served as principal of Barnwell School prior to joining the Department of Education.

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Seven-Link Chain Problem

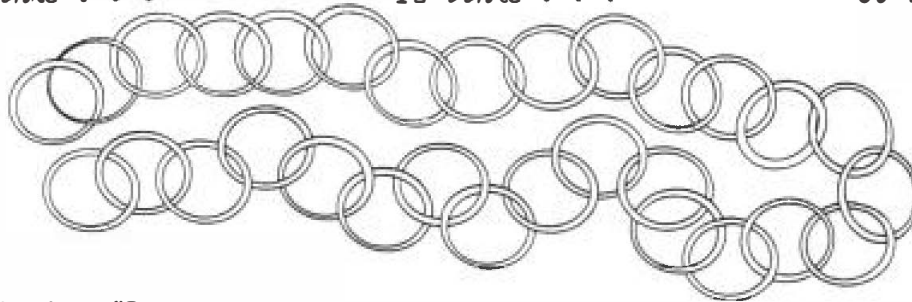
(continued from page 4)

Variation #1

The prince's brother escapes with a section of the gold chain and also finds haven at the home of another peasant. The same conditions (one link per day, with no prepayment or arrears) are negotiated.

The prince states that he needs to cut *two links only* to meet the conditions. What is the *maximum* length of the chain (measured in links) that this second prince had when he escaped?

7 links . . . 12 links . . . 30 links?



Variation #2

The oldest prince escapes with a section of the gold chain that is 63 links long. A third peasant offers a haven to this prince, and again the same conditions are negotiated.

The prince and peasant agree that the conditions may be met by cutting *three* links. Which links were cut? What is the length of the longest segment?