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ABSTRACT:

This document views mathematics instruction as an area that was developed to deal with experiences of the real world, and that needs to change in response to the realities of today's world. To insure the continued teaching of significant ideas and skills, certain traditional topics must be deleted from the curriculum and new ones added. Teaching mathematics must catch up with the technological advances available today, such as the microcomputer and calculators. Teachers are viewed as having the responsibility for teaching the processes of real-world problem solving and motivating pupils to both enjoy mathematics and develop skills. Research to determine the topics and appropriate instructional processes are seen as necessary in order to obtain both the goals of general education and the aims of occupational necessity. Most available textbooks and curricula are viewed as stumbling blocks. It is suggested that teachers will have to work a great deal on their own, with the teacher-training program of vital importance for the success of mathematics education in the 1980's. (MP)

RE-EVALUATING THE SECONDARY MATHEMATICS CURRICULUM FOR THE 80's

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The history of mathematics indicates clearly that mathematics grew out of experiences in the real world. All fields of knowledge from the economic, scientific, and social world are dependent on mathematics for solving problems. Of course, the mathematics teachers have shown the students the marvelous achievements of our forefathers, such as determining how to count objects, add fractions, solve equations, draw maps and geometric figures, measure forces, times, and energies, determine sizes and properties of objects, and compute taxes and earnings. It seems that it is reasonable that the students can learn mathematics in a similar way, largely on the basis of dealing with and experiencing real world problems. The method of working only with pencil and paper, unfortunately, denies students the opportunity to deal with actual problems from the environment in which they live.

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Due to the separation of real life and mathematics, most of our students, especially those from elementary and junior high schools, have decreasing motivation and a poor attitude toward mathematics. Even at the secondary level it is almost impossible for students to see that mathematics will improve their opportunities for meaningful problem solving if they are only engaged in a struggle to memorize formulas, prove theorems in geometry, and to solve, say, mixture problems. The only reason they study mathematics is because mathematics is a required course.

Of course, mathematics teachers have the responsibility of motivating the students not only to develop mathematics skills but also to enjoy mathematics and to learn how to use it to solve real-world problems. To insure the transfer of significant mathematical ideas and skills, it is clear that they must delete certain topics which have, for many years, been an integral part of most mathematics programs. It is not uncommon for students to be asked to factor such expressions as $x^3 + 2x^2 - 5x - 6$. Can such a skill really have any meaning for a fifteen or sixteen year old? Later, these students will devote much time to rationalizing the denominator of such expressions as $\frac{x}{\sqrt{2} - \sqrt{x}}$ or finding the least common denominator, so that they can carry out addition of fractions. (e.g. $\frac{x + 7}{4x^2 - x - 5} + \frac{4}{x^2 + 5x - 6}$). Usiskin

strongly recommends that some topics, such as trinomial factoring in the first-year algebra curriculum, be deleted because they do not have enough applications in later mathematics and, additionally, not enough real-world applications to warrant their inclusion (Usiskin, 1980). Of course, we have to be cautious with the deletion of any topic. One must make certain that this reduction will not interfere with the learner's training and his occupational needs. Certainly, with regard to the secondary school mathematics curriculum, adjustments will be made to reduce the time spent on certain topics, such as the applications regarding mixture problems, logarithms, and factorization involving multiple variables, and much thought must go into determining the role of proof in geometry.

Much research and study will have to be undertaken to determine which topics should be included in order to obtain both the goals of general education and the aims of occupational necessity. More difficult will be determining the appropriate processes for presenting these topics so that students experience "doing" mathematics.

Teaching mathematics must catch up with the technological advances available today. For example, time spent acquiring computational skills should require much less classroom time than is now expended if one employs hand-held calculators. It is exciting to discover in the classroom

that the calculator can be used to help students learn mathematics. Of course, the calculator doesn't have to be a device that merely provides answers to computational exercises (Beardslee, 1978), but with calculators, the amount of time spent in drill problems of arithmetic and algebra can be reduced drastically, providing more time for teachers to introduce new areas such as problem-solving and estimation. In connection with social and commercial problems, the hand-held calculator allows students to deal with realistic sets of numbers. Major emphasis must be given to finding creative uses of calculators in classrooms. Perhaps the advent of the micro-computer poses the most exciting opportunity for altering school programs (Downes, 1979).

In regard to teacher training, such programs should reflect a new attitude of concern for showing the relevance of mathematics if one is to obtain a new generation of enlightened and technically oriented students (Cicero, 1979). One way to achieve this goal would be to introduce more of finite mathematics, including introductory graph theory, linear programming, elementary statistics and computer programming to replace the classical topics which do not relate directly to the solution of real-world problems.

It is clear that the computer has changed our society, just as the Industrial Revolution changed society centuries ago. Automation controlled by the computer is creating an

economic upheaval in industry (Johnson & Rising, 1972). It is reasonable to suggest that a similar upheaval will occur in education. In particular, the micro-computer will challenge designers of school programs to take advantage of their simulation and graphics capability as well as their "word processing" abilities. Creating appropriate software may well occupy a massive amount of time for educators during the next decade (Downes, 1979).

Problem solving should be at the heart of every mathematics course at the secondary level. NCTM's "An Agenda for Action" (1980) listed problem solving as its first recommendation of the direction mathematics programs should be taking in the 1980's. Of course, teachers will have to learn how to teach the processes of problem solving--how to introduce a problem whose solution uses the material to be taught next, and show the class how the new knowledge expands their horizons and increases their value in a technological society. This form of reinforcement will benefit the students and establish a closer relationship with the teacher. Thus in order to increase their effectiveness as problem solvers, teachers will have to work a great deal on their own. At this time the textbooks and curriculum are still very classical and constitute a stumbling block rather than an aid. It would appear that teacher training programs are the most efficient route to success if such an effort is to be tried and to succeed.

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