

Math CLIPS Evidence

November 2011

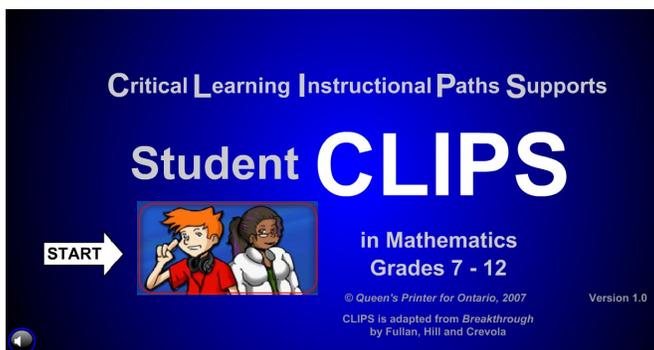
Use of Critical Learning Instructional Paths Supports (CLIPS) can increase student learning and influence teacher practice

CLIPS RESOURCES FOR JUNIOR, INTERMEDIATE, AND SENIOR STUDENTS

CLIPS are interactive web-based tools focused on key topics that allow students to engage in mathematical thinking and learning. They were designed for students with difficulties they typically have in mathematics, as uncovered by various research projects. Descriptive and scaffolded feedback is provided for student interactions. In addition to downloadable interactive tools, such as calculators and manipulatives, all lessons are compatible with interactive whiteboard use and include teacher notes and research notes.

Current CLIPS topics include Fractions, Integers, Linear Growing Patterns (LGP), and Trigonometry. In development, are CLIPS Fractions Operations, Integer Operations, and Linear Relations.

CLIPS are available to students, teachers, faculties of education and parents anytime at www.mathclips.ca.



WHO MAY BENEFIT FROM THE USE OF THIS RESOURCE?

Students in Grades 4-12 can use CLIPS as an alternate approach to learning mathematics. CLIPS tasks and instructions are sequenced to build from one key idea to the next, so that they can make cumulative sense to students. Focused interactions allow students to engage in learning targeted concepts and skills, and use self-checking practice and immediate feedback to gain confidence that learning has occurred.

Teachers using CLIPS can make new mathematical connections for themselves and adjust their instructional approaches for students.

WHAT EVIDENCE DO WE HAVE OF THE EFFECTIVENESS OF USING CLIPS?

CLIPS Fractions, CLIPS Linear Growing Patterns (LGP), and CLIPS Trigonometry all improve student achievement and both teacher and student efficacy.

The integration of online CLIPS learning objects combined with classroom instruction is the most effective way to maximize student learning.

DOES USE OF THESE MATERIALS IMPROVE STUDENT ACHIEVEMENT IN MATHEMATICS FOR TARGETED GROUPS OF STUDENTS?

CLIPS as Remedial Resource

The main beneficiaries of CLIPS: LGP were low achieving students. Students who entered the study with low achievement gained more from the CLIPS: LGP program than students who entered with higher achievement. In addition, students with lower entry scores on achievement and with lower confidence in their ability to learn new mathematics concepts benefited the most. This finding is important because entry-level achievement and student self-efficacy are strong predictors of achievement (Pajares, 1996). This finding suggests that CLIPS: LGP might be efficiently used as a remedial resource as well as a whole class support.

CLIPS for Students with Learning Disabilities

The research involved Grade 7 and 8 teachers and their students identified with a learning disability and following an IEP. All of the teachers we worked with expressed overwhelming surprise at the levels of learning exhibited by their students who had been identified with learning disabilities.

“The concepts were introduced slowly and accessibly and reinforced so that with confidence I can say all my students on an IEP can look at a graph and tell you the rule for that graph, can build a pattern from that graph, and can give you a story related to that graph. I’ve never had that experience before.” (Teacher)

This study suggests that students with learning disabilities can use computer-supported activities to learn complex mathematical concepts.

The CLIPS activities allowed students to construct deep conceptual understanding of complex algebraic relationships rather than memorize procedures.

