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The Influence of an Online Adaptive Program on Students' Math Attitude and Math Achievement as Measured through i-Ready Diagnostic Test Scores

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Abstract

The purpose of this study was to determine if the use of the i-Ready program with a group of eighth grade students, who most were behind on average four years in math, influenced their math achievement and their math attitudes. The i-Ready program is an online adaptive program which school districts are purchasing and are requiring teachers to implement in their classrooms. The program suggests a minimum of 45 minutes per week is spent on students working on two personalized lessons as determined from their diagnostic assessment results. The i-Ready program was implemented in the three math classes for an entire school year: Honors, Sheltered, and Regular. Students completed the diagnostics at the beginning (BOY), middle (MOY), and end (EOY) of the school year, as well as completed a math attitude survey at the beginning and end of the school year, to see if there was an influence of the use of i-Ready towards their math attitudes. A paired sample t-test revealed only participants in the Honors class had a significant difference in i-Ready Diagnostic scores, BOY to EOY. A paired sample t-test revealed no significant difference among students' pre- and post- math attitude survey responses.

Introduction

During the 2021-22 school year, 33.38% of all California students and 28.49% of all students in a school district who tested and completed the Math Smarter Balanced Assessment (SBA) passed with a score in the meet or exceeded level (CAASPP). I taught Math 8 at an urban middle school, and for comparison, during the 2021-22 school year, 13% of the 8th graders at my school passed the SBA while 23.46% of all 8th graders in the school district passed the SBA test. Student math achievement during the 2022-23 school year was not much better; the process to help students improve in math over time isn't a quick fix and will require a change to be implemented over time (Lewis & Kuhfeld, 2023). One of those changes is incorporating an online adaptive mathematics intervention program (OAMIP) in math classrooms, every school year. Research has identified that "technology and media can support children's learning and relationships especially when used intentionally and in

developmentally appropriate ways" (Bang et al, 2022, p.718).

Some schools in the state of California have recently mandated that schools implement an OAMIP to supplement grade-level standards learning and to provide students with individualized intervention. During the 2022-23 school year, a school district in California required all students at schools classified as Black Student Achievement Schools (BSAP) Tier II Intervention to utilize an OAMIP in their schools' math classrooms. Teachers at my school had an option between using IXL or i-Ready, and IXL was selected for the 2022-23 school year. For the 2023-24 school year, all schools in the district will use the same OAMIP, i-Ready. My study will measure the influence implementing an online adaptive math intervention program (OAMIP) in an eighth-grade math classroom would have on students' math attitude and achievement. Students' math attitude has been found to be positively correlated to students' math achievement, a student's attitude towards math influences their math performance (Ali Al-Mutawah, Fateel, 2018). The study will use the district-mandated OAMIP, following the district implementation requirements for the program and grade-level assessments.

Problem Statement

A school district in California created a strategic plan that involved four goals for its students, one of which was a numeracy goal. The numeracy goal of the district was for students to increase their score on the Smarter Balanced Assessment, so they were closer to achieving the level of standard met, which means they scored at grade-level. I teach Math 8 at an urban middle school; in the 2021-22 school year, the average score close to proficiency was –127, a 41-point increase from before COVID. Research by Northwest Evaluation Association (NWEA) identified during the 22-23 school year the achievement gap widened, and students needed more time in school to score at the achievement levels seen before Covid, an average of "4.5 months in math" with 9.1 months for eighth-grade students (Lewis & Kuhfeld, 2023. p. 6). My students need intervention in grade-level standards to support their current math grade-level learning, and in math skills from prior school years so they can improve (Stacy et al., 2017). Math interventions are necessary to support students' math learning, and even more so after COVID. One way to provide students with math practice at their current math level is using OAMIP, which is designed to identify students' math levels and provide lessons to help students improve, with immediate feedback (Stacy et al., 2017). Students' math attitudes have been found to be positively correlated to math achievement, if a student has a positive attitude towards math, then they tend to do better in math (Ali Al-Mutawah & Fateel, 2018). Students' math attitudes will be measured in this study to identify if a change in math attitude occurred over time using the OAMIP, or the i-Ready program. According to the i-Ready program, "[students] feel motivated in the lessons because they are active, supportive, and relevant to their lives" (Curriculum Associates, 2019). Students receive feedback as they work on the lessons and are motivated to take part in the lesson, not just listen to an explanation (Curriculum Associates). There's a need to research if and how i-Ready supports students' math learning due to a district mandate.

