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STUDENT PERCEPTIONS OF AN ONLINE MATHEMATICS CURRICULUM DESIGNED FOR STUDENTS WITH LEARNING DIFFICULTIES

Kristina Higgins
Tarleton State University, USA

Lindy Crawford
College of Education, Texas Christian University, USA

Kelly Silvestri
Coppell ISD, USA

Abstract

Paper presents research on the perception of technology use including dimensions of computer self-efficacy, motivation, and independence of use of electronic support tools of students with learning difficulties in the context of an online mathematics curriculum. While all students showed improvement over the course of the program, some students showed more success with technology-based learning than others. Students with stronger academic profiles when beginning the curriculum were more likely to have higher levels of computer self-efficacy. The themes that emerged from the current study reflect motivation and fun, efficiency, and a diversity of learning strategies and support tools available. The themes of motivation and independence are also reflected in electronic support tool use. This indicates that students with different motivating or independently themed factors use the program in different ways by tailoring the electronic support tools to their individual needs.

Keywords: *on-line mathematics curriculum, students with learning difficulties, motivation, self-efficiency, independence.*

A comprehensive understanding of mathematical knowledge and problem-solving abilities proves essential for students' success throughout school and in the workplace (Hanushek, Peterson, & Woessmann, 2010). However, on a national assessment of mathematical performance, 45% of students receiving special education services score below the basic level, and 38% score at the basic level of performance (National Center for Education Statistics, 2013). Only 16% of fourth graders receiving special education services score within the proficient or above proficient range for mathematics. By eighth grade, this number is cut in half; a mere eight percent of students in special education are proficient in mathematics before entering high school. Therefore, a strong need exists to enhance educational curricula specifically for students in special education to adequately prepare them for a competitive higher academic and workplace environment.

Using technology in the classroom has the potential to vastly effect students' learning environment (Cooper, 2012; Zemelman, Daniels, & Hyde, 2012), especially for students with learning difficulties (Zhang, 2005). The incorporation of universal design has made technology readily available in the classroom (Center for Applied Special Technology [CAST], 2012). Although these technologies show enormous potential to improve the learning of students with learning difficulties, they are not always created with the intention of serving students with learning difficulties and subsequently are not always effective or appropriate (Deshler, Rose, East, & Greer, 2012). Several factors may influence the success of a technology-based curriculum, including a student's self-efficacy with regard to computers, a student's perceptions of technology, and the design of the program itself with respect to the student's ability to individualize the program through the use of electronic support tools (Crawford, Higgins, & Freeman, 2013; Li, 2007; Moran, Hawkes, & Gayar, 2010).

Self-efficacy stems from social cognitive theory (Bandura, 1986) and refers to "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives" (Moran et al., 2010, p. 87). Socialization experiences influence self-efficacy, which consequently impacts student learning through choosing activity, effort expenditure, and persistence (Bandura, 1986). Lackaye, Margalit, Ziv, and Ziman (2006) found that students with learning difficulties report lower levels of academic self-efficacy than students without learning difficulties, even when their academic performance is on par with students without learning difficulties. Hampton and Mason (2003) examined the influence of learning difficulties on self-efficacy and determined that for students with learning difficulties, self-efficacy was mediated by having sources of self-efficacy (e.g. personal performance accomplishment, social persuasion, vicarious learning, and emotional arousal). Thus, students' sources of self-efficacy were malleable and proved more important than the learning difficulties themselves.

Computer self-efficacy involves a person's perception of his or her abilities related specifically to computer skills and knowledge (Murphy, Coover, & Owen, 1989). Moran et al. (2010) found that students' self-efficacy about their own ability to use technology contributes to the effectiveness of the actual use of the technology. Both psychological and behavioral factors influence computer self-efficacy, including curiosity about technology, a positive attitude, intrinsic motivation, and prior use of technology (Moos & Azevedo, 2009).