Hypothesized Affordances of CLIPS for Students with Learning Disabilities

CLIPS lessons support students in focusing their attention. The aspect we want students to notice becomes the focus of their attention through the use of colour, flashing of important words or connected aspects of the relationship. Audio narration directs students' attention to particular aspects of the task.

Mathematical connections can be conveyed to the students interactively in non-static environments through many forms of co-action and visible connections between representations.

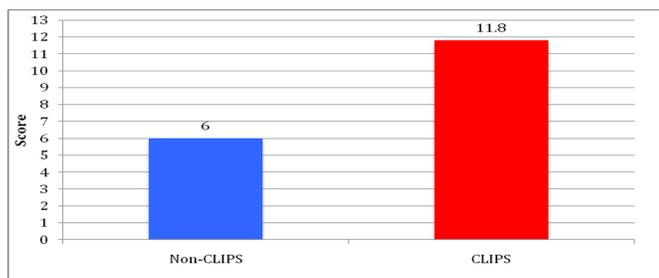
Gender Differences

The effects of math confidence on learning from CLIPS: LGP program was much stronger for females than for males. Females were much more likely to learn from the program if they had high confidence in their ability to learn new mathematics concepts than if they had low confidence. For males the pre-post pattern was the same, regardless of their confidence level. CLIPS: LGP might be a useful tool for the self-directed learning of confident females.

WHAT ARE THE LONGITUDINAL BENEFITS OF STUDENTS USING CLIPS: LINEAR GROWING PATTERNS?

The positive effects of CLIPS use on subsequent achievement were robust, applying equally well regardless of students' grade or gender. Students learned more, i.e., the pre-post increase represented by the effect size was greater, if they were in the CLIPS group that did experience CLIPS in the previous year than if they were in the control group that did not experience CLIPS. Students learned equally well regardless of their grade or gender.

Quantitative data was collected and analyzed for student achievement and student surveys measuring self-efficacy. Students who completed CLIPS a year earlier started their current grade with greater ability to handle LGP tasks than students who had not experienced CLIPS.



The quality of students' generalizing strategies were significantly different.

Non-CLIPS	CLIPS
Used counting strategies primarily to predict the quantity of the 10th term	None of the CLIPS students used a counting strategy
They had to draw out all of the iterations up to and including 10, and then count to determine the result. This strategy did not aid them in finding the number for the one hundredth figure	Rather, they attempted to find a general rule in the pattern, and were generally successful in doing so
MOST were unable to generalize a rule from a pattern	17 out of the 25 CLIPS students were successfully able to do so

Most CLIPS students were able to offer level 3 or level 4 justifications for their answers during the task-based clinical interviews (23 out of the 25 CLIPS students interviewed). In contrast, the majority of non-CLIPS students did not offer a justification, and when asked why their rule worked, said, "I'm not sure" or "because it just does".

		Level 0	Level 1	Level 2	Level 3	Level 4
Item 8	CLIPS	0	0	2	15	8
	Non CLIPS	14	0	10	1	0
Item 9	CLIPS	0	0	2	7	16
	Non CLIPS	11	2	8	1	0

One of the most striking results is the extent to which students who had been part of the Phase I CLIPS project refined their thinking during the course of the interview, as a direct result of being asked to explain their solution process. Overall, there were 28 such episodes coded in the interview transcripts for the 25 CLIPS students. However, there were no such episodes coded for the transcripts of the non-CLIPS students.

The students in the CLIPS: LGP treatment group had more positive attitudes and beliefs about learning mathematics than their non-treatment peers over two years.

The 2009-10 study found that CLIPS: LGP had three positive and one negative effect on student attitudes. The negative effect disappeared: the pre-post decline in student confidence about their ability to learn mathematics with technology observed in 2009-10 rebounded. Students were as confident at the beginning of 2010-11 as they were at the beginning of 2009-10.

"This is a different way to do math. There wasn't a textbook and a million questions. As long as you get to a final answer, it doesn't matter how you got there. I can draw pictures or whatever and it's ok. I can play and make mistakes and then I can figure out what's right and wrong...I'm not being judged." (Grade 7 student)