

Longitudinal Study

College Mathematics Course-Taking and Performance Patterns

Abstract

In this report, the college mathematics course-taking and grades for 145 students who experienced a Standards-based curriculum in middle school and Core-Plus Mathematics in high school are compared with that of students who experienced a more traditional high school program. In their first college semester, Core-Plus Mathematics graduates with similar high school mathematics backgrounds took various college mathematics courses through Calculus II at similar frequencies and with similar success rates as students from more traditional high school mathematics programs.

Background

For five years, the Core-Plus Mathematics Project (CPMP) evaluation team monitored the mathematics course-taking patterns and grades of the 1997 freshman class (graduating class of 2001) in three school districts in which the published first edition of the Core-Plus Mathematics curriculum was used exclusively in grades 9-12. In addition, students in each school came from feeder middle schools in which a reform mathematics curriculum (Connected Mathematics or MathThematics (STEM)) was used. These are three instances of solid implementations of reform curricula. Some demographic data of the schools and their communities are given in Table 1. School names are pseudonyms.

Table 1: *Demographic Data for Schools and Their Communities*

School	Town Population	Enrollment	% Free/Red. Lunch	% Underrep. Minorities	Middle Sch. Curr.
Washington	8,800	484	14.0	27.9	STEM
Adams	11,285	910	26.6	7.3	CMP
Jefferson	14,532	1,436	14.2	2.3	CMP

Students completed achievement tests at the beginning of grade 9 and at the end of each school year. The Iowa Tests of Educational Development - Quantitative Thinking (ITED-Q) was administered to all students at the beginning of grade 9. School ITED-Q means for students at the beginning of grade 9 were at the 56th, 64th, and 66th national student percentiles, respectively. Hence, the students in these schools were somewhat above the national average in mathematics achievement upon entering high school.

Data in this report of the CPMP longitudinal study were drawn from the results of a survey that 2001 graduates completed in January 2002, supplemented by data drawn from the records of two universities that many graduates of two of the schools attended (Western Michigan University and Grand Valley State University). Table 2 reports the number of 2001 graduates, number of graduates for whom we have post-secondary data, and the number of those who reported attending a four-year college/university or a community college in Fall 2001. The fact that nearly all respondents went directly into post-secondary education is partly due to the relative difficulty in contacting those who entered the work force.

Table 2: *Numbers of Graduates, Survey Respondents, and Post-Secondary Activity by School*

School	2001 Graduates	Post-High Respondents	College or University	Community College	Work
Washington	58	14	12	2	0
Adams	159	47	39	6	2
Jefferson	353	132	94	36	2

This report focuses on the preparation of the graduates for college or university mathematics, a total of 145 students from the three school districts. These graduates attended 39 different institutions across the country. To provide points of comparison, we obtained records from two major universities, the University of Iowa (UI) for all freshmen in Fall 2002 and Western Michigan University (WMU) for all freshmen in Fall 2001. Mean ACT Mathematics and ACT Composite scores for these three groups are given in Table 3. As shown, the mean of both scores for the Core-Plus Mathematics graduates was between the two comparison groups. Seventeen of the Core-Plus Mathematics graduates took the SAT rather than the ACT.

Table 3: *Numbers of Students and ACT Means and Standard Deviations by Group*

	N	ACT Math		ACT Composite	
		Mean	SD	Mean	SD
Core-Plus Mathematics	128	22.45	4.71	23.29	3.98
University of Iowa	3,998	24.32	4.33	24.58	3.71
Western Michigan	4,323	22.05	4.06	22.32	3.39

Comparison of All Freshmen

The percents of students in each group enrolling in various mathematics courses and the mean of their grades in each course are given in Table 4. The large difference between UI and WMU is mainly due to differing mathematics requirements. At UI, students are not required to take a mathematics course; rather they have a quantitative literacy requirement that can be met with a number of courses other than mathematics. At WMU, a mathematics course is required of all students, and many take precalculus in their first semester.

