

Reports of surveys by the National Assessment of Educational Progress (1860 Lincoln St., Suite 300, Denver, CO 80295), issued last September, have shown a serious decline in the mathematical problem-solving abilities of this country's 9-, 13-, and 17-year-olds. The implications of the NAEP findings should be of concern to teachers of mathematics at all levels. In a news release of September 13, 1979, Shirley A. Hill, president of the National Council of Teachers of Mathematics, commented on the results of the NAEP surveys. Her statement (slightly revised) appears below, followed by a commentary on the state of mathematics in our schools by Martha Zelinka.

Readers who feel uncomfortable with an issue of the MONTHLY that devotes so much space to the high schools should ask themselves where the college students come from in the first place.

—R.P.B.

NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS

SHIRLEY A. HILL

The results of the second national assessment of mathematics reinforce the warnings that professional organizations concerned with mathematics education have been stressing in recent years. An excessive narrowing of the mathematics curricula—in the name of “Back to the Basics”—to the mechanistic learning of computational skills is detrimental to the development of problem solving.

While students displayed a fairly high level of skill in whole-number computation in the assessment, their abilities to apply these skills to the solution of realistic problems were significantly lower. It is obvious that there is little benefit to be gained by concentrating extraordinary efforts on computing skills and minimal competencies if our graduates cannot effectively *apply* mathematics in the real world. The assessment results present convincing evidence that we cannot simply assume that if students perform well on tests of lower-order skills then they can consequently use those skills in solving real-life problems. And, surely, the latter is our primary objective.

Throughout the NAEP reports, there is evidence that students proceed mechanically and thoughtlessly through problems, seeking a familiar routine or a rigid rule to apply. In many instances a careless reading of what is called for is apparent; in others, one finds a common failure to note that some answers are not realistic or even reasonable. Students often appear to lack a basic sense of quantitative relationships. While a reliance on drill and rote memorization of rules will produce a good showing on tests of short-term retention, this reliance also creates a mind set that is antithetical to insight into the essence of a problem.

The inescapable conclusion to be derived from the results of the second national assessment of mathematics is that there is a critical need for attention to higher-order cognitive skills. Reasoning, analyzing, estimating, selecting appropriate information, and inferring—these are basic skills that are essential to the effective application of mathematics.

The NAEP mathematics report should be invaluable to teachers, mathematics educators, curriculum developers, and school policy-makers in identifying other areas where increased efforts are needed. Foremost among these areas are decimals, ratios, and percents. All are increasingly important to the development of knowledgeable consumers, as is the ability to interpret quantitative data. As the calculator becomes an indispensable tool, the understanding and use of decimals assumes a more prominent place in problem solving. Furthermore, the disappointing assessment results on algebraic items suggest the need to reexamine instructional methods, content, and the present placement of algebra courses in the curriculum for some students.

Responsible readers of the NAEP reports will recognize that simplistic judgments about the overall mathematics success or failure of students, schools, teachers, or society cannot be made from such assessments. Nor was the assessment program designed to elicit such judgments. It is the identification of strengths and weaknesses that will provide guidance to mathematics teaching—not condemnation or praise.

But the challenge of the assessment results goes beyond the education community. During much of this decade, public demand and pressure—and, often, resulting legislation—have placed predominant attention on minimal skills. Tests have been developed to measure the “accountability” of the schools to this mandate. Consequently, mathematics textbooks and tests consisting of computation and routine word problems have dominated the market.

Many schools and teachers have responded to public pressure by focusing mainly upon the materials to be tested or on areas most easily and quickly affected by concentrated classroom effort. Less classroom time has been devoted to the processes of problem solving than to routine processes of paper-and-pencil calculation.

Public opinion should have its place in decisions about educational goals and objectives. But the clear message of the NAEP mathematics reports is a challenge to the public at large. The public must reexamine its present priorities and weigh the results of a mechanistic rote-skill curriculum against the need—now and in the future—for problem solvers with the flexibility to apply their knowledge in unexpected as well as routine ways.

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THE STATE OF MATHEMATICS IN OUR SCHOOLS

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September 13, 1979, was a jubilant day for the Mathematical Association of America: the formal opening of the Headquarters, the Dedication of the Edgar H. Vaughn Building and the Dolciani Mathematical Center in Washington, D.C.

Was it coincidence that the same day saw the meeting of the members of the Committee on National Assessment of Educational Progress? They analyzed the findings of mathematics tests administered in 1978, involving 71,000 youngsters of ages 9, 13, and 17; this set of tests had last been given in 1973. (NAEP is a long-term, government-sponsored program, charged with periodic evaluation of the learning of American children in ten subject areas.)

September 14, 1979, the *Washington Post*: “According to a survey released today, mathematical ability of pupils declines.” Is it the ability that declined?

October 10, 1979, the *Christian Science Monitor*: “High school science in decline, . . . alarming decline in high school math and science teaching. . . . They could use another sputnik.”

These articles are both thoughtful and, no doubt, alarming. Let us hope that the reader goes beyond the headlines. The concerns expressed by Shirley A. Hill, President of NCTM, and Roy H. Forbes, Director of NAEP, about possible reasons for the decline in performance are those anticipated years ago by the mathematics community, when the layman’s vocabulary was first enriched from the monotonous “declining SAT scores” to include “accountability,” “minimum competency,” “back-to-basics,” “mainstreaming.” Since then, these dangerous trends have become reality in many areas. They were offered as “solutions” by outsiders far removed from the classroom scene, mostly politically inspired nonscholars. Yet, and this is most deplorable, criticisms were also voiced by great minds, playing directly into the hands of those responsible for outside pressures. A federal law (PL94-142) now requires that students with special needs be taught in the least restrictive environment—in the classroom, whenever possible. The idea of

Martha Zelinka retired from Weston High School in June 1979 but plans to return to the classroom in the near future. She has been very active in the Association of Advanced Placement Mathematics Teachers. See this MONTHLY, 85 (1978) 629, for more biographical detail.—*Editors*.