Chapter 9

Recommendations and Conclusions

The purpose of this study was to investigate mathematics policies and instructional practices in California and their effects on student achievement. More specifically, this study was designed to address three questions.

1. What classroom instructional practices and materials and what staff development are associated with higher mathematics achievement?

2. To what extent are the instructional practices and characteristics that are identified in high performing classrooms prevalent throughout the state?

3. What influence do state and local policies have on instructional practices?

For each of the three questions, a summary of the findings, and the recommendations that emerge from the findings, are presented in the following sections.

Factors Influencing Achievement: Findings and Recommendations

What classroom instructional practices and materials and what staff development are associated with higher mathematics achievement?

A critical component of this study was to investigate the degree to which student achievement (as measured by the SAT-9) was associated with instructional practices and other factors. Neither instructional practices nor teacher background characteristics, when other variables were controlled, bore other than a minimal relationship to student achievement. In sum, the study did not identify specific, powerful classroom instructional practices, instructional materials, or professional development activities that might explain higher mathematics achievement.

What conclusions can be drawn from this? One possibility is that no particular practice is best at raising student achievement across the wide range of educational settings—in other words, it may be that no one type of practice works for all students in all situations at all times. To the contrary, it appears that masterful teachers pick and choose from a variety of practices to maximize their effectiveness. Indeed, many teachers indicated that they need a broad repertoire of instructional approaches that are consistent with their teaching style to meet the needs of their students.

Recommendations: As this study did not identify particular instructional methods likely to improve student mathematics achievement, the State should exercise caution regarding the endorsement of instructional methodologies in mathematics. The State Board should support a "balanced" approach to mathematics curriculum and instruction, but should avoid advocacy of particular types of practices, through the adoption of curriculum materials and professional development programs. To the extent that the *Mathematics Framework* adopted in 1998 supports the concept of a balanced instructional approach, it may assist teachers in their implementation of such an approach, provided that it is accompanied by aligned materials and professional development.

Another possibility is that certain practices *do* have an effect on student achievement, but that the measures used in this analysis were not fine enough to adequately capture these relationships. For example, as discussed in Chapter 3, surveys are an imperfect measure of identifying instructional practices, as they are subject to inaccurate responses and do not lend themselves to assessments of *quality* of instruction or implementation of certain types of practices. Moreover, a longer time frame may be necessary to examine sufficiently the effects of student exposure to certain types of practices.

Recommendations: Further research is needed to investigate the relationships between instruction and achievement. Such research should explore the use of alternate methodologies (i.e., in place of or in addition to teacher surveys), such as an enhanced classroom observation component in which the same teachers' classes are observed, and perhaps videotaped, multiple times. Moreover, further research should take a longitudinal approach, spanning at least five years. Care, however, must be taken to avoid overburdening teachers with research demands. The State Board and the Legislature should recognize the need for more in-depth, high-quality research and should commit the necessary funds.

Prevalence of Factors Influencing Achievement: Findings and Recommendations

To what extent are the instructional practices and characteristics that are identified in high performing classrooms prevalent throughout the state?

Since observed and reported instructional practices could not be linked with higher performing classrooms, it was impossible to assess the prevalence of such practices. Classrooms with higher performing students exhibited a broad array of instructional

practices and teacher characteristics—as did classrooms with lower performing students. The study did not find prototypical high-performing or low-performing classrooms. As discussed above and in the body of the report, part of the problem may very well lie with the difficulty in conducting this kind of research. In particular, the SAT-9 itself is an incomplete measure and its limitations may render it inappropriate for assessing relationships between practices/characteristics and certain types of achievement.

> *Recommendations:* Future research investigating the relationships between instructional practices and student achievement should carefully define what is meant by "student achievement." If a broad definition is selected, the research methodology should employ a variety of measures to gauge this achievement. For instance, the SAT-9 may be valuable for assessing students' procedural and declarative knowledge, but may be less appropriate for assessing higher-order thinking skills. Thus, to the extent that higher-order thinking skills are deemed an important aspect of achievement, other measures supplementing the SAT-9 may be needed.

Moreover, because the districts that participated in this study were not a random sample of all districts across the state, the results presented herein may not be generalizable to all of the state's students and teachers. This is especially true for districts with small enrollments, as the districts that participated in this study were all relatively large.

> *Recommendations:* If prevalence throughout the state is a key concern, future research should employ a sampling design that selects districts with a wide range of demographic characteristics, such as size, geographic location, and student composition. However, such a design is likely to further raise costs, particularly if (as recommended above) repeat observations constitute a major part of the methodology, and should be weighed against a sampling design in which a greater proportion of the state's total student enrollment is represented (e.g., by sampling primarily from larger districts, as done by this study).

