# A Mathematics Challenge for Tomorrow




*New concepts have kept mathematics teachers in a constant state of change and students and parents in continual perplexity.*

Since the orbiting of Sputnik launched the space race some 35 years ago, U.S. mathematics curriculum planners have introduced New Math, Base 2 calculations, new uses for electronic devices in the classroom, and other innovations that have affected mathematics education on a universal scale. The new concepts have kept mathematics teachers in a constant state of change and students and parents in continual perplexity. The topics of concern range from unfavorable comparisons with math scores of students in other developed countries, "Why Johnny Can't Divide" (even with calculators), to the role computers and other electronic devices should plan in the classroom.

Where is mathematics education going today? What direction should mathematics education take to prepare students for the 21st century? How can Adventist education cope with these changes?

**Adventist Mathematics Education Today**

To determine how well Adventist schools are doing in math, we surveyed the standardized mathematics test scores for 15,297 SDA students ranging from grades 3 through 12. The students were arbitrarily selected from three North American Division union conferences. The scores used reflected students' "Total M" (combined mathematics) norms on the Iowa Tests of Basic Skills Cognitive Abilities Test taken in the fall of 1991 and 1992 for grades 3 through 8, and the Tests of Achievement & Proficiency for grades 9 through 12 for the same years. To determine a weighted average, all norms were manipulated and the difference from the national norm of 50 was determined. These new scores were then averaged. The number of students was also taken into consideration. The results are summarized in Table 1.

The average norm difference from the national norm by grade is summarized in Graph 1.

BY REO E. GANSON

Table 1

# SDA Math Scores

Summery of Average Scores by Grade

| Grade | Average Norm | Number | Average Difference |
|---|---|---|---|
| Grade 3 | 46.43 | 1,704 | -3.57 |
| Grade 4 | 48.31 | 1,838 | -1.69 |
| Grade 5 | 51.12 | 1,827 | 1.12 |
| Grade 6 | 53.78 | 1,920 | 3.78 |
| Grade 7 | 55.92 | 1,828 | 5.92 |
| Grade 8 | 56.28 | 1,759 | 6.28 |
| Grade 9 | 60.06 | 1,641 | 10.06 |
| Grade 10 | 57.24 | 1,073 | 7.24 |
| Grade 11 | 57.55 | 1,275 | 7.55 |
| Grade 12 | 57.48 | 432 | 7.49 |
| Average | 54.02 | (Total) 15,297 | 4.02 |

These charts show that the students' scores closely followed the national average, although the grade 9 students were slightly above the norm. The below-average results for grades 3 and 4 may reflect the Adventist philosophy of education, which delays emphasis on academics until students finish the primary grades. The statistics reflect a strengthening of the mathematics content during the upper elementary grades. This cross-sectional review indicates that with increasing grade levels, there is some progress in comparison to the norm. However, this advantage is lost during the high school years, although the students surveyed at this level did remain constant at 7 points above the national norm.

Adventist educators can take some comfort in these results, since our schools are marginally above the national average for mathematics. Optimism about the future, however, needs to be well guarded. The advantage is less than .03 of a standard deviation, which is marginal at best. Teachers also need to remember that normative comparisons do not indicate the level of students' competency, only their relation to the average. We have a great deal of room for improvement.

## Mathematics Education Today

Nationwide statistics for U. S. students, as reported in *Education Week*, indicate that "only 11 percent of high school seniors who took the American College Testing Program test [in 1992] are prepared for college-level calculus, and one in four will need remedial mathematics in college."[1] The report indicated that this pattern had been consistent over the previous four years.

In a recent review of elementary curriculum materials, Gerald W. Bracey stated that

*while math textbooks claim to emphasize concept development, in reality they emphasize the mastery of algorithms. They present mathematics as a set of rules and procedures that, once memorized, can be applied directly to word problems. This process undermines what emphasis there is on problem solving, estimation, group work, and using manipulatives. The texts place no emphasis on constructing knowledge, justifying answers, encouraging divergent solution strategies, or helping students understand mathematics as a human construction that is subject to revision by other humans.*[2]

