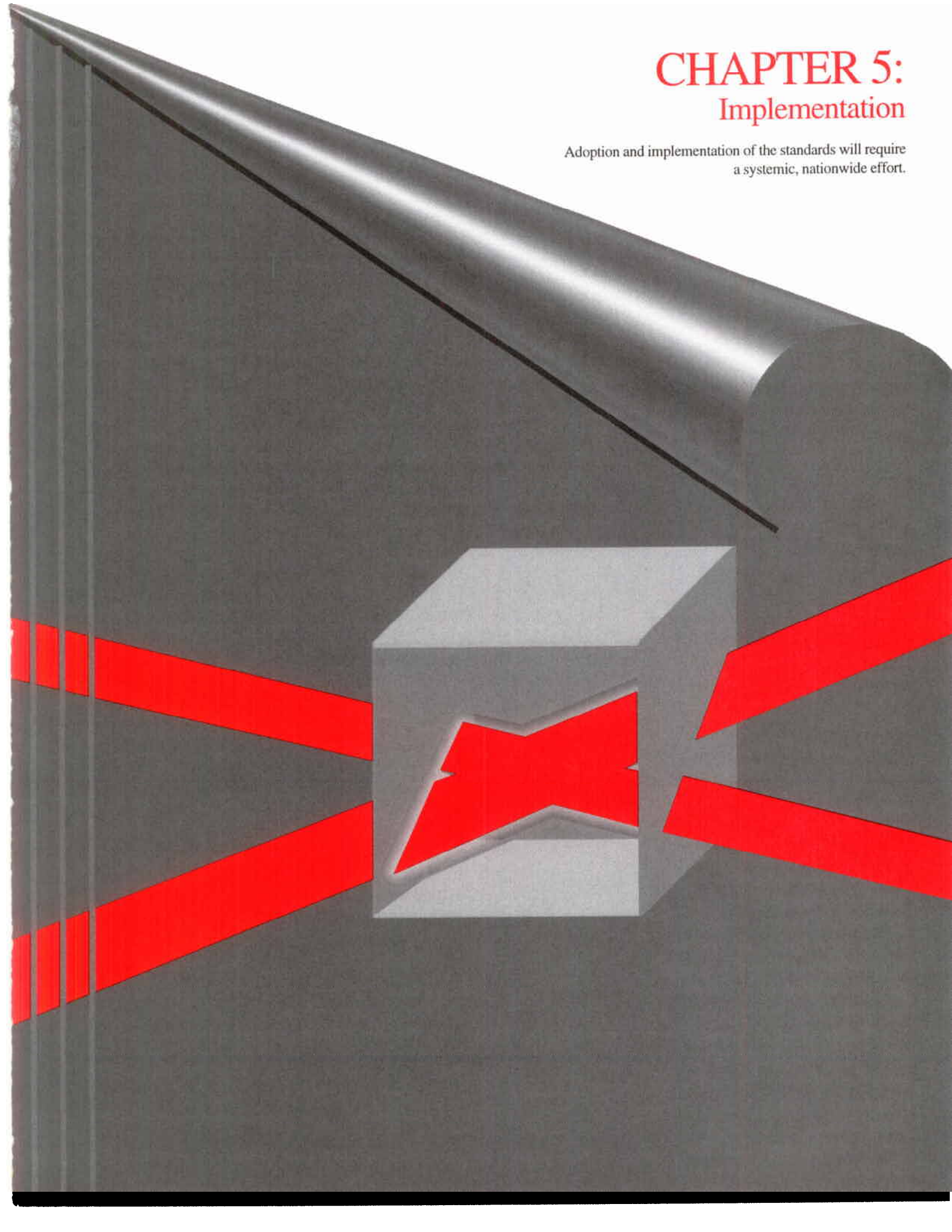


CHAPTER 5: Implementation

Adoption and implementation of the standards will require
a systemic, nationwide effort.



C*rossroads in Mathematics: Standards for Introductory College Mathematics Before Calculus* provides a framework for the development of improved curriculum and pedagogy. Adoption and implementation of the standards will require a systemic, nationwide effort.

Faculty, with strong support from administrators, are primarily responsible for implementing educational reform. Professional mathematics organizations must lead the effort to promote this implementation by making their support highly visible at their meetings and in their publications and by providing professional development opportunities. Furthermore, business, industry, governing bodies, accrediting agencies, and public and private funding agencies must unite behind the efforts to reform higher education. Their voices are heard and respected in the local and national communities.

This chapter describes an integrated national plan of local, state, and national actions that will ensure that reform takes place in a lasting and pervasive way.

INSTITUTIONAL RECOMMENDATIONS

Mathematics departments must become campus leaders in improving all classroom instruction. Faculty can begin the process of reform by discussing and evaluating their own local curriculum and pedagogy using the standards proposed in this document as benchmarks. They should then become active participants in applying the standards to develop methods for improving instruction in their own institutions. The following ideas can be used to spark departmental discussion:

- The introductory mathematics curriculum must become less cumbersome and more meaningful. Topics that have become outmoded because of readily available technology should be deleted. Content should be integrated so that topics naturally connect and build on each other.
- Improvements in pedagogy are necessary for the student to become a more active, involved learner.
- Learning and problem solving through teamwork in the mathematics classroom must reflect the team approach to problem solving and communication expected in the world of work.
- Technology must be used whenever appropriate so that the content is understandable and useful to students.
- Mathematics class must be a fertile ground for exploration and experimentation.

