

From the Rhetoric of Reports to the Clarity of Classrooms

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Educating Americans for the 21st Century® adds its voice to the chorus of concern about mathematics, science, and technology education in our nation. This report, recently released by a special commission of the National Science Board, finds that students are not well prepared and calls for fundamental changes in both what is learned and how it is taught.

Many of the conclusions and recommendations of this Commission echo the findings of a companion commission sponsored by the Department of Education, whose report, *A Nation at Risk*, catapulted the topic of education onto the covers of news magazines and into the rhetoric of the Presidential campaign. In brief, these reports and others¹ find that:

- Participation is lower and students are learning less about the common core curriculum subjects of mathematics and science than in recent years. In addition, standards and expectations in these fields have eroded over the past 20 years.

- Mathematical, scientific, and technological curricula presently being taught in our schools need immediate review and revision with particular attention given to content, emphasis, and approach.

*Available at no charge from The National Science Board Commission on Precollege Education in Mathematics, Science and Technology, National Science Foundation, Washington, DC 20550.

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By 1995, science, mathematics, and technology courses must be accessible to all students and revised to incorporate new knowledge. In addition, students must spend more time studying these subjects.



- The importance of quality teachers is fundamental to the education process. Urgent action is necessary to obtain and retain teachers of highest quality in mathematics, science, and technology.

- The pursuit of excellence in education for all students—whatever their race, gender, economic position, linguistic background, or career aspirations—is central to our nation's future.

Educating Americans for the 21st Century is more specific than the other reports and studies. For example, this report is the first to place a price tag on the proposed changes—some \$1.51 billion—and argues that the increased expenditure should be borne by local, state, and federal governments. It also establishes a target date of 1995 by which time the reforms will be in place. This date gives school personnel 12 years—or one educational cycle—to act on its recommendations.

Perhaps the most interesting recommendations address curricular and classroom reforms. As proposed, courses will have new emphasis; materials will be transformed; and the nature of instruction, with children doing more data gathering, experimentation, and discovery, will change dramatically. Computers, heretofore seen as an extra for the affluent, will become integral to the education of children. What effect will these recommendations have on children, teachers, administrators, and parents? What will it mean to move from the rhetoric of reports to the clarity of classrooms? A discussion of three specific recommendations illuminates possible answers to these questions.

Accessibility for All

One recommendation of the Commission that will influence both the curriculum development and teaching processes concerns the accessibility of mathematics, science, and technology to all members of our society. The Commission declares:

The true test as to whether a school, a school district, or a state is doing a good job of educating its students is not only achievement, but also the distribution of that achievement. . . . Programs are needed in mathematics, science, and technology that reach all students and stimulate each to achieve a knowledge of these subjects that is limited only by his or her talent and temperament (p. 14).

The Commission clearly states its concern for minority students, children from poor economic conditions, and students whose parents do not speak English at home. Participation rates in math and science courses for these students are low. The report argues that expanding the focus of mathematics, science, and technology to all students will increase levels of mathematical and scientific literacy in the nation.

What will it mean to implement this recommendation? First, all who are concerned with children's education need to examine their expectations and assumptions about student participation and achievement. Perceptions and widely held beliefs that the sciences are difficult to learn and accessible only to the college-bound student must be challenged and changed. Teachers, guidance counselors, parents, and school principals who influence student views of mathematics and science must



dispel the myth of elitism that surrounds these subjects.

Second, this recommendation requires those who teach these subjects to examine their instructional methods. Teachers will now be instructing a wider range of students with disparate learning styles and diverse abilities. For some teachers who have been accustomed to teaching the highly motivated, preprofessional student, the changes will be substantial.

The increased emphasis on educating all students demands greater flexibility and sensitivity in the implementation and management of school programs. Guidance counselors and administrators must not only possess expert skills in identifying individual needs, but also must have the capacity, within existing programs, to respond to these needs. While no school will have the resources to instruct each child individually, an increased ability to provide appropriate and varied instructional environments will be necessary to implement this recommendation.

The Need for Curriculum Revision

The Commission draws significant attention to the need for new educational objectives and makes detailed content suggestions for mathematics, science, and technology. In general, the commission observes:

Many of the courses now taught in most American schools badly need revision and updating; better trained teachers must have more up-to-date courseware in order to teach effectively (p.41).

The Commissioners propose that these

revisions include a heavy emphasis on the applications of mathematics and science in order to develop a greater capacity in our students for problem solving, critical thinking, and informed decision making.

What does this recommendation mean for school personnel? Although the National Science Foundation is "to take the leadership role in curriculum evaluation and development for math, science, and technology" (p.45), the responsibility for curriculum reform and revision lies squarely at the feet of local schools:

The Commission believes the *schools* will have to develop new, coherent patterns of K-12 mathematics, science, and technology courses for all students that are explicitly designed to meet the new educational goals (p.45) (*italics added*).

In order to accomplish this task, school boards will need to provide time and appropriate compensation for teachers,

administrators, and other professionals. Although developing and implementing good curricula is neither easy nor rapid, a few suggestions may assist those responsible for this undertaking.

First, set priorities. Many feel that science and technology are in greater need of revision than mathematics. Most elementary teachers already spend a portion of their day teaching mathematics, while this often is not the case with science and is rarely true with computers and technology. To teach science and technology where it has not been taught before will require the greatest curriculum development and implementation efforts; priorities should be set with this in mind.

