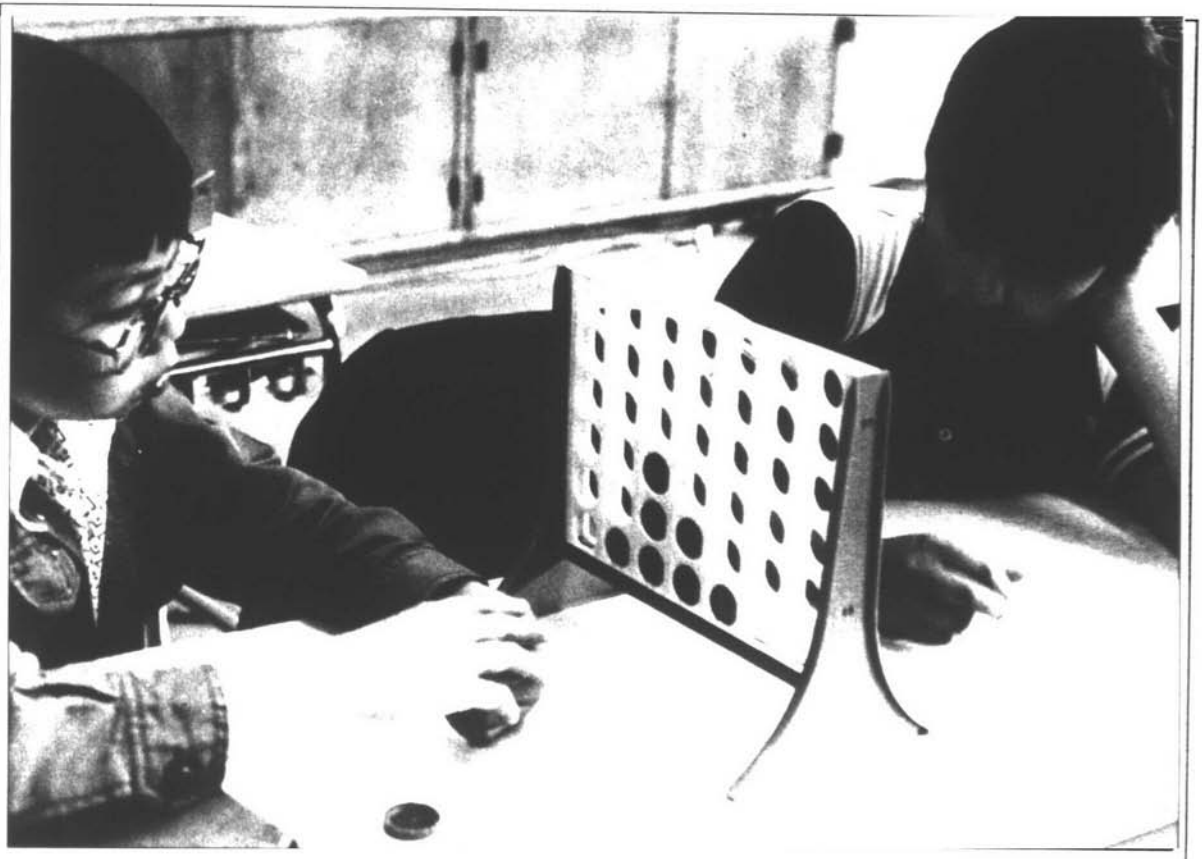

Instructional Policy Issues in Mathematics Education

Ability grouping, homework, student persistence, and quality of instruction must all be addressed if we are to raise mathematics achievement.

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The recent report of the National Commission on Excellence in Education (1983) decried the low mathematics achievement of America's youth and recommended that school districts (1) require all students to take a minimum of three years of mathematics in high school, and (2) recruit better-qualified teachers of mathematics. How likely are these policy recommendations to improve mathematics education?

For the past year the Center for Educational Policy and Management at the University of Oregon has been engaged in research involving observation of mathematics teaching in approximately 50 elementary classrooms. The observations and review of research by my colleagues, Glen Fielding and Del Schalock, and me, suggest that the National Commission has oversimplified the problem of improving mathematics education. Improvements need to stem from careful analysis of the *instructional policy issues* that confront teachers and administrators. Policy makers who ignore these issues are likely to develop solutions that are ineffective or ignored.

Our starting point is the research of Tom Good and Doug Grouws, who identified teaching practices that improve student performance in mathematics as measured by gains on standardized achievement tests (Good, Grouws, and Ebmeier, 1983). They translated the results of their research into an inservice program to help teachers make greater use of these effective practices. In using this inservice pro-

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gram in our research, we discovered that teachers would not implement some of the practices unless certain instructional policy issues were resolved first.

The Homework Issue

The assignment and checking of mathematics homework is one of the critically important practices identified by Good and Grouws. Their study of fourth–grade classrooms obtained a correlation of .49 between homework assignments and student achievement (Good and Grouws, 1979). This is a very high correlation for a single teaching practice. Elementary teachers in our inservice program, however, balked at assigning homework. Their concerns were not about technical aspects of homework, but about homework as a matter of *policy*. Some teachers felt that homework exceeded their expectations about how much work should be required of students. (The recommended practice is 15 minutes of homework four nights a week.) Other teachers stated that their school had a policy against assigning homework.