Table 4: Numbers and Percents of Students and Mean Grades by College Mathematics Course

Math Course	Core-Plus Mathematics		University of Iowa		Western Michigan University	
	N (%)	Mean	N (%)	Mean	N (%)	Mean
None	56 (38.6)	--	2,121 (53.1)	--	1,214 (28.1)	--
Rem. Algebra	10 (6.9)	2.12	203 (5.1)	2.74	243 (5.6)	2.54
Precalculus	52 (35.9)	2.64	1,170 (29.3)	2.71	2,406 (55.7)	2.44
Calculus I	15 (10.3)	3.10	327 (8.2)	2.80	321 (7.4)	2.47
Calculus II	8 (5.5)	2.81	117 (2.9)	3.33	9 (0.2)	2.83
Statistics	4 (2.8)	3.50	228 (5.7)	2.73	119 (2.8)	2.42

Again, the Core-Plus Mathematics graduates tend to fall between UI and WMU in percent taking each course. Exceptions are Remedial Algebra, Calculus I, and Calculus II, each of which had a higher percentage of Core-Plus Mathematics enrollees than either of the two university groups. The overall group differences, except for the one between UI and WMU, explained above, do not appear to be greater than one would expect by chance.

There is also no clear pattern in mean grades. The Core-Plus Mathematics graduates' remedial algebra grades are lower; but Core-Plus Mathematics graduates in Calculus I and Statistics are higher than the two comparison groups. WMU grades are somewhat lower than the other two groups in most courses. That may be because WMU students are not as strong in entering mathematics achievement (see ACT score means), or it may just be institutional differences in grading practices.

Comparison by High School Mathematics Background

A perusal of the University of Iowa data makes it clear that students' college mathematics course-taking and grades differ greatly by the number of high school mathematics courses students completed successfully. (Unfortunately, data on mathematics courses taken in high school by WMU students is not available.) Of the Core-Plus Mathematics graduates for whom we have data, four completed just two years of college preparatory mathematics and 18 completed three years; in each case, too few students to provide reliable information. Therefore, we did separate analyses of course-taking and grades for students who completed four years of high school mathematics (66) and for those who completed five years (57). The data for those taking four years of high school mathematics is given in Table 5.

Table 5: Course-Taking and Grade Data for Core-Plus Mathematics and UI Students with Four Years of High School Mathematics

Math Course	Core-Plus Mathematics		University of Iowa	
	N (%)	Mean	N (%)	Mean
None	22 (33.3)	--	837 (48.7)	--
Rem. Algebra	5 (7.6)	2.53	73 (4.2)	3.13
Precalculus	31 (47.0)	2.59	591 (34.4)	2.59
Calculus I	7 (10.6)	3.07	107 (6.2)	2.55
Calculus II	0 (0.0)	--	22 (1.3)	3.45
Statistics	1 (1.5)	4.00	90 (5.2)	2.68

A higher percentage of Core-Plus Mathematics students took a mathematics course in their first semester, and a higher percentage of UI students completed a statistics course. These differences are probably due to the quantitative literacy requirement at UI, described above. A statistics course will satisfy that requirement. Core-Plus Mathematics graduates' grades in Remedial Algebra are lower than those of UI freshmen, but Core-Plus Mathematics graduates' grades in Calculus I are higher. Overall, there does not appear to be any strong pattern of differences.

The data for students taking five years of high school mathematics is given in Table 6. In the Core-Plus Mathematics schools, students in this category completed the four Core-Plus Mathematics courses and either AP Statistics or AP Calculus. Nine students were exceptions as they were accelerated in grade 8, and they completed both AP Statistics and AP Calculus. There do not seem to be notable differences between the results for the two groups of students.

Table 6: Course-Taking and Grade Data for Core-Plus Mathematics and UI Students with Five Years of High School Mathematics

Math Course	Core-Plus Mathematics		University of Iowa	
	N (%)	Mean	N (%)	Mean
None	23 (40.4)	--	444 (37.7)	--
Rem. Algebra	1 (1.8)	1.50	9 (0.8)	2.67
Precalculus	14 (24.6)	3.14	378 (32.1)	3.04
Calculus I	8 (14.0)	3.13	204 (17.3)	2.97
Calculus II	8 (14.0)	2.81	93 (7.9)	3.30
Statistics	3 (5.3)	3.33	51 (4.3)	3.10

Summary

In sum, these 145 students entered college after completing as many as seven years of Standards-based curricula. There are no patterns of deficiency overall or when high school mathematics background is kept constant. In their first college semester, Core-Plus Mathematics graduates with similar high school mathematics backgrounds (and somewhat lower ACT scores) took various college mathematics courses through Calculus II at similar frequencies and with similar success rates as students from more traditional high school mathematics programs.