

College Prep Math Assessment in Algebra I and Geometry 1993 Results

Executive Summary

This report is a careful look at the results of a study of approximately 3700 students from Algebra and Geometry classes who participated in an assessment during May of 1993. Each student worked on two of the exam questions shown in Attachment 1 and was required to show his or her work. A typical question was:

You are in charge of buying potato salad for the annual Central High picnic and are told that 50 pounds of salad will feed about 140 people. About how many pounds of salad should you buy if you want to feed 300 people?

Papers from CPM and non-CPM students were coded so that the students could not be identified and mixed together to guarantee uniform grading. Each paper was graded holistically on a scale of 0-4 with 3 representing satisfactory work and 4 representing excellent work.

The overall result is that CPM students have uniformly higher means on these tests than students from non-CPM classes (more than 27% higher for algebra and 18% higher for geometry). The results are true for both sexes, all ethnic groups, all grade levels and are significant overall at the .0001 level; that is, there is a probability of .0001 or less that the CPM and non-CPM students performed equally well. This year a new sub-study was added, comparing scores of students within the same school. The mean scores differed substantially among schools, but the classes of CPM students always scored higher.

Methodology

In May, 1993, examinations were sent to about 40 schools which had both CPM and non-CPM classes in algebra and geometry. (Here we use the term "non-CPM" to denote a class using any one of the various standard textbook series--e.g., Houghton-Mifflin, Prentice-Hall, etc.) Each CPM teacher was asked to find non-CPM teachers at his or her school who would give the examination to their students as well so that we could be assured of roughly comparable groups of students taking the examination. All of the teachers involved were volunteers.

Each of the students was asked to fill out a brief questionnaire detailing their age, grade level, gender and ethnicity. Then students were given 20 minutes to work on the two questions from one of six forms of the assessment. Care was taken to ensure that each of the tested classes used approximately the same number of each of the six different forms of the test. Each teacher also filled out a questionnaire giving their gender, number of years of teaching experience, the text used, and the number of years they had taught from this particular text.

All of the examinations were sent to the CRESS Center at UC Davis, where each student's responses were coded by the same number on their information sheet and each of their two response sheets. Then the papers were separated into piles by question number and the papers within each pile were shuffled so that they would be graded in random order. Approximately 2650 students took the Algebra assessment and 1050 students took the Geometry assessment. From these original numbers, we were able to salvage 2536 Algebra and 945 Geometry complete data sets. In each case about 2/3 of the papers were done by CPM students.

During June of 1993, group of 30 teachers participated in the grading which was done holistically on a 5-point scale. On this scale a 0 represented no useful work (either nothing done or nonsense); 1 represented an understanding of the problem, but little progress toward a solution; 2 a reasonable start toward a solution, but an approach with significant gaps or misconceptions; 3 an almost complete solution which might contain minor errors; and 4 a full and complete solution. For each problem, the group agreed on a rubric for the scoring by looking at several sample papers. After the group had come to an agreement the shuffled papers were each graded by at least two people and, in case of disagreement, by a third person. The consensus score was recorded.

Analysis of the data

All of the data was analyzed by the SPSS statistical package with the assistance of Neil Willett of the UC Davis Statistical Consulting Laboratory. In the first pass of the data it was determined that there was no significant difference in the performance of males and females on the same problem, but there were differences attributable to differences between ethnic groups, grade levels, teachers, schools and program. Because of differences between individual teachers and schools, the data was analyzed by a *random effects* analysis, where we assume that differences between schools and teachers exist as well as by a *fixed effects* analysis, where we assume that all teachers and schools are substantially identical.

In each case of program comparison, the difference favored CPM students, generally by a substantial and statistically significant margin.

When ethnic differences existed within a program, the white and Asian (and sometimes Hispanic) students scored higher than Blacks. However, CPM students of all ethnic groups outscored traditional students of all ethnic groups (except Asians for Geometry). That is, Black CPM students scored higher than students from any ethnic group in traditional classes. (This is illustrated in the graph of Figure 1 under the Executive Summary.)

