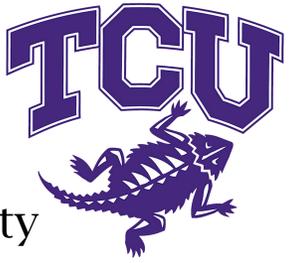


Assessing Relationships Between Electronic Tool Use, Academic Abilities, and Gain Scores for Students Using a CBI Math Program



Kristina Higgins, Ph.D., Lindy Crawford, Ph.D., and Jacqueline D'Angelo, Ph.D. Texas Christian University

Introduction

Computer-based instruction (CBI) has been implemented in classrooms for almost three decades, and one of the advantages of CBI is allowing the user to tailor instruction to their particular style of learning.¹ An essential part of individualizing CBI involves the students' use of active electronic support tools, which may be related to students' prior academic achievement or working memory.² The Math Learning Companion (MLC) program is an online mathematics program designed as a supplemental mathematics curriculum for students in the later elementary and early secondary grades.³

Purpose

- Examine the relationship of students' prior academic skills, working memory, and electronic support tool use.
- Understand the impact of students' prior academic skills and working memory on their pre/post-test gain scores.

Methods

Sample

- 77 students in Grades 4, 5, and 6.
- Students in grades 4 and 5 worked through Curriculum A, whereas students in grades 6 worked through either A or B depending on pretest scores and teacher recommendations
- 24 students attended a private school specifically for individuals with learning disabilities
- 53 students attended a public school, were low-performing in mathematics, and were receiving supplemental instruction

Procedures

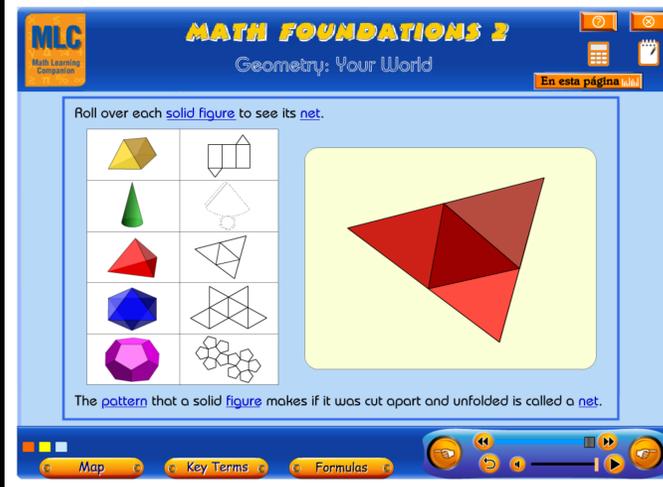
- Participants were assessed on their basic academic fluency skills, curriculum-specific knowledge, and working memory prior to the start of the curriculum.
- The curriculum lasted 6 weeks, with students participating in a total of six lessons.
- Participants were given a curriculum-specific post-test after the intervention.

Measures

- Math Fact Fluency (CBM)
- Oral Reading Fluency (DIBELS-DORF, Good & Kaminski, 2002)⁴
- Test of Working Memory (Swanson, 2011)⁵
- Curriculum-specific pre/post-test
- Frequency counts of number of clicks on for each electronic support tool

Electronic Support Tools Available in MLC

- Calculator
- Audio Support (Lesson)
- Audio Support (Quiz)
- Key Terms Dictionary (Lesson)
- Key Terms Dictionary (Quiz)
- Hyperlinks
- Need-More-Help Button
- Formulas
- Digital Notepad



Results: Relationships between Tool Use and Achievement

- Gains were significant from pretest to post-test $t_{(72)} = 6.463, p < .001$
- Correlations between frequency active electronic support tool use, gain scores, Woodcock-Johnson Broad Math scores, and specific dimensions of Wechsler's IQ scales.

