IES Institute of Education Sciences

Dana Center Mathematics Pathways

Intervention Brief | Developmental Education

WHAT WORKS CLEARINGHOUSE™
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Not all students enroll in college prepared for college-level coursework. In response, many colleges attempt to identify students who are underprepared for college-level courses and then place them into developmental courses intended to help them succeed. These courses are usually offered on a non-credit basis and do not count toward graduation. As a result, students enrolled in developmental education can take longer to graduate than peers who enroll in credit-bearing college courses from the outset.

Several interventions have been designed to accelerate students' transition from developmental to credit-bearing college courses, including the *Charles A. Dana Center Mathematics Pathways*, hereafter referred to as *Dana Center Mathematics Pathways* or *DCMP*. *DCMP* offers multiple math pathways aligned to programs of study, accelerated enrollment in credit-bearing college math courses, integrated student supports, and math instruction that incorporates evidence-based curricula and pedagogy.

This What Works Clearinghouse (WWC) report, part of the WWC's Developmental Education topic area, explores the effects of *DCMP* on student progression in developmental education and progression in college. The WWC identified seven studies of *DCMP*. Three of these studies meet WWC standards.[1] The evidence presented in this report is from studies of the impact of *DCMP* on community college students–including Asian, Black, White, and Hispanic students–in urban, suburban, and rural settings.

What Happens When Students Participate in *DCMP*?

The evidence indicates that implementing *DCMP*:

- **is likely to increase progression in developmental education**
- **is likely to increase progression in college**

Findings on *DCMP* from three studies that meet WWC standards are shown in Table 1. The table reports an effectiveness rating, the improvement index, and the number of studies and students that contributed to the findings. The improvement index is a measure of the intervention's effect on an outcome. It can be interpreted as the expected change in percentile rank for an average comparison group student if that student had received the intervention.

Table 1. Summary of findings on *DCMP* from studies that meet WWC standards

		Study findings	Evidence meeting WWC standards (version 4.0)	
Outcome domain	Effectiveness rating	Improvement index (percentile points)	Number of studies	Number of students
Progressing in developmental education	Positive effects	+21	3	46,012
Progressing in college	Positive effects	+8	2	11,163

Note: The improvement index can be interpreted as the expected change in percentile rank for an average comparison group student if that student had received the intervention. For example, an improvement index of +21 means that the expected percentile rank of the average comparison group student would increase by 21 points if the student received *DCMP*. The improvement index values are generated by averaging findings from the outcome analyses that meet WWC standards, as reported by Rutschow et al. (2019), Schudde & Keisler (2019), and Schudde & Meiselman (2019). A positive improvement index does not necessarily mean the estimated effect is statistically significant. Progressing in developmental education outcomes reported in these studies include ever passed a college-level math class and completed the developmental math sequence. Progressing in college outcomes reported in these studies include college-level math credits earned and college-level credits earned. The effects of *DCMP* are not known for other outcomes within the Developmental Education topic area protocol, including college enrollment, academic achievement, postsecondary degree attainment, credential attainment, employment, and earnings.

BOX 1. HOW THE WWC REVIEWS AND DESCRIBES EVIDENCE

The WWC evaluates evidence based on the quality and results of reviewed studies. The criteria the WWC uses for evaluating evidence are defined in the Procedures and Standards Handbooks and the Review Protocols. The studies summarized in this report were reviewed under WWC Standards (version 4.0) and the Developmental Education topic area protocol (version 4.0).

To determine the effectiveness rating, the WWC considers what methods each study used, the direction of the effects, and the number of studies that tested the intervention. The higher the effectiveness rating, the more certain the WWC is about the reported results and about what will happen if the same intervention is implemented again. The following key explains the relationship between effectiveness ratings and the statements used in this report:

Effectiveness rating	Rating interpretation	Description of the evidence
Positive (or negative) effects	The intervention ***likely*** to change an outcome	Strong evidence of a positive (or negative) effect, with no overriding contrary evidence
Potentially positive (or negative) effects	The intervention ***may*** change an outcome	Evidence of a positive (or negative) effect with no overriding contrary evidence
No discernible effects	The intervention ***may result in little to no change*** in an outcome	No affirmative evidence of effects
Mixed effects	The intervention ***has inconsistent effects*** on an outcome	Evidence includes studies in at least two of these categories: studies with positive effects, studies with negative effects, or more studies with indeterminate effects than with positive or negative effects

How is *DCMP* Implemented?

