



# Effectiveness of Computer-Based Instruction Program's Electronic Support Tools on Achievement



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## 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.<sup>1</sup> An essential part of individualizing CBI involves the students' use of active electronic support tools, which may promote mathematical metacognition in the process of understanding mathematical concepts and complex problems.<sup>2</sup> The Math Learning Companion (MLC) program is an online mathematics curriculum for students in the later elementary and early secondary grades.<sup>3</sup>

## Methods

### Sample

- 19 sixth-grade students enrolled in a laboratory school for students with learning disabilities over two years.
- School provides small group explicit instruction.
- Twelve boys, seven girls, average age 11.53.
- Subcategories of disabilities (11 subjects comorbid across categories):
  - Dyslexia - 13
  - Disorders of written expression - 8
  - Disorders of mathematical calculations - 3
  - Disorders of spelling - 1
  - Auditory processing - 1
  - ADHD - 10
  - Receptive and expressive language disorders - 2
  - Pervasive developmental disorder - 1

### Procedures

- Students completed six lessons from the MLC website ([www.mathlearningcompanion.net](http://www.mathlearningcompanion.net)).<sup>3</sup>
- Program lasted four weeks, four days per week, for 45 minutes per day.
- Tests based off of the concepts learned in the lessons were given before and after the completion of the program.
- Interviews with some students and their teacher were conducted after the end of the program.

### Measures

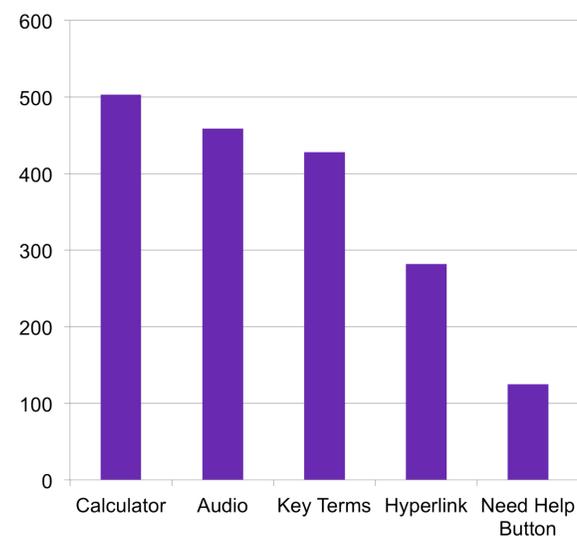
- Frequency counts of electronic support tool use.
- Gain scores from pretest to post-test.
- Achievement:
  - Woodcock-Johnson Broad Math scores<sup>4</sup>
  - Wechsler IQ - Full Scale, Verbal Composite, Perceptual Reasoning, Working Memory, Processing Speed<sup>4</sup>

### Data Analysis

- Descriptive analysis of frequency of tool use.
- Correlations between tool use, pre/post-test gain scores, and achievement measures.
- Cross-case analysis of four types of tool users.

## Frequency of Tool Use

Bar graph depicting the number of times students used each tool over the course of the program.



## Relationships between Tool Use and Achievement

Correlations between frequency active electronic support tool use, gain scores, Woodcock-Johnson Broad Math scores, and specific dimensions of Wechsler's IQ scales.

	Overall Tool Use	Calculator	Audio	Key Terms	Hyperlink	Need More Help
Pre/Post Gain Scores	.51*	.59**	.51*	.06	.20	.39
WJ Broad Math Score	-.37	-.43	-.37	-.24	-.35	-.58**
IQ - Full Scale	-.49*	-.29	-.47*	-.47*	-.46*	-.65**
Verbal Composite	-.48*	-.31	-.45	-.49*	-.43	-.58**
Perceptual Reasoning	-.27	-.11	-.27	-.28	-.25	-.39
Working Memory	-.30	-.02	-.26	-.33	-.32	-.32
Processing Speed	-.02	.18	.07	.01	-.08	.09

\*\*p < .01, \*p < .05

## Cross-Case Analysis

- Students are using the tools to individualize the program to their needs.
- Students who are lower achievers (Sasha and Andrea) use the tools for repetition of concepts and obtaining multiple explanations of concepts.
- Students who are higher achievers either quickly figure out which tools benefit them and only use these tools (David) or do not use the tools because they do not need the extra support (Juan).

## Discussion

- Students use the active electronic support tools as needed to maximize their conceptual understanding.
- Students who showed higher gain scores were more likely to use the tools than students with lower gain scores (specifically the calculator and audio features).
- Students with lower IQs are more likely to use the tools overall, specifically the audio features, the key terms dictionary, the hyperlink, and the Need More Help button.

## Implications

- 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.

## Sasha

- Used 303 electronic support tools - represents high tool use (used audio 196 times).
- Average achievement scores (WJ - 102, IQ - 102).
- Pre/post-test gain score of 9 points.
- Diagnosed with dyslexia.
- When asked about the audio support tool:
 

"I really like it because it gives more information, and I just learn something better when I hear it...I like it because sometimes when I read it I don't really understand it because I, like, maybe will skip a word and whenever it reads aloud to me I understand it better."

## David

- Used 81 electronic support tools - represents average tool use.
- High achievement scores (WJ - 137, IQ - 126).
- Pre/post-test gain score of 7 points.
- Diagnosed with dyslexia and disorders of written expression.
- When asked about the key terms dictionary:
 

"... You see, I've used it when I was trying to learn it. You know, right at the beginning they introduced a new term; it doesn't make sense to me, then I go to my sources, I use the key-term thing and I go to that word and then I click on that and learn it also."

## Andrea

- Used 125 electronic support tools - above average tool use.
- Low achievement scores (WJ - 83, IQ - 97).
- Pre/post-test gain score of 11 points.
- Diagnosed with dyslexia, learning disabilities in math, disorders of expressive & receptive language.
- When asked about the most helpful tool:
 

"... probably the one where it gives you the definition of the word... because sometimes I couldn't remember what the word meant so I clicked on it and it kind of helped me to find out what it meant again and then I remembered what it was... [Calculator was useful] when you don't exactly know it. When you can't really find out on the paper what the answer is."

## Juan

- Used 14 electronic support tools - represents low tool use.
- High achievement scores (WJ - 144, IQ - 127).
- Pre/post-test gain score of 4 points.
- Diagnosed with dyslexia and ADHD.
- Teacher comments:
 

"... He so gets it. You know, really, and I'd hate to put myself out of, you know, a teaching job, but really, he doesn't need me... he's a self-taught learner. I'm just along for the ride, really."

## References

- <sup>1</sup>Slavin, R. & Lake, C. (2008). Effective programs in elementary mathematics: A best evidence synthesis. *Review of Educational Research*, 78, 427-515.
- <sup>2</sup>Fitzgerald, 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.
- <sup>3</sup>Freeman, B. (2010). Math Learning Companion, Digital Directions International. Retrieved from <http://www.mathlearningcompanion.net/public/>
- <sup>4</sup>Woodcock, R.W., Mather, N. & McGrew, K.S. (2001). *Woodcock-Johnson III Tests of Achievement*. Itasca: Riverside.
- <sup>5</sup>Wechsler, D. (2004). *The Wechsler intelligence scale for children—fourth edition*. London: Pearson Assessment.