Purpose

IXL and i-Ready have been used as OAMIP at schools in the district I work for. However, currently there aren't

"any peer-reviewed journal articles reporting rigorously-designed studies of IXL" or i-Ready, but IXL and i-Ready use and math achievement have been studied in masters' theses and dissertations (Hollands & Pan, 2018, p. 3). The purpose of this study is to identify the influence i-Ready would have on the students' math attitudes and achievement. The district would benefit from the results to help guide future implementation of i-Ready in math classrooms in schools where students need support in numeracy or have a similar student population as the school in the study. I taught Math 8 at an urban middle school, where the average score close to proficiency was –168 in the 2018-2019 school year, and–127 in the 2021-2022 school year. The data reveals that my students need intervention in not only grade-level standards to support their current math grade-level learning, but also in math skills from prior school years so that they can improve, at least 50 points in the distance from 3 and be ready for Algebra 1 in the ninth grade.

Literature Review

To improve in math, students need to practice math, but math skills that are at their current math level, not just the grade level that students are enrolled in (Stacy et al., 2017). One way to provide students with math practice at their current math level, at school and at home, is through the use of math applications or websites that are designed to identify students' math levels, provide lessons to help students improve, and provide them with immediate feedback, such as the IXL Math program (Stacy et al., 2017). IXL Math is an online program, which schools or teachers can purchase, that provides students with math practice at their current math level, feedback to the student when they answer a problem correctly and incorrectly, by demonstrating how to solve the problem (Stacy et al., 2017). It supports students' math learning in learning new skills by suggesting skills from prior school years that students may review before they attempt the new lesson (Botzakis, 2017). Teachers are given data on students' progress over time and the application identifies skills students need additional support with (Hollands & Pan, 2018).

Stacy et al., (2017) completed a research study among second to seventh-grade students, with four cohorts of students in Ohio testing the IXL program, using IXL as an enrichment, summer school, or in-school tutoring program. In the study, younger students demonstrated math improvement in math fluency in the summer setting than older students, about half of the students improved in the in-school program, and in the after-school program "on average students improved more than half a grade level on calculation competence, with over half of them improving more than one grade level (55%)" (Stacy et al., 2017, p. 9). Hollands and Pan (2018) studied IXL use in schools (Grades 1-7) in the northeast United States where students had devices. Students' scores on the Star Math Assessment were evaluated at the beginning and end of the program, but any improvement in the test results were insignificant (Hollands & Pan, 2018).

A similar OAMIP to IXL is i-Ready. I-Ready was created by Curriculum Associates, and they recommend students work a minimum of 45 minutes on personalized lessons a week for at least 18 weeks for students to demonstrate gains (Curriculum Associates, 2019). Moreover, Curriculum Associates indicated the program works for all students. Research on the i-Ready program completed by Curriculum Associates, during the 2017-18 school year, identified students who worked the recommended time demonstrated improvement in their diagnostic scores

than students who didn't use i-Ready (Curriculum Associates, 2019). This research is correlational and uses i-Ready diagnostics results to identify student math achievement (Curriculum Associates, 2019). Research on OAMIPs doesn't always show a significant improvement in students' math achievement; studies vary in length and some studies have identified students who do not use the program (Hilz, Guill, Roloff, Sommerhoff, & Aldrup, 2023). To identify if, and what, influences an OAMIP has on students' math achievement, the duration of a study needs to be long enough to measure students' math progress and use multiple assessments. The current study aims to do this.