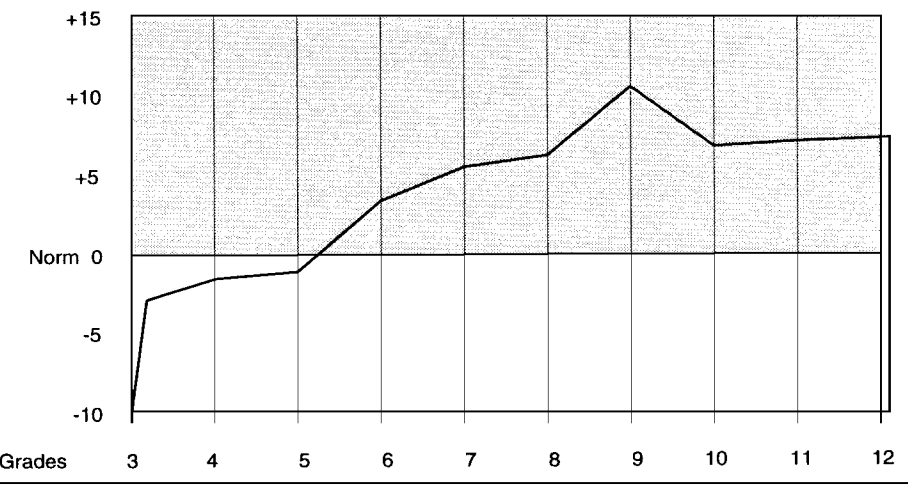
Richard S. Newman and Mahna T. Schwager reported in a study of 177 students that today's students prefer teacher help over assistance from other students. Students in grades five and seven were more concerned than students in grade 3 about social comparisons in the math classroom. The pupils felt that strong teacher encouragement was essential to student success in mathematics.[3] This places a continued emphasis on the role of the classroom teacher as a caring, supportive individual.

Research clearly indicates that mathematics teaching is maintaining the status quo. A new focus is necessary as educators consider the rapidly changing environment that society must cope with during the 1990s and beyond.

Graph 1

SDA Math Scores

Average Difference From National Norm by Grade




## Mathematics Education for Tomorrow

The National Council of Teachers of Mathematics (NCTM) has published Curriculum and Evaluation Standards for School Mathematics. In this document, they emphasize "the importance

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of students finding mathematical problems in everyday situations and developing a variety of strategies to solve those problems."[4] The guidelines depict the teacher as a professional, a specialized decision-maker, the central informant. In the NCTM guidelines, algorithms continue to be important, but only after the students have experienced an environment of exploration and discovery.

Teachers need to accept the challenge offered by the new NCTM standards.

## *Where is mathematics education going today?*

Bosch and Bowers support the concept in relation to teacher "talk time" in the classroom. They indicate that about two-thirds of the talk time "is done by the teacher and two-thirds of that time is spent in giving direction, lecturing, and criticizing students."[5] They add that teachers must make sure that they confront real problems in mathematics, combat boredom and discouragement, and care for each student's unique needs. "Mathematics teachers must ensure that the teaching/learning process is student-centered and student-directed."[6]

Pilot studies are beginning to show the strengths of the new focus in mathematics education. Viadero reports that although the majority of teachers continue to emphasize "how to do" math, those who have implemented methods that involve students in the math process and who place mathematics in the larger environment have higher student scores on standardized tests.[7] Merseth states that mathematics education needs to construct understandings by building relationships with the students' prior knowledge. The students need to form clusters of knowledge before functioning in the rigor of algorithms. Instruction needs to offer students avenues of exploration through use of multiple representations and explanations.[8]

Educators must also seek to connect math to the real world. According to West, students should be encouraged to seek "ways to solve problems, rather than focusing on reaching a predetermined solution."[9] West continues by stating that "discrete math," which encourages students to think about ways to solve problems, rather than focusing on reaching a predetermined solution, can be traced to the emergence of computer applications in the classroom and the use of the computer to solve complicated, complex, and intricate problems with relative ease. The intersection between discrete math and the social sciences offers opportunities for integrating "real world" problems into the mathematics curriculum.

## *What direction should mathematics education take to prepare students for the 21st century?*

Mathematics education needs to be rejuvenated in several ways: by refocusing on understanding, by bringing the students' environment into mathematics, by considering the real world in problem solving, by reducing the focus on algorithmic processes, and by teachers becoming more effective, caring people in the classroom. If we do this, Adventist education can not only keep up, it will become a leader in producing mathematically literate students.

*Dr. Reo E. Ganson is an Associate Director in the Department of Education at the General Conference of Seventh-day Adventists in Silver Spring, Maryland. He has served as a mathematics instructor and college president.*

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