Another factor contributing to the effectiveness of technology-based instruction in the classroom involves students' perceptions of technology use. Positive student perceptions of technology can lead to successful student outcomes (Knezek, Miyashita, & Sakamoto, 1993; Muir, Knezek, & Christensen, 2004). Li (2007) surveyed 575 students about technology in the classroom and discovered several themes: technology increased learning efficiency, was motivating and fun, and enabled a diverse approach to teaching and learning. Furthermore, students felt that advanced technology needed to be used more often because "they need to master current technology to meet the demands of the workplace" (p. 386). Little empirical research has specifically examined the perceptions of students' with learning difficulties related to technology use in the classroom.

Along with an individual student's self-efficacy and perceptions about technology, the design of computer-based instructional programs may affect student performance. For example, computer-based instructional programs contain electronic support tools embedded in the program that serve to individualize instruction (Anderson-Inman & Horney, 1996; Englert, Manalo, & Zhao, 2004). Electronic support tools are the components within a program that users select and implement themselves; for mathematics this could include items such as an embedded calculator, dictionary, or audio support (Crawford & Freeman, 2011). Research has shown that students with stronger academic profiles use fewer tools, whereas students with weaker academic profiles use more tools, indicating that some students use electronic support tools to tailor a program to their individual needs (Crawford, Higgins, Huscroft-D'Angelo, & Hall, 2014). Furthermore, Crawford et al. (2012) found that students with learning difficulties use specific tools as needed to maximize their benefit from a supplemental mathematics program. However, use of electronic support tools has yet to be studied when students use the program as a core curriculum.

The current paper examines perceptions of technology use – which includes the dimensions of computer self-efficacy, motivation, and independence – and use of electronic support tools of students with learning difficulties in the context of an online mathematics curriculum. This study pilots an online curriculum implemented as students' core mathematics curriculum with the intention of determining how students' self-efficacy and perceptions of using this curriculum relates to how they use (engage or interact with) the program. Specifically, this paper seeks to answer the following research questions using a mixed methods approach:

1. How does a student's perception of learning math through an online curriculum relate to their academic profile and gains from pretest to posttest?
2. In what ways does perception of learning math through an online curriculum influence students' actual electronic support tool use?
3. In what ways do students' perception of learning math through an online curriculum impact their views about their own challenges in learning?

Method

Participants. Participants in this study attended a laboratory school specifically for students with learning difficulties. Six boys and two girls participated in the program, and ranged in age from 10-12 at the start of the program. All students had attended the laboratory school for five years, and had multiple disorders, including learning difficulties and/or behavioral or emotional issues, as diagnosed by the Diagnostic and Statistical Manual of Mental Disorders – IV (DSM-IV; American Psychiatric Association [APA], 2000). A licensed diagnostician assessed all students upon their acceptance to the school, and a psychologist confirmed their diagnoses. Researchers obtained the diagnoses by file review. See Table 1 for a list of DSM-IV diagnoses by student.

Table 1. Student profiles, academic scores, gains from MLC, and computer self-efficacy

ID	Gender	Learning Difficulty Profile	WJ Broad Math Score	Wechsler Full IQ	Processing Speed	MLC Gain Score	CSE
1	M	Dyslexia Disorders of written expression LD – spelling ADHD	89	99	68	2	4.0
2	M	ADHD Dyslexia Dysgraphia LD – Math LD – Spelling	101	119	91	5	7.4

Continued Table 1

3	M	ADHD Anxiety Tic disorder Dysgraphia Dyslexia LD-Math	101	118	97	3	8.5
4	F	ADHD Dyslexia Dysgraphia LD – Math Phonological Disorder	93	120	91	12	5.2
5	M	ADHD Anxiety	91	90	85	3	7.6
6	M	Dyslexia Dysgraphia	100	96	80	4	9.5
7	F	ADHD Dyslexia Developmental Coordination Disorder Static Encephalopathy	90	92	85	8	5.8
8	M	Dyslexia ADHD	85	92	85	8	4.5

At this school, students used technology in the form of netbooks (small laptops) in every classroom as well as attended a daily technology class for 70 minutes per day. Direct technology lessons included using the Microsoft Office suite, various content-based websites (literacy, mathematics, science, etc.), and using the internet for research. Furthermore, the eight students in this study have used netbooks for their fourth and fifth year at this school. Because of the students' familiarity with netbooks as well as the availability of the devices, the netbooks were the method of delivery for the online curriculum.