The following section provides details of how *DCMP* is implemented. This information can help educators identify the requirements for implementing *DCMP* and determine whether implementing this intervention would be feasible at their institutions. Information on *DCMP* presented in this section comes from correspondence with the developer and from the studies that meet WWC standards (Rutschow et al., 2019; Schudde & Keisler, 2019; and Schudde & Meiselman, 2019). Since the *DCMP* model has evolved since these studies were conducted, we describe the current components of *DCMP* and note where those components differ from the model studied in Table 2.

- **Goal:** *DCMP* aims to ensure all students in higher education are prepared to use mathematical skills in their careers and personal lives, enabled to make timely progress towards completion of a certificate or degree, and empowered as mathematical learners.
- **Target population:** *DCMP* is designed to accelerate the progression of college students who may not be ready for college-level math coursework and have been disadvantaged by the traditional system of standardized test placement and multiple semesters of developmental math courses.
- **Method of delivery:** Math instruction in *DCMP* courses is delivered using evidence-based curricula and pedagogy. Students also receive individual advising from their college to help them align their math course selection with their program of study. Students continue to receive integrated supports from their college throughout their college experience.

Comparison group: In the three studies that contribute to this intervention report, students in the comparison group enrolled in the colleges' traditional developmental math courses, and typically spent two or more semesters to complete the colleges' math requirement. Courses are typically lecture-based and focus on algebraic skills leading to college-level algebra.

- **Frequency and duration of service:** Students are placed directly into college-level math courses with appropriate supports in one of three math pathways–statistical reasoning, quantitative reasoning, or path to calculus–based on their program of study. With the exception of students in science, technology, engineering, and math (STEM) programs of study, most students complete their college-level math requirement in one semester. Students in STEM programs of study complete their first college-level calculus math requirement in the first year.
- **Intervention components:** *DCMP* is comprised of several components, including math course sequences aligned to students' programs of study; first-semester co-requisite model; instruction using evidence-based curricula and pedagogy; enhanced coordination between college faculty, advisors, and student support staff; and alignment of math pathways between two- and four-year colleges. Refer to Table 2 for additional details.

Table 2. Components of *DCMP*

Key component	Description
Math course sequences aligned to students' programs of study	*DCMP* offers math pathways options to fit the needs of students in various programs of study. Specifically, *DCMP* developed curricula for three math pathways: (1) a statistical reasoning pathway for students in the social sciences and health professions; (2) a quantitative reasoning pathway for students in the humanities and liberal arts; and (3) a path to calculus pathway for students in STEM.
First semester co-requisite model	In the first semester of *DCMP*, students are enrolled directly into the appropriate college-level math course aligned to their program of study. Co-requisite support courses are provided to help students engage and succeed in the college-level courses. It is important to note that the Dana Center revised the *DCMP* model to a first semester co-requisite model after the studies that meet WWC standards were conducted. The three studies featured in this report (Rutschow et al., 2019; Schudde & Keisler, 2019; and Schudde & Meiselman, 2019) investigated the effects of the original *DCMP* model where students completed an accelerated developmental math course in the first semester and immediately enrolled in a credit-bearing introductory college-level math course aligned to their program of study in the second semester. In Schudde & Meiselman, 2019, six out of the 27 community colleges also implemented the co-requisite model.
Evidence-based curricula and pedagogy	In the *DCMP* courses, curricula are organized around broad mathematical concepts. The curricula are contextualized around real-world problems and incorporate the use of real datasets. Instruction uses a variety of strategies, such as small group work, class discussions, and interactive lectures, and students actively engage in analyzing data and problem-solving. Students are challenged to apply learned skills to unfamiliar and non-routine problems and develop multiple strategies and solutions to each problem.
Enhanced coordination between college faculty, advising, and student supports	Students receive college advising to help them make informed decisions about their program of study based on their career and life goals. College faculty, advisors, and student support staff enhance collaboration to provide consistent support across the students' entire college experience and to build student self-efficacy through instructional strategies, ongoing check-ins, tutoring, and other supports.
Alignment of math pathways with four-year colleges (community colleges only)	Community college leadership arranges written articulation agreements with four-year colleges to provide credit for students' math courses upon transfer from the community college to the four-year college.