Students' attitude towards math has been a topic of research in math studies and dissertations. Hwang and Son (2021) analyzed 4,853 eighth-grade students' data that was collected for the 2019 Trends in International Mathematics and Science Study (TIMSS) and measured their attitude towards math and math achievement. The TIMSS used a 27 item Math Attitude survey that had three factors 1) Like math, 2) Value math, and 3) Confident in math. Each student completed 25 math problems which measured four units 1) algebra (30%), 2) numbers (30%), 3) geometry (20%), and 4) data and probability (20%) (Hwang & Son, 2021). The data analysis showed students who scored higher on the math achievement test had positive attitude towards math than students who had negative attitudes towards math.

Ortega (2016) completed a dissertation study where eighth grade students completed a math attitude survey, pre- and post at the beginning and end of the school year after using problem-based learning instructional conversations and writing in the classroom; 12 student participants were also interviewed. Although there was no significant change in students' math attitudes from the beginning to the end of the school year, of the students who used the Power Teaching program and writing, from the interviews, it was revealed students found math to be challenging, but all students can be successful with effort; "they believed student and teacher [helped] them learn math the best" (Ortega, 2016, p. 100).

With the i-Ready program, students are each assigned personalized lessons, but, if needed, they can ask the math teacher or their classmates for help while they work on the lessons. Kelly (2011) completed a dissertation study with high school students to identify if students' math attitudes changed over time. Students completed a math attitude survey, and were invited to be interviewed, and it was found that teachers have the most influence on students' math attitudes and working with students one-on-one is one way to make students feel supported (Kelly, 2011).

A study involving college algebra students, found that students' math attitudes can change over time (Hodges & Kim, 2013). Forty-three students from a college Algebra class for non-math majors participated and were randomly selected for the experimental or control group. Students in the experimental group watched a six-minute motivational video before they took their first test and completed the Fennema-Sherman Mathematics Attitudes (FMSA) scale (1976) before and after the video. The students in the control group also completed the math attitude survey before and after the first test, without watching the video. There was a small increase in students' math attitudes in the experimental group, but not in the control group, indicating that an intervention was performed and possibly influenced students' math attitudes.

Method

Quantitative Design

This study used a quantitative experimental design to better understand students' math attitudes and math achievement after a year of implementing the i-Ready program in eighth-grade students' Math classes. The i-Ready program was used in the math intervention class, as mandated by the school district the participants and teacher are a part of. Students completed the diagnostic assessment in the i-Ready program during three parts of the school year - beginning, middle, and end. The diagnostic assessment resulted in a scale score, identified which math grade level each student performed at, and provided each student with a personalized math lesson to work on, based on their i-Ready diagnostic results. Students completed a math attitude survey at the beginning and end of the school year (see Appendix). There were three groups of students involved in the study: a) students enrolled in the honors math class, b) students in the Sheltered English class, and c) students in a regular eighth-grade math class. All classes were about 80 minutes long in duration and met daily. Students had the same teacher for their Math class and Math Tutorial/Intervention class, and the i-Ready program was used during a portion of the Tutorial class.

The Researcher

The research study was completed in my classroom during the 2023-2024 school year. I am an experienced teacher, with 17 years teaching middle school math, specifically in eighth grade. I also have earned my doctoral degree in education and have prior experience in research and collecting data. Although the i-Ready program was new to me, it wasn't difficult to administer the diagnostic test, view the reports on students' diagnostic scores or the reports on instruction, and navigate the program. The school year prior I had a similar experience of using an online math adaptive program with an assessment and individualized lessons with my students and the school had a math instructional coach who could provide support to teachers when needed. Due to my experience in the classroom, I kept records of students' test data and the weekly number of i-Ready lessons completed as part of my instruction and weekly grades. The district required the implementation of the i-Ready program for individualized math intervention for students. Therefore, I included the two required lessons as a part of the students' Math tutorial grade. Additionally, I created a math tracker for students to record their progress in i-Ready and to know their grade level identified from the i-Ready Diagnostics; thereby, students could be accountable for their grades and monitor their progress.