Online Curriculum

The Math Learning Companion (MLC; Digital Directions International [DDI], 2013) is an online mathematics curriculum for students in grades 3-8 that provides 73 lessons across seven content areas. MLC is derived from *HelpMath* (DDI, 2005), a program designed as a supplementary math curriculum for English Language Learners, and this program received accolades in the What Works Clearinghouse for significantly improving posttest scores for students using the program and met the WWC criteria without reservation (Tran, 2005). The sections of MLC are designed to provide several techniques to teach multiple learning strategies that are aligned with the Common Core State Standards for Mathematics (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). Each lesson is comprised of a real world scenario, an introduction to the vocabulary of the lesson, direct instruction, opportunities for practice, built-in games, and a summative quiz. Within this context, multiple learning strategies are presented for each concept. For example, when students learn multi-digit multiplication, they are presented with and work through problems using the common method, the FOIL method, and the lattice method. They choose the strategy that works for them and can use it throughout the rest of the lesson.

For the current study, the students' mathematics teacher chose 10 lessons to serve as the students' classroom curriculum. This teacher used MLC as a supplemental curriculum in the previous school year; thus, she selected the lessons based on previous knowledge of the program. Two practice lessons, Math Foundations 1 – Place Value and Math Foundations 2 – Addition and Subtraction, were given as practice lessons to help students adjust to the format of the online curriculum. The curriculum itself included Division, Fractions, Measurement, and Geometry from Math Foundations 1, and Place Value, Fractions and Decimals, Multiplication, Division, Perimeter and Area, and Geometry from Math Foundations 2.

Procedure

Prior to beginning the program, students were verbally administered the ten question computer self-efficacy questionnaire. Students completed the MLC pretest to assess where their strengths and weaknesses were as related to the curriculum they would complete. Students' academic profile scores were obtained from academic testing conducted in the previous school year.

Over the course of the study, the teacher used MLC daily as the core classroom curriculum. Each student had their own laptop, and the teacher projected the program onto a Promethean board. Thus, the teacher and all of the students moved through the curriculum together. Because each student had their own laptop, they had the ability to move forward or go back in the lesson at will, as well as having access to the available electronic support tools. Furthermore, if the students completed a lesson but did not pass the quiz, they were provided the opportunity to work through the lesson again on their own. Students used the program for approximately 75 minutes per day, four days per week, over the course of 12 weeks, and 10 MLC lessons were completed during this time.

Researchers collected observations of the students using MLC and recorded any student issues or suggestions they had for the program. Frequency counts for clicks of electronic support tool use were also reported daily. After the completion of the curriculum, the students took a post-test intended to reflect the skills learned over the course of the program. The students were also interviewed about their experience with the MLC program overall and about the use of specific electronic support tools.

Measures

Academic profiles were created for each student through their standardized test scores. Students' Woodcock-Johnson Broad Math score (Woodcock, McGrew, & Mather, 2007) are used to represent their mathematics ability in this study prior to beginning the curriculum. The WJ Broad Math score has a test-retest reliability of r = 0.95 (Schrank, McGrew, & Woodcock, 2001). Their Wechsler Intelligence Scale for Children (WISC; Wechsler, 2004) IQ subscale scores, including processing speed, verbal composite, perceptual reasoning, and working memory, are used to represent their general academic ability. The internal consistency reliability scores for the full scale is r = 0.97, processing speed is 0.88, verbal comprehension is 0.94, perceptual reasoning is 0.92, and working memory is 0.92; the test-retest reliability scores are as follows: full scale IQ = 0.93, processing speed = 0.86, verbal comprehension = 0.93, perceptual reasoning = 0.89, and working memory = 0.89 (Williams, Weiss, & Rolfhus, 2003). The Math Learning Companion has a pretest and posttest built into the program that involves a 30-item test specifically related to the content of the curriculum to assess students' gains from the program itself.