The Influence of Policy: Findings and Recommendations

What influence do state and local policies have on instructional practices?

The study yielded a great deal of information with bearing on this question; survey responses, classroom observations, and interviews with classroom teachers, school site administrators, and district personnel all provided a wealth of data on the influence of policies on instruction. Toward the end of the study, interviews conducted with a variety of other stakeholders on the policy implications of the study's findings lent additional points

of view and in some cases provided context for the study's findings. Among those interviewed for this purpose were several policy makers, representing the State Board of Education, the legislature, influential mathematics educators, and organizations representing teachers, school boards, and administrators.

Findings and recommendations on the influences of policy are divided into the following subsections: standards, instructional materials, professional development, assessment, and classroom context. Frequent changes in policy direction and tone of the policy debate also are discussed.

Standards. Teachers generally reported that while they support the idea of standards, the proliferation of competing standards (e.g. district, state, NCTM) has caused confusion and a lack of clarity over what they are expected to teach. Many teachers believe that the current state standards encompass more than can be taught in a given year, and some also report concerns that particular standards may be inappropriate for their designated grade level. Policy makers should also be aware that, as of the 1998–1999 school year, standards appeared to have had less of an impact on classroom practices than had textbooks and assessments.

Recommendations: The State Board should establish a procedure for periodically reviewing the mathematics standards and framework in light of implementation problems. The Board should carefully and systematically evaluate student performance over time, and solicit the advice of classroom teachers who are attempting to implement the standards and framework.

Districts should take care to present teachers with a single standards document, rather than having separate state and district versions. While it is perfectly appropriate for districts to augment state standards with their own additions, these supplements should be merged with the state standards so that teachers can rely on one unambiguous set of standards. Moreover, to maximize the influence of standards on instruction, the standards document should be distributed to individual teachers. This dissemination must be an ongoing process, as new teachers are constantly entering the profession. Finally, teachers need access to performance standards to assist in their implementation of content standards.

If there is interest in assessing implementation of the standards on a system-wide level (as opposed to assessing individual student mastery), the State might consider exploring the development of a matrix sampling test. Such an assessment, which would not be taken by every student in the state but only by samples of students who would see different items, would be able to gauge the implementation of a significantly larger portion of the mathematics standards than would a single assessment administered to all students.

Instructional Materials. Teacher interviews and classroom observations indicated that textbooks are a primary determinant of what is taught. Many teachers find that a single curriculum program is inadequate to meet the range of needs of their students, and supplement the district-adopted text with other books and materials, some of which may not be on the state-approved adoption list. Some teachers in our sample were using texts from earlier adoption cycles. Because the average textbook contains far more lessons than most teachers cover in a school year, teachers pick and choose among the sections and chapters. Thus, even when they use state-adopted texts, there is no assurance that the curriculum actually covered will be congruent with state standards.

Recommendations: The State Board and the Curriculum Commission should ensure that the curriculum materials that are available to teachers are aligned with standards, accommodate the wide range of student needs, and enable the presentation of a balanced instructional approach.

If possible, districts and schools should purchase the materials in ways that are conducive to teacher and student use both in school and at home (e.g., not requiring an excessive amount of photocopying). To maximize the actual use of the materials and the effectiveness of their implementation, teachers should be provided with opportunities and incentives to engage in professional development related to the use of the materials.

Finally, until evidence of widespread implementation of adopted materials becomes available, caution should be exercised in attributing student achievement to the use of particular adopted materials, as adoption alone is no guarantee of actual use in the classroom.

Professional Development. The need for high-quality professional development was consistently indicated by all data sources. Survey results highlighted the particularly telling mismatch between fourth grade teachers' need for training in mathematics content and methodology and the amount provided. Teachers who addressed this point in the policy implications interviews were positive in their assessment of the California Mathematics Project, even though it may have had limited impact relative to statewide need. There also seemed to be a consensus among those interviewed toward the end of the study that the thrust of the Governor's initiative is on point. (The Governor's initiative proposes university-based professional development institutes during the summer, with follow-up instruction and professional feedback during the school year. The focuses are on teachers as learners, the teaching of mathematics content through a variety of instructional strategies, and meeting the needs of students.)

Recommendations: The State should continue to work to provide sufficient resources for every California teacher of mathematics to participate in high-quality, sustained professional development.[1] Professional development should attend both to mathematical content and to pedagogy; both are important. Key aspects of professional development should be the use of materials (as discussed above) and the instructional implementation of the standards and framework in the classroom.