Participants

The 31 participants were my students from all of my eighth-grade classes during the 2023-2024 school year. They were eighth grade students at a small, Title 1 urban school, and made up about 50% of the eighth-grade class. I had the students daily, for two class periods including their regular math class and the math tutorial class. The students in the honors math 8 class were students in the magnet program. Some had been identified as Gifted and Talented Education (GATE). Most had applied to be in the magnet program. The students in the sheltered English class were students who had not demonstrated proficiency in the English Language on the English Language

Proficiency Assessment for California (ELPAC) the prior school year. They were identified as English learners (EL). All of the students spoke English and were in an English support class to help them pass the test. The students in the third group were randomly enrolled in the class by the counselors and they were in the regular math program at the school.

Data Sources

The data collected for this study included the Math Attitude Survey, pre- and post, and the i-Ready Diagnostic scores throughout the school year. The Math Attitude Survey had 23 questions (see Appendix). The statements were rated on a Likert scale that ranged from "strongly disagree" to "strongly agree". Statements focused on learning, working alone, working with others, and using technology at school. The survey was created by the Kaput Center for Research and Innovation in STEM Education at the University of Massachusetts in Dartmouth. The i-Ready program was purchased by the district I worked in at the time of the study, and was the program used for students to complete the Diagnostic. The Diagnostic provided an overall scale score, a grade level equivalent, and a grade level placement for four units in Math: Numbers and Operations, Algebra and Algebraic Thinking, Measurement and Data, and Geometry placement.

Ethical Procedures

Students and their parents or guardians received consent forms, along with an information sheet, notifying them about the study and indicating that participation was voluntary and optional. Students were asked to take the copies home and return them with a *Yes, I agree to participate in the study,* or *No, I don't want to be a part of the study*. Participants were eighth graders who were under 18 years of age. Their parents, or guardians, also had to sign a consent form if they were allowing their child to participate. Students returned their forms folded in a sealed envelope with their names on the front. The forms were stored in a locked cabinet throughout the school year and were opened in the summer following the study. This process guaranteed anonymity of students and families who agreed or did not agree to participate in the study. To preserve anonymity, each student was assigned an 8-digit ID code to use when completing the math attitude survey to ensure names were not attached to surveys and responses were anonymous.

Limitations

This study had limitations. First, it had a small sample size. I had three groups of students, with less than 90 students' total. At the beginning of the school year, a new math 8 section was opened and about 10 students from the third group were moved randomly to a new class with the other eighth grade math teacher. Further, the school had attendance issues whereby students were absent frequently. Therefore, students missed out on class time, such as when they were provided with class time to work on their personalized lessons on i-Ready.

The expectation was to complete the personalized lessons at home, since it was publicized and expected that they each complete 2 i-Ready lessons weekly. Another limitation is the perception of what "strongly agree" and

"strongly disagree" means to each person. Everyone perceives those responses differently and some participants may be more willing to use those terms while some may not.

Population

Description : The students in this study were eighth-grade students in an urban school district at a Title 1 school. There were three groups of students, magnet students, Sheltered English, and students in the general education program. Thirty-one students were included in the study.

Rationale: The school the study was completed at required the use of an online math adaptive program to support students' math learning, specifically to provide individualized math intervention. Schools that require the use of an online math adaptive program, like i-Ready, could benefit from the results of this study because not much research has been done with the i-Ready program. This results of the study might determine whether the program helps increase student math achievement.

Results

The research question for the study was what influence does using an online math adaptive program (OAMIP) have on students' math achievement and math attitudes, specifically the i-Ready program. To answer if using an online adaptive program has an influence on students' math achievement, students were required to complete two i-Ready personalized lessons a week, in addition to completing the i-Ready Diagnostic three times throughout the school year: beginning of the year (BOY), middle of the year (MOY), end of the year (EOY). i-Ready was the program implemented by the school and lessons were selected for each student based on their i-Ready Diagnostic Assessment results. Means of the diagnostic assessment scores and a paired sample t-test were completed on students' i-Ready Diagnostic scores: BOY, MOY, and EOY to identify if there was an influence of using the i-Ready personalized lessons on students' math achievement and math attitudes.

There was a total of 31 participants in the study who completed i-Ready Diagnostics at three different times during the school year. Descriptive statistics were completed at each time, calculating the average of the Diagnostic score for all 31 participants as a group (see Table 1), and segregating the data by Math class: Honors, Sheltered, or Regular (see Table 2).

