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[Publications & Resources](#)

Building Academic Skills in Context: Testing the Value of Enhanced Math Learning in CTE

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[HOME](#) > [PUBLICATIONS & RESOURCES](#) > [ARCHIVE OF PAST CENTER REPORTS](#) > [BUILDING ACADEMIC SKILLS...](#)

[Research Reports](#)

[Impact Reports & Brochures](#)

[Journal & Magazine Articles](#)

[Archive of Past Center Reports](#)

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[Videos](#)

[Podcasts](#)

[Webinars](#)

[Presentations](#)

Building Academic Skills in Context: Testing the Value of Enhanced Math Learning in CTE

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Executive Summary:

Many high school students, particularly those enrolled in career and technical education (CTE) courses, do not have the math skills necessary for today's jobs or college entrance requirements. Math is found in all areas of CTE, but is largely implicit to both teachers and students. This report describes a group randomized trial (GRT) research study designed to test a model for enhancing mathematics instruction in high school CTE courses emphasizing the mathematics that is already embedded in the CTE curriculum. The aim was to help CTE teachers make mathematics more explicit in a meaningful context and then help reinforce students' mathematics understanding both in and out of that context.

We hypothesized that conceptual mathematics learning and transferability of skills could be enhanced by using a contextual approach, and that testing students on both traditional (abstract) and applied math problems would show whether this was accomplished. The creation of explicit connections between situations is critical if students are to transfer their knowledge and skills outside the classroom, whether it is to another context or to a testing situation. We call this approach contextual. Unlike other models that are context-based, the mathematics in our contextual model arose from the CTE curriculum, rather than being forced into it.

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The Math-in-CTE model, developed by the National Research Center for Career and Technical Education (NRCCTE), consists of both teacher professional development and a seven-element pedagogy. The process involved professional development in which groups of CTE teachers from each of five occupational areas (agriculture, auto technology, business/marketing, health, and information technology) worked with math teachers in examining the CTE curriculum and identifying the embedded mathematical concepts. The CTE and math teachers worked together in teams to develop CTE instructional activities that would enhance the teaching of mathematics that already existed (but was previously not emphasized) in the CTE curriculum. The seven-element pedagogy was designed to move CTE students gradually from a contextual understanding of mathematics to a more abstract or traditional

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[View All](#)

[Programs of Study](#)

[Curriculum Integration](#)

[Retention & Completion](#)

[Accountability & Assessment](#)

understanding such as that often reflected in standardized tests. No commercially available curricula were suited to test this particular pedagogical model; therefore, teachers needed to develop their own lessons. We believe this early investment on the part of teachers was a critical component to the success of the model.

Volunteer teachers were recruited and randomly assigned to an experimental or control group. Because random assignment was conducted at the teachers' classroom level, rather than at the individual student level, the unit of analysis in this research study was the classroom. This design is called a group randomized trial (Murray, 1998) and calls for analysis of student math scores aggregated to the classroom level. A total of 131 CTE teachers took part in this study: 57 teachers in the experimental group and 74 in the control group. Almost 3,000 students in those teachers' classrooms also participated.

During the 2004–2005 school year, the experimental CTE teachers taught the math-enhanced lessons they had developed in their professional development workshops. Teachers in the control condition were asked to teach their regular CTE curricula with no changes. Participants in both conditions were paid. Although random assignment should theoretically yield equal groups, pretesting of students was done in fall 2004 to ensure equality of classroom averages at the start of the school year. Pretest scores were then used as a covariate in the analyses, as is typically done despite the assumption of group equality due to random assignment (Fraenkel & Wallen, 2003). Three different types of posttests were administered at the end of the school year (spring 2005) after all of the enhanced lessons had been taught: TerraNova (a global, standardized test of math ability), ACCUPLACER (a college placement exam), and WorkKeys® (a test of applied mathematics ability). In addition, students in each of the five occupational areas took a posttest that assessed their occupational knowledge and skills in that area; these tests were administered to determine whether or not the instruction time used for enhancing math was detrimental to the learning of the CTE content.

Both quantitative and qualitative data were collected and analyzed to assess fidelity of the treatment and to gain understanding about experimental teachers' experiences during implementation of the model. Teacher surveys and focus groups were conducted. CTE–math teacher-teams were asked to meet before each lesson and submit reports after the lesson was taught. Additionally, each teacher was observed once during the semester by a member of the research team, and instructional artifacts were collected from each classroom.

After 1 year of exposure to the math-enhanced lessons, the students in the experimental classrooms performed significantly better on the TerraNova and ACCUPLACER tests of math ability. They also performed better on WorkKeys, though the difference was not significant. Furthermore, there were no differences in measures of occupational or technical knowledge—meaning that CTE students' math skills increased without detracting from the content skills learned in their CTE courses.

The results presented in this report were achieved without the need for exemplary school-based leadership or cultural change within the school, as opposed to what is commonly concluded from other school reform literature. Instead, the improved math performance of the experimental students was produced by assembling teams of teachers in a single occupational area and providing them with a process and a pedagogy through which they could successfully enhance the math in their own curricula. Essential to the model was the ongoing teamwork between CTE instructors and their math partners in an authentic community of practice.

Stone, J. R., III, Alfeld, C. Pearson, D., Lewis, M. V., & Jensen, S. (2006, July). *Building academic skills in context: Testing the value of enhanced math learning in CTE (Final study)*. St. Paul, MN: National Research Center for Career and Technical Education, University of Minnesota.

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