Second, don't ignore existing materials. Although the Commission has called for new educational objectives for mathematics, science, and technology, this does not mean that all existing curricula are to be discarded. Some may

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need only minor modifications.

Many materials may be enhanced by the addition of local information. Students often find today's textbooks boring and uninteresting because the material is presented in a context that enables publishers to sell the same material in 50 states. With the call for an "introduction of practical problems which require the collection of data" (p.45), teachers and school administrators should use their schools and communities to add local color to appropriate materials.

Third, get help from others. In addition to reviewing existing materials in textbooks and from the National Science Foundation, school personnel should look for assistance from the business and scientific communities. The Commission observes that "curriculum content requires revision, not only to make the substance more meaningful to students and excite them but also to incorporate new knowledge" (p. 45). Elementary and secondary schools are not generators of new knowledge about technology and science; instead they impart what others have found. To obtain up-to-date information in a world that is changing rapidly requires the schools to increase their contact with those on the outside and to implement a curriculum development process that permits the constant integration of these ideas into the curriculum. A fruitful collaboration, where the educators bring the knowledge of how children learn and the scientists contribute an understanding of how the technology is applied, will result in a stronger curriculum.

Increased Time-on-Task

Hoping to address the declines in levels of both participation and achievement, the report recommends that "considerably more time [be] devoted to the study of mathematics, science, and technology throughout the elementary and secondary grades" (p.23). The report interprets "considerably more time" to mean a lengthened school day, week, and/or year; a minimal allocation of 60 minutes per day in mathematics and 30 minutes per day in science at the elementary level; a full year of mathematics and of science and technology in grades seven and eight; and at least three years of mathematics and three years of science and technology, including one semester of computer science at the high school level.

What will this recommendation mean for schools and classrooms? At both the primary and intermediate levels, increased time-on-task will challenge the skills of teacher planning and preparation. Asking students and teachers to spend more time working with mathematics, science, and technology requires more materials, more scientific experiments and equipment, more manipulatives, and more computers. Activities will need to be varied skillfully in order to derive maximum benefit from the increased instructional time.

In addition to demanding greater teaching skills, increased time-on-task will require significant schedule changes in schools. Because it is difficult for young children to maintain a high level of concentration for a sustained period of time, the 60-minute

requirement for mathematics and 30 minutes for science will need to be divided into small blocks of time throughout the day. Also, for schools where classes move to subject specialists and separate building areas for different instruction, changes in schedules to permit increased time for mathematics and science will have a direct effect on time allocations for other subjects. Increasing class meeting time for one subject and not another is virtually impossible in some schools.

At the secondary level, raising graduation requirements to include three years of mathematics and three years of science and technology is an appropriate and reasonable suggestion, and yet their impact on high schools may be more significant than some have realized. For example, in 1980 only 34 percent of our high school graduates studied three or more years of mathematics and 23 percent achieved the same level in science. Mandating that all students study three years in each requires the expansion of mathematics course offerings by nearly 55 percent while science must increase its capacity by 80 percent. With more than 40 states reporting a shortage of qualified math and science teachers under present conditions, the question of teacher supply becomes a critical factor in the successful implementation of this recommendation. Increased graduation requirements will have little impact on the knowledge and literacy of students if there aren't enough good teachers.

Increased graduation requirements also will cause secondary school guidance counselors, teachers, and adminis-

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trators to face an internal problem—student motivation. Many students required to attend additional classes won't like being in these classes, particularly if their previous efforts in the subject have been unsuccessful and the material resembles past experiences. For students who for eight years have failed to learn basic computational skills, little hope exists in a ninth or tenth year that the same material and approach will bring success. Thus, the influence of increased time in mathematics and sci-

ence classrooms will depend largely upon changes in teaching methodologies and curriculum materials.

A Note About Parents

As the recommendations of *Educating Americans for the 21st Century* are implemented in the schools, educators must be aware that parents may find that the materials their children study in mathematics and science classrooms is very different from what they studied when they were in school. Courses will

have different emphases and the nature of instruction will change.

Parents must be helped, as these proposals are implemented, to accept the modifications and share fully with school personnel in the responsibility for their children's education. Encouragement from home, ranging from active interest in homework to learning with the child about computers and technology, will greatly enhance the mathematical, scientific, and technical literacy of our youth and our nation.

Can We Do It?

Educating Americans for the 21st Century outlines an ambitious objective for government officials, professional educators, students, and parents. This objective is:

The improvement and support of elementary and secondary school systems throughout America so that by the year 1995 they will provide all the nation's youth with a level of education in mathematics, science, and technology . . . [that is] the highest quality attained anywhere in the world (p. 5).

In its specific set of recommendations, the report moves the discussion of possible action closer to reality and invites a careful examination and consideration of how to begin. Not every recommendation will be accomplished with equal speed or success. But the time has come to begin. □

'Action for Excellence, National Task Force on Education for Economic Growth; America's Competitive Challenge: The Need for a National Response, Business-Higher Education Reform; Academic Preparation for College: What Students Need to Know and Be Able To Do, The College Board; Report of the Twentieth Century Fund Task Force on Federal Elementary-Secondary Education Policy; The Paideia: An Educational Manifesto.

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