College administrators must recognize the need for curricular and pedagogical improvements. They must provide leadership, support, and incentives for human resource development as well as the necessary space and technology to implement the standards. Such changes will involve adjustments to course descriptions, credit hours, scheduling, and fees.

"The document is designed to attract national attention to the issue of implementing reform in introductory college mathematics and thereby provide support to mathematics faculty and impetus for them to become involved."

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PROFESSIONAL ORGANIZATIONS

All national mathematics professional organizations and their related affiliated groups are encouraged to participate in implementing the standards for improving instruction in introductory college mathematics. AMATYC, AMS, MAA, NADE, NCTM, and SIAM should assume a coordinated leadership role. Their newsletters and journals, as well as sessions and workshops at national and regional meetings, can play a major role in promoting the standards. Professional organizations should also take the lead in forming networks of key leaders in two- and four-year colleges and universities and in encouraging members to implement the standards (NSF, 1992).

In addition, national support and coordinating organizations, such as the National Association of State Science and Mathematics Coalitions (NASSMC); Mathematicians for Education Reform (MER); the Mathematical Sciences Education Board (MSEB); the Conference Board of the Mathematical Sciences (CBMS); and the Coordinating Board of AMATYC, MAA, and NCTM should provide endorsement and assistance in the dissemination and implementation of the standards outlined in this document.

State mathematics organizations should also assume a leadership role in the initiation, discussion, and development of improved curriculum and pedagogy in introductory college mathematics. Where more than one state mathematics professional organization exists, they should coordinate their efforts. To support these efforts, state governing and coordinating boards should become knowledgeable advocates for reform; funding agencies should provide for the necessary infrastructure (NSF, 1991).

At a local level, the organization of consortia of two- and four-year colleges and universities will be encouraged through various state and regional mathematics groups. These consortia should provide a framework for development and dissemination of materials, professional development activities, and institutional research on instructional effectiveness.

OTHER RECOMMENDATIONS

Regional accreditation associations should become advocates for reform in introductory college mathematics. This step is critical in alerting administrators to the need for change.

The report *Matching Actions and Challenges* (NSF, 1991) sets a goal that, by 1996, 25 percent of the nation's faculty who teach introductory college mathematics should be supporting educational reform at the introductory level. The National Science Foundation, other governmental bodies, and private foundations, should support this goal.

PROPOSED REGIONAL WORKSHOPS

A series of regional workshops, each bringing together faculty members and administrators, will develop implementation plans for the standards at the regional, college, and classroom levels. Workshops should have sufficient numbers of attendees to ensure that working groups will continue to direct and coordinate reform initiatives after the workshops are over.

"Researchers in mathematics education have recognized that students' beliefs, faculty beliefs, and beliefs of groups outside the classroom are factors to be considered in educational reform. . . . Classroom change will only take effect if students will accommodate and approve of these changes and the community outside the classroom will be supportive of a virtual revolution in the educational process with all its inherent consequences."

Pao-sheng Hsu.
UME Trends, March 1995, p. 16.

These workshops and other implementation efforts will

- inform a wide audience of the reform issues and ideas for improving curriculum and instruction,
- review current exemplary materials and activities and share information and insights about current reform projects in introductory college mathematics,
- set goals and plan for continuing the reform efforts,
- develop assessment strategies appropriate to the standards,
- empower teams of faculty and consortia of two- and four-year colleges and universities to work jointly toward reform, and
- enhance the ability of two- and four-year college and university mathematics faculty to obtain funding for reform projects.

The workshops should lay the groundwork for systemic change and improvement in introductory college mathematics.

DEVELOPMENT OF MATERIALS

Development of new materials based on the standards set forth in this document is essential to lasting reform. Publishing companies and manufacturers of calculators and software can help to stimulate the development of new materials. Professional organizations and mathematics faculty must educate commercial suppliers about the nature of the standards. Publishers, in turn, can support faculty in their efforts toward reform by making available quality instructional materials. Additionally, curriculum project writing teams, composed of a consortium of two- and four-year colleges and universities, may jointly develop and pilot new materials in their own classrooms. To ensure consistency with the NCTM Standards, writing teams should involve high school mathematics faculty as consultants.

SUMMARY

Implementation of these standards as a new vision of introductory college mathematics will require a concerted national effort. National and regional mathematics organizations and two- and four-year colleges and universities must cooperate to provide curricular and faculty development. Resources provided by funding agencies will be critical catalysts in reform.

"Major reforms will not happen without dealing with teacher anxieties and frustrations as they attempt to change."

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"I used to believe that mathematics was just learning the procedures and memorizing the rules and if you could do that you would be able to do mathematics. After this semester, I see mathematics not just as problems, but as a special way to look at things."

A student's comments