

# Minnesota Mathematics Achievement Project

## A Summary of Research Findings for Teachers, Principals, School Boards, and Parents

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Below we describe key findings from the Minnesota Mathematics Achievement Project (MNMAP), a recently completed research project that examined the relationship between high school mathematics curricula and college-level mathematics performance. We believe this summary of research results will be useful to high school mathematics teachers, principals, school boards, and parents as they consider mathematics curriculum options for all high school students.

The National Science Foundation (NSF) - funded the MNMAP from 2006 to 2012 with several extensions. MNMAP was a program of coordinated research that published 15 papers in highly regarded peer-reviewed research-oriented journals. (*Journal for Research in Mathematics Education* - 4, *Educational Research Quarterly* - 2, *American Educational Research Journal*, *Journal of Engineering Education*...etc.).

Prepared by both faculty and graduate students, 10 of the 15 papers analyzed data encompassing four years (or two years in the case of community college students) of college mathematics work and mathematics performance.

Five others were concerned with placement recommendations, and their impact on subsequent college-level performance, or pre-college students' performance on standardized assessments as a function of their

enrollment in various high school mathematics curricula.

Thirty-two four-year, and 21 two-year community colleges were involved at one time or another, utilizing a pool of approximately 20,000 students, all from five contiguous Midwest states. The number of student varied with the specific study.

**The most important and consistent finding across all of the papers is that the NSF-funded integrated high school curricula prepared students equally well for college mathematics when compared with more traditional (single-subject) textbook approaches.**

The NSF-funded curricula were: Core-Plus Mathematics: *Contemporary Mathematics in Context* (CMIC), *Interactive Mathematics Program* (IMP), and *Mathematics Modeling Our World* (MMOW). All of the high school students who studied mathematics as an integrated subject were enrolled for three or four years in one of these three programs.

Results indicate that each of these curricula supported students' subsequent college-level mathematics course taking patterns (four-year trajectories), achievement, and persistence. This is in direct contrast to the dire prognostications and claims from some members of the post secondary anti-reform mathematics community for the need to revert back to more traditional approaches. These ongoing debates, as you will recall, became known as the Math Wars.

The findings of no-difference between traditional high school mathematics programs and the three NSF-funded curricula were consistently demonstrated whether we looked at community college results, smaller public or private colleges, major university results, STEM majors, students with more intense college mathematics course-taking profiles, one or multiple institutions, partitioned students on the basis of prior mathematics achievement, or examined performance in introductory college statistics coursework. The integrated students performed equally as well as students with a more traditional textbook-oriented high school mathematics

background on all but one of the dependent variables that were of interest to project personnel. A higher percentage of integrated students enrolled initially in developmental level coursework in collage, defined here as any course considered a prerequisite for college algebra. After this first developmental mathematics course, there were no differences in the number or level of subsequent mathematics courses or achievement patterns.

In summary, our findings suggest, there are good reasons to consider a more active and intense problem-solving focused approach to high school mathematics as envisioned by the author teams of the three integrated curricula and the NCTM Standards. Such an approach is designed to be accessible to a wider range of students and has both psychological and sociological advantages for students. It is also far more consistent with the cognitive perspective of mathematics learning as we now understand it.

We conclude that there is no royal road to success in college mathematics. Our findings suggest that multiple and very different approaches in both content and instruction are worthy of serious consideration. As of this writing, two of the three NSF-funded curricula is available in their second editions. *Core-Plus Mathematics* is now available in its third edition.

We hope that you will find results useful in your curriculum considerations as they, taken as a whole, constitute a large-scale refutation of the anti-reform mathematicians' positions that had earlier trashed these three secondary school NSF-funded programs (CMIC, MMOW, and IMP) and caused chaos within the mathematics education community. Their predictions, based only on anecdotal "evidence" suggested that students would not do well in college mathematics. These were reckless predictions and turned out to be categorically wrong.

Cordially,  
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