Students' Perceptions of Technology Use. The construct of students' perceptions of technology use is comprised of three dimensions: computer self-efficacy, motivation, and independence. Computer self-efficacy was measured using an adapted subscale of a larger technology questionnaire created by Moran et al. (2010). This questionnaire was verbally administered to students, who then rated the question on a 10-point Likert scale. For example, the researcher would read the statement "I could complete the online program if no one were around to help me," and the student would rate their attitude toward the statement anywhere from 1 – "I do not agree with this, I don't think I could do it," to 10 – "I completely agree with this, I think I could do this easily." This subscale focused on computer self-efficacy in the classroom, and Cronbach's alpha for this scale is 0.84 (see Appendix A for Computer Self-Efficacy questionnaire).

Students' perceptions of motivation and independence are derived from two sources: researcher field notes and a follow-up interview after the students completed MLC (see Appendix B for the Interview Protocol). At least one researcher sat in the classroom every day that MLC was used and took continuous observation notes. If the students were working independently, the researcher spent a fixed amount of time with each student listening to the lessons on their headphones along with the student without interfering with the lesson. Daily field notes were typed into a document and compiled for each student. The follow-up interview focused specifically on students' perceptions of their mathematic abilities, the overall program, and about specific support tools. The field notes and interview transcriptions provided the basis for the qualitative data analyses.

Electronic Support Tool Use. Electronic support tools (ESTs) in MLC include the calculator, audio support, a key terms dictionary, formulas, hyperlinks, a notepad, and a need more help button. The calculator assists with basic algorithmic functions, but has no scientific or graphing capabilities. The audio support will read aloud the text on the given screen for every page of MLC in both English and Spanish, including replaying the narration of the lessons, speaking aloud the quiz questions and answers, and speaking aloud all text within dictionary and formula pages. The key terms dictionary provides definitions for all mathematically-related terms in MLC, and the formulas button provides information on all geometric and algebraic formulas. The hyperlinks are embedded throughout each page of MLC and takes users directly to a specific word in the dictionary or formula. A digital notepad gives users the opportunity to take notes directly in the program and use these on subsequent pages or the quiz via either direct entry or cut-and-paste. Finally, the need-more-help button appears on pages where students must answer questions, and provides the students with more information about the particular concepts presented on that page. Frequency counts of EST use were exported daily directly from MLC and compiled to represent each student's total use of each tool over the course of the program.

Data Analysis

Data analysis for this study involved a mixed-methods approach. Quantitative analyses include a descriptive analysis of students' academic profile, pretest and posttest scores, computer self-efficacy ratings, and electronic support tool use. A Wilcoxon signed rank test was also conducted to determine any change in students' pretest and posttest scores over the course of the program.

Prior to data analysis, all data were thoroughly examined and compared to researcher observation and field interviews for consistencies. In this process, it came to the attention of the researchers that Student 8 used the Key Terms dictionary 391 times total, and 383 uses were in one session. After consulting the field notes and discussing this behavior with the student, it became apparent that this student was scrolling through the dictionary to find a specific term. Because this single event drastically skewed the EST click frequencies, the data were re-analyzed to reflect this series of events as a single use of the Key Terms dictionary with the justification that the student was searching for a single term. This is the only time this type of event occurred for any of the students in any of the researcher observations or student interviews, thus it was treated as a single event.

Profiles were created for each student to further examine the significance of their gains from the program and why the students found success within the program. Qualitative data analytical techniques were used to examine the relationships between students' perceptions of technology use and academic profiles, gains within the program, electronic support tool use, and spontaneously self-identified challenges in learning. To adequately answer the research questions, student interviews and researcher field notes were qualitatively analyzed through the deductive process of theming and coding described in Ely, Vinz, Downing, and Anzul (1997). Two researchers separately reviewed each student's interview as well as field observations for student-identified common themes, and three themes emerged from this process: motivation, independence, and challenges in learning. Motivation is comprised of student responses related to using a computer-based instruction over traditional instruction, which involve a preference for using the computer, a lack of textbooks, eliminating the need for writing, and the computer-based curriculum being described as fun. Independence involves students preferring to work through the program by themselves, a preference for multiple learning strategies, enjoying the availability of multiple tools, and the efficiency of the computer program as related to independent work. Challenges in learning involve students directly mentioning their own difficulties in mathematics, reading, writing, physical capabilities, memory, and attention. Figure 1 gives specific examples of student statements for each of these dimensions.

