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RESEARCH SUMMARY

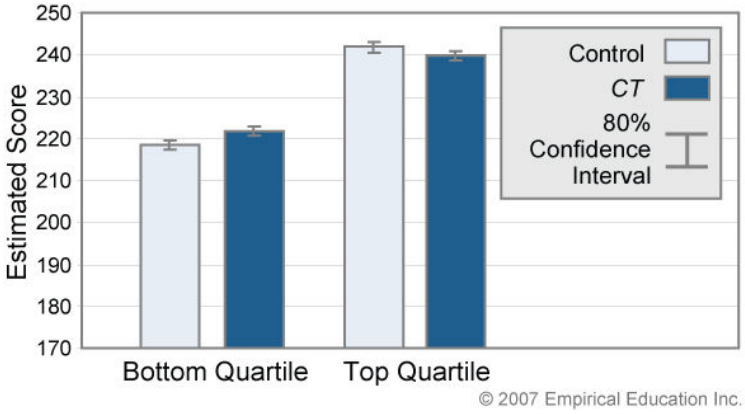
Comparative Effectiveness of Carnegie Learning's Cognitive Tutor *Bridge to Algebra* Curriculum: *A Report of a Randomized Experiment in the Maui School District*

Introduction. Under the *Math Science Partnership Grant*, the Maui Hawaii Educational Consortium sought scientifically based evidence for the effectiveness of Carnegie Learning's *Cognitive Tutor® (CT)* program as part of the adoption process for pre-Algebra programs. During the 2006-2007 school year, we conducted a follow-on study to a previous randomized experiment in the Maui School District on the effectiveness of *CT* in Algebra I. In this second year, the focus was on the newly developed *Bridge to Algebra* program for pre-Algebra. Maui's choice of *CT* was motivated in part by previous research showing substantially positive results in Oklahoma (Morgan & Ritter 2002). Our previous findings in Maui—less positive results for *CT* overall and somewhat negative results for certified teachers—called for additional study with the unique locale and ethnic makeup of Maui.

The research question was whether students in classes using *CT* materials score higher on standardized math assessment, as measured by the Northwest Evaluation Association (NWEA) General Math Test, than those in a control classroom using the pre-Algebra curricula currently in place. The district was also interested in learning whether *CT* is a teacher-friendly tool that could feasibly be used in their setting, whether there would be a differential impact on specific ethnic groups, and whether uncertified teachers would gain more from *CT* than certified teachers.

Findings. We found that most students in both *CT* and control groups improved overall on the NWEA General Math Test. We did not find a difference in student performance in math between groups. Our analysis of the Algebraic Operations sub-strand revealed that many students in both groups did not demonstrate growth in this scale, again with no discernible group differences.

However, for Algebraic Operations outcomes, we found a significant interaction between the pre-test and *CT*: students scoring low before participating in *CT* got more benefit from the program's algebraic operations instructions than students with high initial scores (see bar graph). Moreover, we noted an indication of a differential impact favoring Filipino students over White students on the Algebraic Operations subscale. Since the groups of interest (Filipino and Hawaiian/part-Hawaiian students) overall had lower average pretest scores, the results suggest that *CT* may help to reduce the achievement gap between those groups and others.



Differences between *CT* and Control Algebraic Operations Outcomes: Median Pretest Scores in Top and Bottom Quartiles

The district was also interested in *CT's* effectiveness for students taught by certified teachers versus non-certified teachers. In the previous year's study of *Cognitive Tutor for Algebra I*, control students of certified teachers had outperformed control students of non-certified teachers. But the program appeared to have a detrimental effect for certified teachers and no effect for non-certified teachers, both for math overall and for algebraic outcomes. In this experiment on pre-Algebra, we find certified and non-certified teachers performing about the same in their control classes. For math overall (but not the Algebraic Operations subscale), we find that *CT* gave the non-certified teachers an advantage.

Our goal was to provide the Maui School District with useful evidence for determining the impact of *CT* within the local setting. Considered as a district pilot, the study adds to the information available on which to base local decisions. Although our study did not provide evidence of a positive impact of *CT* on student math achievement in general, we found some positive effects. Overall, despite the repeated challenges teachers faced in implementation, *CT* was successful in raising student engagement in math and demonstrating, on the algebra-related subscale, gains for previously lower-performing students. The program also appeared to be particularly beneficial for non-certified teachers. Because a small number participated in the study, we consider these conclusions for teachers suggestive but not conclusive.

Design and Analysis. The design of our Maui experiment was similar to the Oklahoma study, in that pre-Algebra classes were randomly assigned to *CT* or to control. We used a coin toss to assign 32 classes in five Maui schools to use the *CT Bridge to Algebra* program or to continue using the pre-Algebra program currently in place. Each of the 12 teachers involved in the experiment had equal numbers of *CT* and control classes. In their *CT* classes, they used *Bridge to Algebra* for eight to nine months until the NWEA math posttest was administered in May 2007.

The research for this experiment encompasses a multiple methods approach. We collected pre- and posttest math scores from NWEA and class rosters and demographic information on students and teachers from the district. To measure and document implementation factors and student and teacher interactions with the materials, we also collected qualitative data through classroom observations, phone interviews, and web-based surveys from teachers.

Because our findings differed from those in Oklahoma, this small study illustrates a general caution in interpreting findings from isolated experiments and demonstrates the importance of conducting multiple replication trials of any application in varying contexts and conditions. Large numbers of trials will begin to build the confidence we can have about the product and, more importantly, they will provide the multiple examples of its functioning with different populations and conditions. Then users of the research will not only have evidence of the product's average impact, but they will also be able to find contexts that are very similar to their own in order to obtain more specific guidance of its likely impact under their conditions. Here, it is important to interpret the results in relation to what teachers were using in control classes and to the usage patterns, implementations, and applications in *CT* classes. It is also relevant that half the *CT* teachers were using *CT* for the first time, and their initial unfamiliarity may have affected implementation. Finally, the size of this experiment precluded detection of small differences.

Overall Teacher Impressions. Our qualitative data sources revealed that teachers experienced similar resource challenges in implementing *CT* as in year one: lack of classroom computers, access to the computer lab, and *CT* materials. Another challenge related to the misalignment between *CT* content and state math standards in middle and high school. Despite these challenges, teachers (and students) reported a generally positive attitude about *CT* overall. Teachers were particularly pleased with how engaged their students were with the *CT* software and the *CT* approach to collaborative learning. (It must be noted that 45% of the teachers reported that this approach affected instructional practices in their control classes. We were not able to determine whether this contamination made a difference in outcomes.)

To read the complete report, contact:

Empirical Education Inc.
www.empiricaleducation.com
425 Sherman Avenue, Suite 210
Palo Alto, CA 94306
(650) 328-1734