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ABSTRACT

In 1995, the American College Testing (ACT) Program conducted a study of the effects of using a calculator in its ACT Assessment and PLAN mathematics tests taken by approximately 38,000 students. Whether there would be changes in the PLAN and ACT score scales as a result of permitting calculator use on the mathematics tests was explored with samples of 14,710 8th graders, 7,403 10th graders, 4,519 12th graders, and minority samples of 7,436 10th graders and 4,764 12th graders. Whether gender and ethnic groups would be disadvantaged by allowing calculator use was also studied. In addition, new nationally representative norms were obtained for PLAN, ACT, and the EXPLORE assessments. Results indicate that calculators may be used on the PLAN and ACT assessments without changing the meaning of the test scores. Nor was there any consistent evidence to suggest that the use of calculators disadvantages any group based on ethnicity or gender. For these reasons, the ACT has decided to allow calculator use beginning in the fall of 1996. (SLD)

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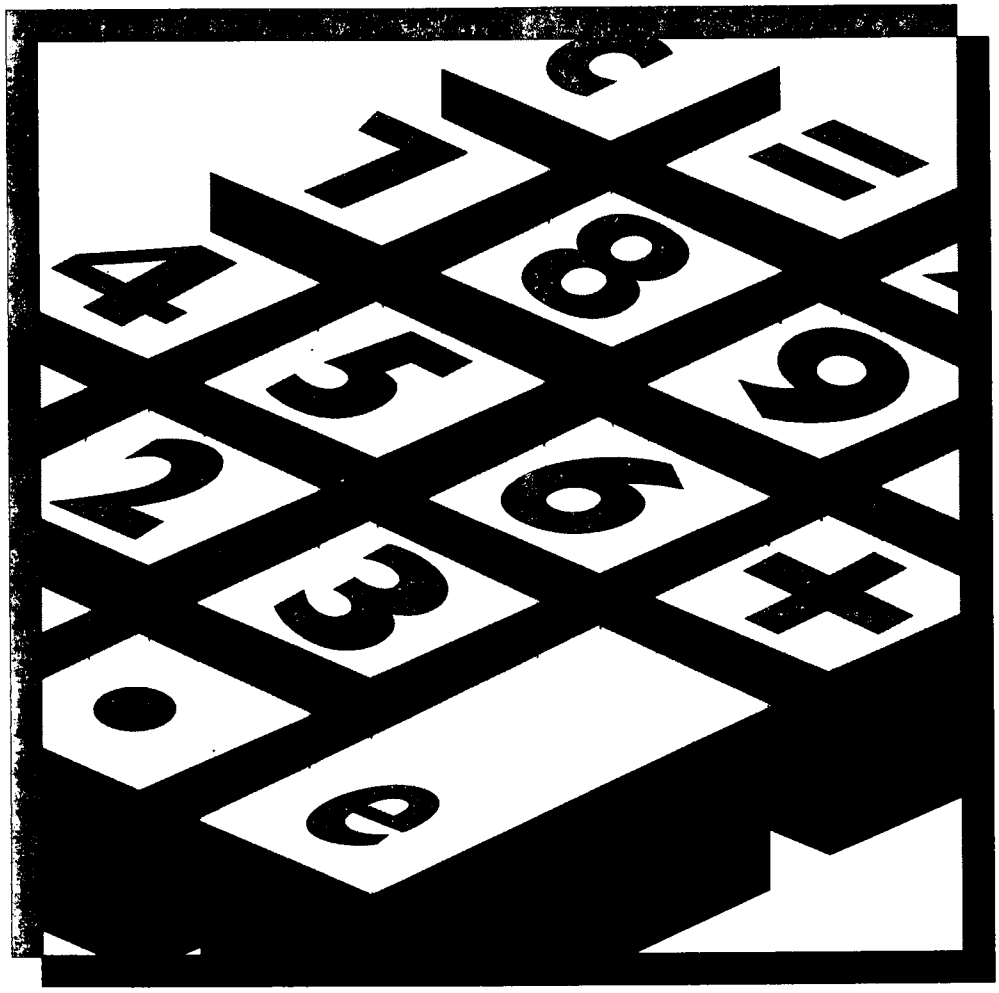
Using Calculators on the PLAN and ACT Assessment Mathematics Tests



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Beginning in the fall of 1996, ACT will permit students to use calculators on the Mathematics Tests in PLAN and the ACT Assessment. The decision to initiate this change in our testing procedures was made after a great deal of research into what is being taught in mathematics classrooms and how students perform on tests when they use calculators. As a result of this research, we concluded that students may use calculators on the PLAN and ACT Assessment Mathematics Tests and that doing so will not change the meaning of the test scores from what they meant when students did not use calculators.