Table 1

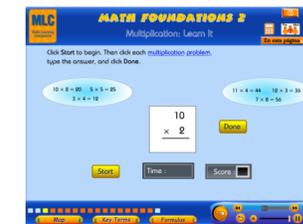
Correlations between individual tool use, gain scores, and academic abilities

	Pre/Post Gain Score	Math Fact Fluency	Reading Fluency	Working Memory
Calculator	.15	-.36***	-.35***	-.31**
Audio - Lesson	.14	-.20	-.22	-.19
Audio - Quiz	.13	-.26*	-.41***	-.09
Key Terms - Lesson	.33**	-.16	-.11	-.04
Key Terms - Quiz	.39***	-.02	-.06	-.17
Hyperlinks	.08	-.04	-.09	-.10
Need-More-Help	.28*	-.24*	-.11	-.22
Formula	-.09	-.19	-.17	-.03
Notepad	.26*	.05	.12	-.00

*p < .05, **p < .01, ***p < .001

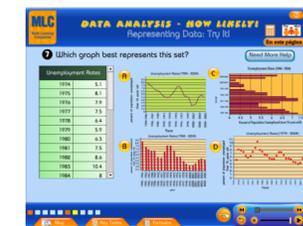
Curriculum A (N = 39)

- Math Foundations 1
 - Measurement
- Math Foundations 2
 - Place Value
 - Fractions and Decimals
 - Multiplication
 - Division
 - Perimeter and Area



Curriculum B (N = 34)

- Numbers Make Sense
 - Working with Rational Numbers
 - Working with Irrational Numbers
- Algebra
 - Interpreting Graphs
 - Variables
- Data Analysis
 - Representing Data
- Geometry
 - Coordinate Geometry

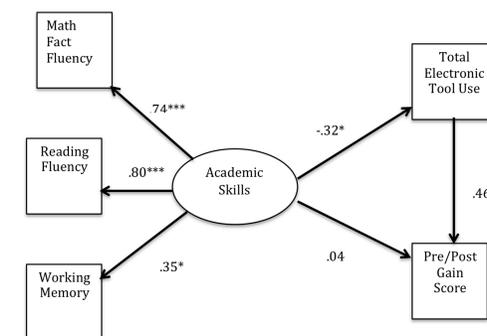


Results: Pathways from Academic Skills to Gain Scores

- A confirmatory factor analysis was conducted on all prior academic skills, and a latent variable was created from working memory, reading fluency, and math fluency.
- No direct relationship between academic skills and pre/post-test gain scores.
- Inverse relationship between prior academic skills and electronic support tool use.
- Positive relationship between electronic support tool use and pre/post-test gain scores.

Figure 1

SEM model of academic achievement, electronic tool use, and gain scores



*p < .05, **p < .01, ***p < .001

Discussion

- Students with stronger prior academic skills are less likely to use electronic support tools.
- Students who use electronic support tools are more likely to show higher gain scores from MLC.
- Electronic support tool use mediates the relationship between prior academic skills and gain scores.
- Students who need more support due to weaker prior academic skills are more likely to use the electronic support tools, and subsequently more likely to show significant gains from MLC.

Implications

- An underlying metacognitive process may that drive students to strategically use the tools as needed to maximize program benefits.
- Future research should focus on the metacognitive processes students use to individualize CBI programs and how self-efficacy in the area of mathematics relates to the effectiveness of the program.
- Teachers and practitioners should use CBI programs that implement active electronic support tools to maximize conceptual understanding.
- Program developers should focus on creating CBI programs that implement active electronic support tools to further allow students to tailor the program to their individual needs.

References

- ¹Slavin, R. & Lake, C. (2008). Effective programs in elementary mathematics: A best evidence synthesis. *Review of Educational Research*, 78, 427-515.
- ²Fitzgerald, G., Koury, K., & Mitchem, K. (2008). Research on computer-mediated instruction for students with high incidence disabilities. *Journal of Educational Computing Research*, 38(2), 201-233.
- ³Freeman, B. (2010). Math Learning Companion, Digital Directions International. Retrieved from <http://www.mathlearningcompanion.net/public/>
- ⁴Good, R. H., and R. A. Kaminski. *Dynamic Indicators of Basic Early*. 6th ed. Eugene: Institute for the Development of Educational Achievement, 2002. Print
- ⁵Swanson, H. L. (2011). *Test of Working Memory - abbreviated*. University of California - Riverside.