Motivation	
Prefers CBI over traditional media	▪ "You know when you split a number, then I didn't get it with the book, but the computer helped me understand." ▪ "This doesn't feel like work when we're doing it on the computer."
No textbooks	▪ "You don't have to carry about those big books." ▪ "It's way easier than a one pound book… they were hurting my back and shoulders, so I like the laptop better."
Eliminates need for writing	▪ "We can do our own work on the computer and we don't have to write it down." ▪ "I wont mess up when I write."
Fun	▪ "It's fun and it teaches you all the different types of math." ▪ "It's a fun thing kind of like a game."
Independence	
Working through program alone	▪ "I can learn it my own way, kind of like by myself, so it's easier for me to understand." ▪ "I think it's helping me with very little teacher help."
Multiple learning strategies	▪ "I like the way it gives you some tricks if you need tricks for it." ▪ "It shows me different ways of how to do this and stuff."
Multiple tools available	▪ "I definitely used the calculator and the notepad, the key terms, pretty much all of them." ▪ "Sometimes I would use the calculator, sometimes the notepad, or sometimes use paper and pencil…on the final quiz I would use the key terms, the dictionary."
Efficient	▪ "It's more quicker than the teacher teaching you." ▪ "It's really efficient. I mean, you just click the problems and it does it. It doesn't waste time."
Challenges in Learning	
Math	▪ "Everything [in math] is hard."
Writing	▪ "I don't like writing stuff down because I don't have a very steady hand."
Reading	▪ "I have to read it over and over again, just to figure out what it says so I can actually answer the question, that kind of thing I'm not good at."
Memory	▪ "Whenever I heard it speak and I needed to remember things…I would take notes on it."
Attention	▪ "Some days… are harder to pay attention."
Physical	▪ "I can only use crayons with my right hand; with left hand things smear…it doesn't hurt to type."

Figure 1. Direct student quotes about each dimension for the themes Motivation, Independence, and Challenges in Learning

Two researchers coded each of the students' information for these three themes along the aforementioned dimensions, and two students' were double coded for 90% reliability; discrepancies were discussed until agreed upon by both researchers. Frequency counts of the different dimensions for each theme are presented in Table 2.

Table 2. Frequencies of students' self-reported Motivation, Independence, and Challenges in Learning

	Motivation				Independence				
ID	Prefers CBI over traditional media	No text-books	Eliminates need for writing	Fun	Working through program by themselves	Multiple learning strategies	Multiple tools available	Efficient	Self-Identified Challenges in Learning
1	1	0	3	1	2	1	0	4	Reading Memory Physical
2	1	0	0	2	2	1	0	0	None
3	2	0	1	2	1	1	3	0	Math
4	3	3	1	0	3	2	2	0	Memory Attention
5	0	0	0	0	1	0	2	2	None
6	0	0	0	5	1	4	0	0	None
7	1	1	1	4	1	0	0	0	None
8	0	1	1	2	0	1	0	0	Math Writing Physical

Note: Frequency counts represent each time the different dimensions of each theme were spontaneously mentioned in field observations and/or student interviews.

Results

Descriptives. The results of the descriptive analyses for students' academic profiles, pretest and posttest scores, computer self-efficacy ratings, and electronic support tool use are presented in Table 3. For all lessons combined, students used electronic support tools an average of 27.63 (*SD* = 14.53) times over the course of the study. The lowest amount of tool use by a student is four tools, whereas the highest amount of tool use by a single student is 49. In regard to academic gains, when comparing the scores on the pretest and post-test, the *z*-value of the Wilcoxon signed rank test is -2.52. Because of the sample size is less than 20, a *W*-value is used to determine significance instead of a *p*-value. The *W*-value is 0 (with a critical level of 3), indicating a significant increase over the course of the curriculum.