In 1992, we established the ACT Educational Planning and Assessment System (EPAS), consisting of EXPLORE for grade 8, PLAN for grade 10, ACT Assessment for grades 11 and 12, and Work Keys for grades 9 to 12 and beyond. We regularly confirm that the educational achievement tests included in EPAS are based on what is being taught in today's middle and secondary schools. We also monitor skills taught in secondary schools that are essential for success in postsecondary education and in the workplace. By carefully observing what is being taught in mathematics, we have found that calculators have become more and more an essential part of learning in mathematics, from classwork to homework to classroom tests. In addition, the use of calculators has been sanctioned by the National Council of Teachers of Mathematics (NCTM) in their *Curriculum and Evaluation Standards for School Mathematics*.

In light of the purposes and uses of EXPLORE, we have supported the use of calculators on the EXPLORE Mathematics Test since the program was introduced in 1992. Use of calculators has also been permitted on the Applied Mathematics Test in Work Keys since its introduction. We were concerned, however, whether most high school students had access to calculators, and whether it would be fair to permit the use of calculators on higher-stakes tests like the ACT Assessment. Results of a 1995 national ACT study indicated that almost 90 percent of grade 12 students and about 83 percent of grade 10 students use calculators for mathematics classwork. Although these findings encouraged a decision to permit the use of calculators on our tests, we wanted to be sure that the use of calculators on higher-stakes tests would be fair to all students and that gender and ethnic groups would not be disadvantaged if calculators were permitted.

In the fall of 1995, we conducted a major national study looking into the effects of using a calculator on ACT's Mathematics Tests, involving approximately 38,000 students. The main purpose of this study was to determine whether there would be changes in the PLAN-ACT score scale as a result of permitting calculator use on the Mathematics Tests. In other words, would

the scores reported to students and schools still mean the same thing? We also wanted to verify that gender and ethnic groups would not be disadvantaged by the introduction of calculator use on the tests. Finally, we wanted to obtain new nationally representative norms for EXPLORE, PLAN, and the ACT Assessment. The samples selected for the study included schools chosen to represent various regions of the United States, sizes of school, percentages of minority population, and grade levels.

The sample sizes are reported in Table 1.

Table 1
Sample Sizes

Samples	N
Grade 8	14,710
Main Sample - Grade 10	7,403
Main Sample - Grade 12	4,519
Minority Sample - Grade 10	7,436
Minority Sample - Grade 12	4,764

Table 2
Numbers of Students in Gender and Ethnic Groups Included in the Study

Form	Ethnicity		Gender	
	African American	Caucasian American	Females	Males
PLAN - with calculator	1,268	1,370	1,962	1,696
PLAN - no calculator	1,334	1,338	2,062	1,623
ACT - with calculator	1,063	794	1,341	1,028
ACT - no calculator	1,062	795	1,320	1,050

To determine what effects the use of calculators might have on how students from different ethnic groups and of both genders perform on the Mathematics Tests, we selected groups of students from the samples described in Table 1. The numbers of students in each group actually included in the analyses are reported in Table 2. The numbers of students in ethnic groups other than African American are not reported because of insufficient representation of these groups in the samples.

In the study, a random sample of 10th-grade students took the PLAN Mathematics Test and a random sample of 12th-grade students took the ACT Assessment Mathematics Test. Half of the students in each of these samples were permitted to use calculators; the other half were not. In a separate sample, students in grade 8 took a standard version of EXPLORE, which already permitted calculator use, so that we could obtain new national norms for EXPLORE.

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Results

We wanted to make sure that the single score scale for the PLAN Mathematics Test and the ACT Assessment Mathematics Test would not change when students are permitted to use calculators, as compared to when calculators were not permitted. We found that we could continue to use the present score scale for the Mathematics Tests. This means, for example, that a 12th-grade student who receives a scale score of 23 on the ACT Assessment Mathematics Test, using a calculator or not, can interpret that 23 as representing the same level of achievement that a score of 23 on that test has represented in the past. Or a student who obtains a scale score of 16 on the PLAN Mathematics Test, using a calculator or not, can conclude that the score of 16 represents the same level of achievement as it did previously.

We also wanted to detect whether calculator use would affect unfairly the performance of certain gender or ethnic groups. We found that there was no consistent evidence to indicate that the use of calculators disadvantaged any group based on gender or ethnicity.

Another component of the calculator study involved collecting updated national norms for students who will take EXPLORE, PLAN, or the ACT Assessment in the fall of 1996 and beyond, when students will be permitted to use calculators on the Mathematics Tests in all three programs. These norms, collected not only for Mathematics but also for English, Reading, and Science Reasoning, provide updated information about how students perform on all three programs relative to students testing nationally.

Conclusion

The results of the research described in this report have led us to conclude that calculators may be used on the PLAN and ACT Mathematics Tests and that their use will not change the meaning of the test scores from what they meant when students did not use calculators. In addition, there is no consistent evidence to suggest that use of calculators disadvantaged any group based on gender or ethnicity. The combination of these results, our continued monitoring of what is being taught in mathematics classes, and the importance of the NCTM *Standards* has led to our decision to permit students to use calculators on all of the Mathematics Tests in the ACT Educational Planning and Assessment System.

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