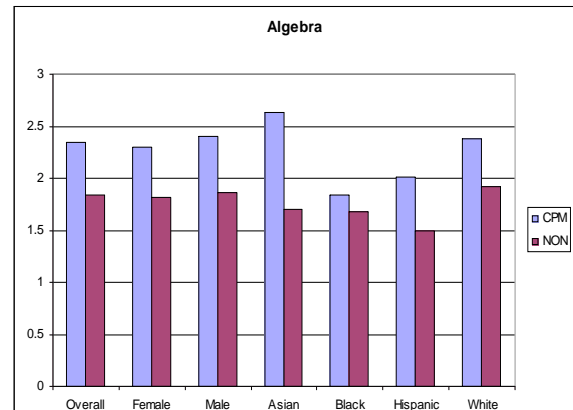
In addition to comparing overall means of the two groups, we compared the proportion of those who scored a 3 or a 4 on their responses. These were the responses that were considered essentially correct. Again, the proportion of CPM students who scored a 3 or a 4 was significantly higher than the proportion for students in traditional classes.

Attachment B

As mentioned in the body of the text, exams were graded at two sites: Davis and Riverside. Both Algebra and Geometry exams were graded in Davis, while only Algebra exams were graded in Riverside. In each case the examinations were graded by a set of teachers who mutually agreed upon the criteria for grading and then graded the papers that were mixed up among all schools and identified only by number.

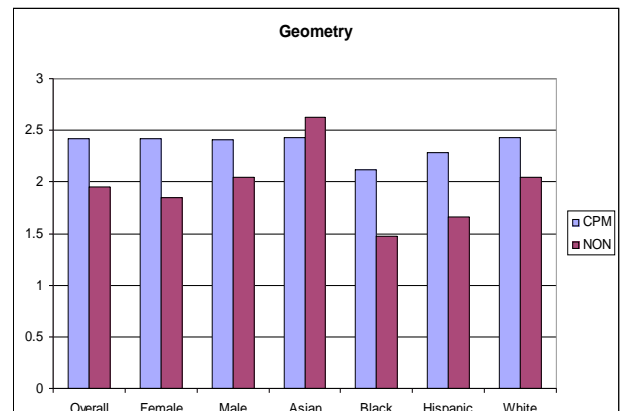
Overall Means for Algebra

| | CPM | NON |
|----------|-------|-------|
| Overall | 2.340 | 1.841 |
| Female | 2.295 | 1.820 |
| Male | 2.400 | 1.864 |
| Asian | 2.636 | 1.697 |
| Black | 1.834 | 1.680 |
| Hispanic | 2.015 | 1.496 |
| White | 2.374 | 1.924 |



Overall Means for Geometry

| | CPM | NON |
|----------|-------|-------|
| Overall | 2.415 | 1.955 |
| Female | 2.418 | 1.845 |
| Male | 2.411 | 2.046 |
| Asian | 2.425 | 2.631 |
| Black | 2.122 | 1.478 |
| Hispanic | 2.280 | 1.662 |
| White | 2.431 | 2.044 |



Comparisons within the same school

One of the advantages of this year's data collection is that it is possible to compare the scores of students for different teachers within the same school. The generally reliable assumption is that students in different algebra classes at the same school come with approximately the same backgrounds.

In the tables below, class means are given for each CPM and non-CPM class at the same school followed, when appropriate, by the average of the two means in parenthesis. Schools are identified as suburban (S), urban (U), rural (R) and junior high (J). Looking at these scores allows comparison within schools. You will notice that the scores differ dramatically among the schools, but the differences almost always favor CPM students.

In the tables below, class means are given for each CPM and non-CPM class at the same school, followed, when appropriate, by the average of the means in parenthesis. Schools are identified as Suburban (S), Urban (U), Rural (R) and Junior-High (J).

Table A: Algebra

| School | CPM Class Means | non-CPM Class Means |
|---------------|--------------------|------------------------|
| School 1 (S) | 2.11 | 2.11, 2.20 (2.16) |
| School 2 (U) | 2.05, 1.96 (2.00) | 1.61, 1.33 (1.47) |
| School 3 (S) | 1.99 | 1.92 |
| School 4 (UJ) | 1.87 | 1.54 |
| School 5 (R) | 2.16, 1.36 (1.76) | 1.59, 1.48 (1.54) |
| School 6 (U) | 1.48 | 1.26, 1.00 (1.13) |

Table B: Geometry

| School | CPM Class Means | non-CPM Class Means |
|----------------|--------------------|------------------------|
| School 1 (R) | 2.85 | 1.82 |
| School 2 (U/S) | 2.74 | 1.75 |
| School 3 (U/S) | 2.70 | 1.76 |
| School 4 (S) | 2.78, 2.55 (2.66) | 1.82 |
| School 5 (R) | 2.35 | 1.98 |
| School 6 (R) | 2.26 | 1.69 |
| School 7 (R) | 1.93 | 2.11 |