What Does *DCMP* Cost?

This preliminary list of costs is not designed to be exhaustive; rather, it provides educators an overview of the major resources needed to implement *DCMP*. The program costs described in Table 3 are based on the information available as of December 2020.

As reported in Rutschow et al. (2019), the average *DCMP* start-up cost for each college was about $140,450 over two years. Start-up costs included administrative costs to plan and align courses and conduct meetings with college leadership, training for faculty and advisors, and time spent revising curricula and preparing to teach the new courses. The ongoing costs of implementing *DCMP* beyond the existing costs to deliver traditional developmental math courses were, on average, $19,340 per year at each college or $132 per student. The Dana Center contributed an additional $295,057 in estimated start-up costs toward aligning math pathways at each college and statewide, developing math curricula, and hosting initial and ongoing faculty professional development.

Table 3. Cost ingredients for *DCMP*

Cost ingredients	Description	Source of funding
Personnel	Faculty, advisors, and other support staff receive initial training and ongoing professional development on how to implement *DCMP.*	Colleges
Facilities	No additional facility costs are required beyond the standard costs for faculty and advisor office space and classroom space to deliver instruction.	Colleges
Equipment and materials	The Dana Center has developed curricula to include full lessons and lesson guides for implementing *DCMP*. Using the curricula is not a requirement for implementing *DCMP*. However, the Dana Center offers the curricula for free with a technology-based homework platform that costs a one-time fee of approximately $40 per student. Students may be required to purchase calculators and textbooks.	The Dana Center or colleges (curricula); Students or parents (calculators, textbooks, and homework platform fee)
Other	Start-up costs can include aligning math pathways at the college and statewide, establishing an online learning community for instructors to share instructional practices, and facilitating written transfer agreements with four-year colleges. The Dana Center offers a free implementation guide online: https://dcmathpathways.org/implementation-guide and is available to provide professional development in these areas at a cost.	The Dana Center (implementation guide); Colleges (professional development)

For More Information:

About *DCMP*

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About the studies reviewed

Rutschow, E. Z., Sepanik, S., Deitch, V., Raufman, J., Dukes, D., & Moussa, A. (2019). Gaining ground: Findings from the Dana Center Mathematics Pathways impact study. New York, NY: Community College Research Center at Teachers College, Columbia University, and MDRC. https://eric.ed.gov/?id=ED600649

Schudde, L., & Keisler, K. (2019). The relationship between accelerated dev-ed coursework and early college milestones: Examining college momentum in a reformed mathematics pathway. *AERA Open, 5*(1). https://eric.ed.gov/?id=EJ1210499

Schudde, L., & Meiselman, A. Y. (2019). Early outcomes of Texas community college students enrolled in Dana Center Mathematics Pathways prerequisite developmental courses. New York: NY: Center for the Analysis of Postsecondary Readiness. https://eric.ed.gov/?id=ED597974

WHERE THE STUDY WAS CONDUCTED

3 studies, 46,012 students in at least 27 community colleges in Texas.

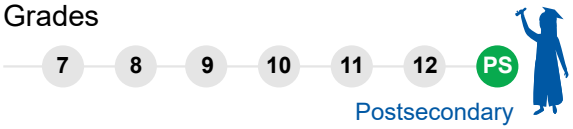
urban, suburban, and rural areas

Race

Ethnicity

Gender

Grades



LEARN MORE

Read more about the *Dana Center Mathematics Pathways* intervention and the studies that are summarized here in the Intervention Report.

Endnotes

[1] There may be overlap among the samples in two of the studies (Rutschow et al., 2019 and Schudde & Meiselman, 2019), but study characteristics are sufficiently different to consider them separate studies under version 4.0 of the WWC standards.