# Study 2: Assessing Relationships Between Electronic Tool Use, Academic Abilities, and Gain Scores for Students Using a CBI Math Program

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## Background

- This study was designed in response to findings from the previous study which generated questions about individualization of the program.
- One advantage of computer-based instruction involves allowing the user to tailor instruction to their particular style of learning (Slavin & Lake, 2009).
- An essential part of individualizing computer-based instruction involves the students' use of active electronic support tools.

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# Background

- Active electronic support tools are defined as technology-based support tools available to users if they choose to use them (Crawford & Freeman, 2011).
- These tools allow users to tailor the program to their individual needs.
- Student's prior academic ability and general working memory may impact their use of active electronic support tools.

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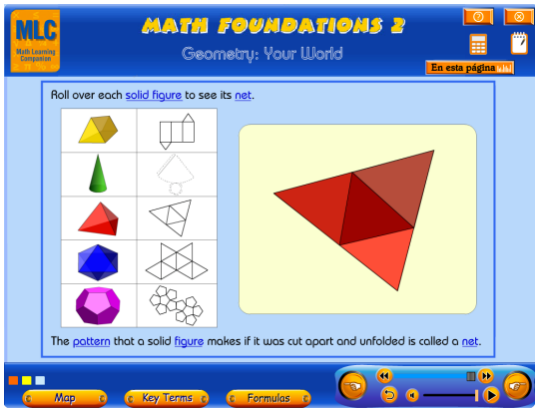
# Electronic Support Tools Available in MLC

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



## Study 2: 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.

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## Research Questions

- Question 1: What are the relationships between students' prior academic skills, their gain scores, and electronic support tool use?
- Question 2: How do students' prior academic skills directly and indirectly impact their gain scores as mediated by electronic support tool use?

# Participants

- 77 students in Grades 4, 5, and 6.
- Students in Grades 4 and 5 worked through Curriculum A, whereas students in Graded 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 receiving supplemental instruction
- Limited demographic information was available for participating students

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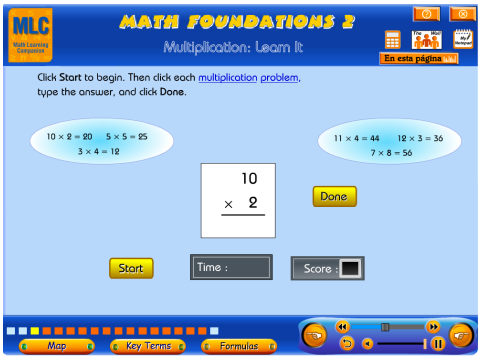
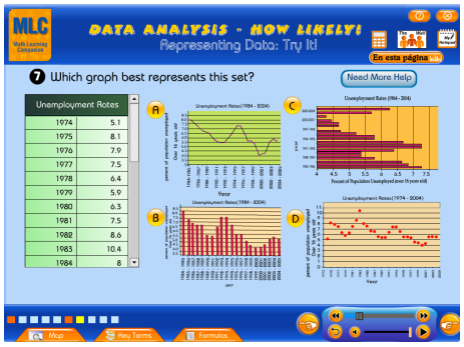
# Curriculum A (*N* = 39)

- 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




# Measures

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

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## Method

- 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.

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## Data Analysis

- **Question 1: What are the relationships between students' prior academic skills, their gain scores, and electronic support tool use?**
  - Correlations were used to examine the relationship of students' prior academic fact fluency, working memory, gain scores, and electronic support tool use.
- **Question 2: How do students' prior academic skills directly and indirectly impact their gain scores as mediated by electronic support tool use?**
  - Structural equation modeling was used to understand the impact of students' prior academic skills on their pre/post-test gain scores as mediated by electronic support tool use.

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# Relational Analyses

- A significant gain from pretest to post-test was found
  $t_{(72)} = 6.463, p < .001$
- Overall tool use positively correlated with pre/post gain scores
  $r = .31, p < .05$
- Overall tool use negatively correlated with reading fluency
  $r = -.25, p < .05$
- No significant relationships found between prior academic skills and pre/post gain scores

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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

# Structural Equation Model

- 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 exists between academic skills and pre/post-test gain scores.
- An inverse relationship exists between prior academic skills and electronic support tool use.
- A positive relationship exists between electronic support tool use and pre/post-test gain scores.

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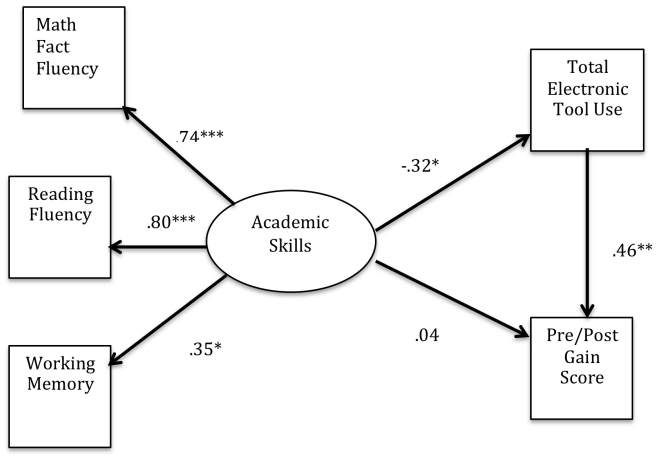
Figure 1

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




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

# Conclusion and Implications

- 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 likely to show significant gains from MLC.
- An underlying metacognitive process may drive students to strategically use the tools as needed to maximize program benefits.

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