Table 3. Descriptive statistics (N = 8)

	Min	Max	Mean	SD
Academic Profile				
WJ Broad Math Score	85	101	93.75	6.16
Wechsler Full IQ	90	120	103.25	13.34
Verbal Comprehension	87	121	105.63	12.15
Perceptual Reasoning	90	123	108.87	11.12
Processing Speed	68	97	85.25	8.70
Working Memory	86	129	102.43	14.60
Computer Self-Efficacy	4.0	9.5	6.56	1.98
Tool Use				
Total	4	49	27.63	14.53
Audio	0	16	5.88	6.33
Key Terms Dictionary	2	20	8.13	6.62
Formula	0	3	0.75	1.17
Calculator	0	20	5.75	7.87
Need More Help Button	0	14	5.63	4.41
Notepad	0	11	1.50	3.85
MLC Pretest	12	25	18.00	4.78
MLC Post-test	20	29	23.63	2.62
Gain Score	2	12	5.63	3.42

Computer self-efficacy, technology perceptions and academic profiles

Students' academic profiles, MLC gain scores, and computer self-efficacy scores are reported in Table 1. Overall, students who rated themselves above average *(M* = 6.56, *SD* = 1.98) on the computer self-efficacy scale also had above average WJ Broad Math scores (*M* = 93.75, *SD* = 6.16), above average IQ scores (*M* = 103.25, *SD* = 13.34), and with the exception of Student 6, above average processing speed (*M* = 85.25, *SD* = 8.70). However, these same students all had below average MLC gain scores (*M* = 5.63, *SD* = 3.42), indicating that although these students came into the program with higher levels of confidence surrounding computers and a stronger academic profile, they gained less from the program than students who viewed themselves as less confident in their ability to use technology and who came into the program with a weaker academic profile.

Upon further examination of Table 2, the same four students with stronger academic profiles (Students 2, 3, 5 and 6) were more likely to use the term 'fun' when citing a motivating factor of the program, and less likely than the students with weaker academic profiles to cite a preference of computer-based instruction over traditional instruction – this was cited three times by students with stronger academic profiles and five times by students with weaker academic profiles. Students with weaker academic profiles were more likely to cite a lack of textbooks and eliminating the need for writing as motivating factors for using MLC. Also, students with stronger academic profiles were more likely to discuss having multiple learning strategies or multiple tools available within the theme of independence. For students with weaker academic profiles, independence was more likely to be related to working through the program by themselves and the efficiency of the program.

Computer self-efficacy, technology perceptions and EST use

Table 4 focuses exclusively on the frequency use of each electronic support tool by individual students. When examining the students' tool use with regards to their computer self-efficacy score, students who rated themselves above average on computer self-efficacy used slightly fewer tools overall (M = 25.75, SD = 18.41) than students who rated themselves lower on computer self-efficacy (M = 29.50, SD = 12.01). The students with the highest and lowest computer self-efficacy scores (9.5 and 4.0) used the fewest tools (4 and 12, respectively); all of the other students used 24 or more tools and rated themselves closer to the computer self-efficacy mean. Interestingly, these two students are also the only two without a primary diagnosis of ADHD.

Table 4. Frequency of student EST use

ID	Total Tool Use	Calculator	Audio	Key Terms	Formula	Notepad	Need More Help
1	12	0	4	4	0	0	4
2	26	20	0	5	1	0	0
3	49	0	14	20	0	1	14
4	35	16	0	2	0	11	6
5	24	4	5	5	2	0	8
6	4	0	0	2	0	0	2
7	39	5	8	18	0	0	8
8	32	1	16	9	3	0	3

When frequencies of individual tool use are examined, no clear pattern emerges as related to students' computer self-efficacy. For example, five students used the calculator: Student 2 used the calculator 20 times, Student 4 used it 16 times, Student 5 used it 4 times, Student 7 used it 5 times, and Student 8 used the calculator once (see Table 4). Students' 2 and 5 rated themselves above average on computer self-efficacy, and Students 4, 7, and 8 rated themselves below average on this scale. This lack of a pattern holds true for the other ESTs, indicating that students are using a variety of tools in a variety of quantities.