Assessment. The SAT-9 appears to be the dominant driver of instruction. Since it measures only a portion of the standards, even with the augmentation, over time it will have the effect of narrowing the curriculum to what is tested, and the nature of the test may shape the way students are taught. Teachers report spending much time in test preparation, which takes time away from instruction. The current test is not necessarily aligned with grade level curriculum or textbooks, so some students are being tested on material that has not yet been taught.

Recommendations: The State Board should continue to improve and augment the STAR program so that its components are properly aligned with state standards. Were the STAR program fully aligned with the content standards, the emphasis on assessment might help bring about the effect of student mastery of the standards. As long as there is a lack of alignment, improvement in scores may not be truly indicative of the type of student improvement desired.

Classroom Context. Many teachers indicated that the greatest influences on their instruction were policies relating to class size, quantity of time for instruction, and student preparation and promotion. Clearly, the importance of such policies, and their relevance to mathematics instruction, should not be underestimated. These policies operate alongside those that appear more directly related to mathematics (such as those concerning standards or curriculum materials), and cannot be considered "separate" or "unrelated." At the level of the classroom, the effects of multiple types of policies are intertwined. Thus, it is crucial that the various policies be consistent with one another and, preferably, form a coherent whole.

[1] Some recently enacted legislation is a strong first step. In particular, AB 1331 (passed in 1998) appropriated funds for teachers of mathematics in grades 4–12 to participate in professional development that is aligned with the state standards and framework. (AB 2790, currently pending, would increase the available funds.) AB 2442, also passed in 1998, provides funds for teachers to take mathematics courses at accredited institutions of higher education.

Recommendations: As mathematics instruction does not exist in a vacuum, mathematics policy must be placed in the context of the numerous other education-related policies that exist. The State Board and the Legislature should take care to ensure that all of the current state education policies are aligned with and support one another.

Frequent Changes in Policy Direction. Frequent changes in state policy direction tend to diminish the state's ability to influence the mathematics taught in California classrooms and may in fact impede teachers' efforts to raise student performance. State policy makers tend to call for dramatic changes in mathematics curriculum without assessing the actual level of implementation of the prior approach, without adequate evidence of the causes of the current level of student performance, and without sufficient evidence of the effectiveness of the new approach.

Recommendations: The State should stay the course. Planning should take a long-term view, focusing on developing and revising policies based on feedback, rather than abruptly changing direction at the first hint of less-than-desired student performance. The state should also systematically gather evidence of what mathematics curriculum is being implemented and how it is being taught and seek causal relationships between actual practice and student outcomes. Anecdotal testimony may not accurately portray reality across more than 1000 California school districts.

Tone of the Policy Debate. Stakeholders interviewed toward the end of the study reported that the acrimonious debate associated with the recent changes in mathematics standards, framework, textbook adoption, and professional development has limited the willingness of teachers to participate in policy discussions. Failure to air differences of opinion and seek areas of agreement can lead to balkanization and an unstable agreement on what constitutes appropriate mathematics curriculum and instruction. Ultimate success of any mathematics program requires that teachers understand and support the underlying rationale and have the training and materials necessary to support successful implementation.

Recommendations: The State Board should set a positive tone for professional discussion and policy debate. Representatives of all stakeholder groups should be "at the table," and a wide range of perspectives should be considered.

Conclusion

As this report has indicated, the difficulties of implementing state policy initiatives at the classroom level are substantial. Traditional policy tools, it seems, often are less effective than desired and may have unintended consequences. The State has a number of means by which it can influence mathematics instruction; the question is how to use them, if at all. The overarching message of this report is one of *caution:* caution in attributing reasons for low (or high) student achievement, and caution in making reforms that do not have a clear basis in research.

Nevertheless, as suggested by this chapter, there are a variety of actions the State can take to support teachers' attempts to raise student mathematics achievement. Indeed, there is strong evidence that teachers are dedicated to helping students achieve in mathematics and want to increase their own effectiveness as teachers of mathematics. However, they often feel thwarted in their attempts to be effective by the realities of their teaching situations, including everything from the need to photocopy materials to the lack of professional development funds to the multiple ability levels within their classrooms. Policies and reforms whose rationales may have not been clearly conveyed to teachers and which they may not have bought into—as well as the flux in policy—only add to the difficulties teachers face. Thus, the key will be to include teachers and all stakeholders in the reform process and to ensure that feedback from a wide variety of educators and community members helps guide efforts to improve the mathematics achievement of all of California's children.