Apparently no teacher in the inservice program wanted to initiate homework as an individual policy. The reluctance is understandable. Since elementary schools typically have two or more teachers at each grade level, it is awkward for one teacher to assign homework if colleagues do not. One objective of the inservice program, then, was to help teachers establish a school-level homework policy consistent with research on effective mathematics instruction. The support of building principals was instrumental to achieving this objective. In fact, several principals promised to intervene if parents complained.

Once the policy was established, the teachers had no difficulty assigning homework. In follow-up inservice sessions, most teachers reported that students and their parents responded favorably to brief homework assignments that reinforced existing skills.

In contrast, assigning homework is accepted practice in the typical high school. Even at this level, though, there are policy issues concerning amount, type, and grading of homework. For example, the National Commission found that two-thirds of high school seniors report doing less than one hour a night of homework. The way these issues are handled may affect student effort and achievement in mathematics.

The Ability Grouping Issue

Our observation of elementary classes indicates that teachers find it very difficult to cope with the range of individual differences in students' ability to learn mathematics. A principal who participated in the Good and Grouws inservice program observed: "Teachers appear to spend 40 percent of their time dealing with the bottom 10 percent of the class."

The usual policy for handling student differences in ability to learn mathematics in elementary school is to individualize instruction. Teachers usually implement this policy by assigning a great deal of seatwork based on "individualized" worksheets or learning packets. Research findings indicate, however, that students learn better if teachers spend less time on seatwork and more time developing concepts and algorithms through explanations, discussion, and demonstration (Dubriel, 1977).

The problem with emphasizing development instead of seatwork is finding a level of explanation that all students can understand. One way to handle this problem is an instructional policy that we have seen in some schools: two teachers at the same grade level exchange students during the math period so that one teacher instructs all the slow learners, while the other teacher instructs the regular and fast learners.

This is usually referred to as ability grouping, which is strongly supported by research. For example, Edward Begle, in concluding his review of research on ability grouping, stated,

> The evidence is quite clear that the most able students should be grouped together, separate from the rest of the student population. When this is done, these high ability students learn more mathematics than they would otherwise and do not develop any undesirable attitudes. At the same time, the remaining students do just as well on both cognitive and affective variables without the very able students in class with them (Begle, 1979, p. 106).

The importance of ability grouping probably increases as students progress through schools. For example, Julian Stanley (1977) found that mathematically precocious students in junior high school can learn several years of high school mathematics in just a few weeks over the summer. It seems a waste to keep these students in regular classes when they can be grouped instructionally for fast progress.

The Student Persistence Issue

The majority of states currently require just one year of mathematics in high school, so the question arises: Why would students choose to take courses beyond the minimum? An answer is suggested in the finding that the *perceived usefulness* of mathematics predicts high school students' decision to elect additional mathematics coursework (Perl, 1979; Pedfro, Wolleat, Fennema, and Becker, 1981). Given this finding, the National Commission's recommendation that high schools require three years of mathematics seems insufficient. If a student does not see the utility of mathematics, requiring three years of coursework is apt to cause negative student attitudes

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toward mathematics, school absenteeism, and teacher stress from having to deal with recalcitrant learners.

Thus, instructional policy should focus on ways to increase the perceived usefulness of mathematics for students, rather than just increasing course requirements. This goal might be accomplished by having school counselors and teachers conduct career and academic counseling on the utility of mathematics. Luchins and Luchins (1980) found that counselor encouragement was significantly related to election of advanced math courses by male students, and that teacher encouragement was significantly related to election of advanced math courses by female students. There is also evidence that high school students perceive a need for such counseling, but counselors do not satisfy it, especially in the case of female students (Richmond, Tucker, and Martin, 1979).

The Instructional Quality Issue

The National Commission's report noted that the proportion of secondary students taking a general program of study increased from 12 percent in 1964 to 42 percent in 1979. Many of these students take only "general math." Research has demonstrated that the quality of instruction in this course is much lower than in advanced mathematics courses. Michigan State University researchers found that "teachers lower their expectations for general math students, resulting in a tendency for them to teach general math classes in a distinctively different manner than higher-level algebra classes: with less direct instruction, less goal clarity, less assistance with seatwork, less encouragement, and less opportunity for discussion" (Institute for Research on Teaching, 1983, p. 1).

Finding a solution to these differences in instructional quality will be difficult. A policy of increasing mathematics requirements while ignoring instructional quality is doomed to failure. Low-track students might wind up receiving more of the same thing—poorly taught general math. A policy of recruiting highly qualified mathematics teachers may be no more successful since there is little relationship between teacher characteristics and student achievement in mathematics (Begle, 1979). Rather, better solutions may come from developing a differentiated mathematics curriculum that effectively serves students with different interests and abilities, accompanied by staff development for teachers and administrators and supervision to ensure instructional quality across curriculum tracks.

Conclusion

Policies for improving mathematics education must develop from a careful analysis of classrooms and schools. Students, teachers, and administrators seldom act unilaterally; their instructional behavior is constrained by school norms about academic expectations and instructional quality, by grouping patterns, and by learner characteristics. The National Commission's recommendations concerning teacher recruitment and course requirements are a good starting point but are not sufficient to overcome these constraints.

Improvement of mathematics education requires instructional policies that address the constraints directly. These policies include schoolwide homework requirements, ability grouping, availability of academic and career counseling, staff development programs on effective teaching practices, and supervision to control instructional quality.□

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