When considering the themes of motivation and independence, a clear pattern emerges for students who have higher levels of tool use versus students with lower levels of tool use (see Table 2). The four students who used the most tools, Students 3, 4, 7, and 8, were more likely to discuss the motivating factors of 'preferring CBI over traditional media' and 'no textbooks'. The two remaining motivating factors (eliminating the need for writing and fun) were cited as often as students with low tool use. However, for the factors that contributed to the theme of independence, students who used less tools were more likely to discuss the factors of 'efficiency' and 'multiple learning strategies' and as likely to discuss 'working through the program by themselves' as the students with high tool use. The students with high tool use were only more likely to discuss having multiple tools available as a strong factor for independence.

Overall, the theme of motivation for using computer-based instruction was stronger for students with higher tool use (23 total factors mentioned versus 13 total factors mentioned), and the theme of independence was stronger for students with low tool use (20 total factors mentioned versus 14 total factors mentioned). This conclusion also supports the idea that students are using the program for different reasons and tailoring the program to their individual needs.

Computer self-efficacy, technology perceptions and challenges in learning

Students' who rated themselves above average on the computer self-efficacy scale were less likely to name a specific challenge in learning than students who rated themselves lower on the computer self-efficacy scale (see Table 2). Only one of the four students with higher CSE scores named a specific challenge, and they cited math as their challenge in learning. Three of the four students with below average CSE scores cited multiple challenges in learning, including math, writing, reading, physical ailments, memory, and attention.

When examining the themes of motivation and independence, students who did not designate any challenges in learning were overwhelmingly more likely to consider the program 'fun' than students who identified challenges (11 mentions of fun versus 5 mentions of fun). Students who identified challenges were more likely to prefer CBI to traditional media, and cite both the lack of textbooks and the elimination of the need for writing as motivating factors. These same students also discussed the efficiency of the program and the multiple tools available more often than the students who did not identify a challenge in learning. The frequencies for 'working through the program by themselves' and 'multiple learning strategies' were the same for both groups of students.

Discussion

This study reports the self-perceptions of students using an online mathematics curriculum designed for students with learning difficulties. While all students showed improvement over the course of the program, some students showed more success with technology-based learning than others. Students with stronger academic profiles when beginning the curriculum were more likely to have higher levels of computer self-efficacy, similar to the findings reported in Hampton and Mason (2003). These same students, however, did not denote a preference for computer-based instruction over traditional instruction, although they considered computer-based instruction 'fun,' and were also less likely to spontaneously discuss any learning challenges.

The themes that emerged from the current study reflect some of the themes cited by Li (2007), including motivation and fun, efficiency, and a diversity of learning strategies and support tools available. By examining these themes in-depth, it became clear that while all of the students enjoyed learning through an online curriculum, they cite different reasons for this preference based on their computer self-efficacy and self-identified challenges in learning. Thus, practitioners should find online programs that have a mixture of features that appeal to their students, especially when working with students with learning difficulties.

The themes of motivation and independence are also reflected in electronic support tool use. Students with higher frequencies of tool use cited a preference for computer-based instruction and a lack of using textbooks, whereas students with lower frequencies of tool use noted that they enjoyed the program because of its efficiency and the availability of multiple learning strategies. This indicates that students with different motivating or independently themed factors use the program in different ways by tailoring the electronic support tools to their individual needs, similar to the findings in Crawford et al. (2012) and Crawford et al. (2014). Interestingly, there is no clear pattern between students' computer self-efficacy and electronic support tool use. This could be do to students' prior experiences with technology – even though some students are more confident than others in their ability to use technology, they all feel capable of using the tools and tailoring them to their individual needs.

Limitations

The current research has several limitations. First, because this curriculum is used in a single classroom, the sample size is very small. To draw any definitive conclusions, the study will need to be replicated with a larger population. Second, one teacher was responsible for all of the students; thus, the impact of the online curriculum could change with a different instructor. Furthermore, the specific mathematics topic may have influenced students' perceptions. For example, some students may have had a more positive perspective of learning fractions, whereas others may have found fractions extremely difficult. This could potentially influence the students' overall perceptions of the online curriculum. Third, because all of the students were specifically at a school for students with learning difficulties, their exposure to these types of programs may or may not be greater than students in a public school setting.

Implications for Future Research

The current study examined an online curriculum with the intention of collecting in-depth qualitative and quantitative data to better understand how students with learning difficulties engage with the program. Students with learning difficulties have demonstrated positive responses to online learning that is designed using explicit instruction, sequencing information, and use multiple modalities to present information (Keeler, Richter, Anderson-Inman, Horney, & Ditson, 2007); all of which are a part of this online curriculum. This paper serves to inform practitioners as to how influential technology-based programs can be for students with learning difficulties as well as inform developers as to how to build technology-based programs that have the potential to directly impact student learning. Future studies can build upon this current work by replicating this type of study with a larger population in a more diverse setting or performing an experimental study that examines differences in students who receive the curriculum and those who receive traditional instruction.

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STUDENT PERCEPTIONS OF AN ONLINE MATHEMATICS CURRICULUM DESIGNED FOR STUDENTS WITH LEARNING DIFFICULTIES

Summary

Kristina Higgins, Tarleton State University, USA
Lindy Crawford, College of Education, Texas Christian University, USA
Kelly Silvestri, Coppell ISD, USA

The current paper examines perceptions of technology use – which includes the dimensions of computer self-efficacy, motivation, and independence – and use of electronic support tools of students with learning difficulties in the context of an online mathematics curriculum. A comprehensive understanding of mathematical knowledge and problem-solving abilities proves essential for students' success throughout school and in the workplace. Only 16% of fourth graders receiving special education services score within the proficient or above proficient range for mathematics. Therefore, a strong need exists to enhance educational curricula specifically for students in special education to adequately prepare them for a competitive higher academic and workplace environment. Use of electronic support tools has yet to be studied when students use the program as a core curriculum. This paper seeks to answer the following research questions using a mixed methods approach: how does a student's perception of learning math through an online curriculum relate to their academic profile? In what ways does perception of learning math through an online curriculum influence students' actual electronic support tool use? In what ways does students' perception impact their views about their own challenges in learning?

Six boys and two girls participated in the program, and ranged in age from 10-12 at the start of the program. The Math Learning Companion (2013) is an online mathematics curriculum for students in grades 3-8 that provides 73 lessons across seven content areas. Academic profiles were created for each student through their standardized test scores. Students' Woodcock-Johnson Broad Math score was used to represent their mathematics ability in this study prior to beginning the curriculum. Wechsler Intelligence Scale for Children IQ subscale scores were used to represent their general academic ability. The Math Learning Companion has a pretest and posttest built into the program that involves a 30-item test specifically related to the content of the curriculum to assess students' gains from the program itself. Electronic support tools (ESTs) in MLC include the calculator, audio support, a key terms dictionary, formulas, hyperlinks, a notepad, and a need more help button.

While all students showed improvement over the course of the program, some students showed more success with technology-based learning than others. Students with stronger academic profiles when beginning the curriculum were more likely to have higher levels of computer self-efficacy. These same students, however, did not denote a preference for computer-based instruction over traditional instruction, although they considered computer-based instruction 'fun,' and were also less likely to spontaneously discuss any learning challenges.

The themes that emerged from the current study reflect motivation and fun, efficiency, and a diversity of learning strategies using support tools. By examining these themes in-depth, it became clear that while all of the students enjoyed learning through an online curriculum, they cite different reasons for this preference based on their computer self-efficacy and self-identified challenges in learning. Thus, practitioners should find online programs that have a mixture of features that appeal to their students, especially when working with students with learning difficulties.

The themes of motivation and independence are also reflected in electronic support tool use. Students with higher frequencies of tool use cited a preference for computer-based instruction and a lack of using textbooks, whereas students with lower frequencies of tool use noted that they enjoyed the program because of its efficiency and the availability of multiple learning strategies. This indicates that students with different motivating or independently themed factors use the program in different ways by tailoring the electronic support tools to their individual needs. Interestingly, there is no clear pattern between students' computer self-efficacy and electronic support tool use. This could be due to students' prior experiences with technology – even though some students are more confident than others in their ability to use technology, they all feel capable of using the tools and tailoring them to their individual needs.