Table 1. Participant Descriptive Statistics (n = 31)

n = 31	Mean	i-Ready Grade Equivalent
BOY	463.68	4 (High)
MOY	471.39	5
EOY	481.94	6 (Early)

Table 2. Participant Descriptive Statistics by Class

Mean	Honors (n = 11)	Sheltered (n = 11)	Regular (n = 9)
BOY	508.36	441.18	436.56
MOY	512.73	429.73	471.78
EOY	545.09	433.45	437.22

Diagnostic scores were converted to a grade level equivalent using the i-Ready program Conversion Table (see Table 3). The average diagnostic BOY score for the 31 participants was 463.68 or Grade 4, for MOY it was 471.39, equivalent to Grade 5, and for EOY it was 481.94 or Grade 6. The participant group had a growth of 18.26 points from the BOY to EOY, equivalent to at least one grade level.

Table 3. i-Ready Mathematics-Overall Placements

	Emerging K	Grade K	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
Grade K	100–361	362–372	449–472	473–498	499–800									
		373–411												
		412–448												
Grade 1	100–346	347–401	402–412	473–498	499-516	517–800								
			413–448											
			449–472											
Grade 2		100–386	387–427	428–440	499–516	517–526	527–800							
				441–472										
				473-498										
Grade 3		100–386	387–412	413–448	449–463	517–526	527–540	541–800						
					464–498									
					499–516									
Grade 4		100–386	387–412	413–433	434–464	465–481	527–540	541–564	565–800					
						482–516								
						517–526								

Grade 5		100–386	387–412	413–433	434–449	450–479	480–497	541–564	565–574	575–800				
							498–526							
							527–540							
Grade 6		100–386	387–412	413–433	434–449	450–464	465–494	495–513	565–574	575–585	586–800			
								514–540						
								541–564						
Grade 7		100–386	387–412	413–433	434–449	450–464	465–479	480–507	508–530	575–585	586–598	599–800		
									531–564					
									565–574					
Grade 8		100–386	387–412	413–433	434–449	450–464	465–479	480–492	493–517	518–540	586–598	599–610	611–800	
										541–574				
										575–585				
Grade 9		100–386	387–412	413–433	434–449	450–464	465–479	480–492	493–502	503–514	515–555	599–610	611–629	630–800
											556–585			
											586–598			
Grade 10		100–386	387–412	413–433	434–449	450–464	465–479	480–492	493–502	503–514	515–555	556–585	611–629	630–800
												586–598		
												599 – 610		
Grade 11		100–386	387–412	413–433	434–449	450–464	465–479	480–492	493–502	503–514	515–540	541–563	564–589	630–800
													590–610	
													611–629	
Grade 12		100–386	387–412	413–433	434–449	450–464	465–479	480–492	493–502	503–514	515–540	541–548	549–571	572–601
														602–629
														630–800

The paired Sample t-Test for the group of 31 students demonstrated a significant increase in i-Ready scores from BOY to EOY only, two-sided p of .028, with a p-value of 0.5, (see Table 4). The 18.26 points growth from the BOY to EOY of the group was the only pairing that was statistically significant.

Table 4. Paired Sample t-Test of i-Ready Diagnostic Scores (N = 31)

	One-Sided p	Two-Sided p
BOY - EOY	.014	.028
BOY - MOY	.194	.389
MOY - EOY	.036	.071

The study included participants from three eighth-grade classes: honors, sheltered, and regular, so I calculated the means on each of the diagnostic tests for each of the three groups, to see if the significant difference from BOY to EOY was for the whole group or maybe one or two of the groups, (see Table 5). The average diagnostic scores for the Honors (BOY, MOY, EOY) were 508.36, 512.73, and 545.09, an increase of 36.73 points from BOY to EOY. This group began with a grade equivalent of seventh grade, according to the i-Ready conversion table, and ended with a grade equivalent of eighth grade. The average diagnostic scores for the Sheltered (BOY, MOY, EOY) were 441.18, 429.73, and 433.45, a decrease of 7.73 points from BOY to EOY. According to the i-Ready conversion table, this group started at a third-grade level and ended at a second-grade level. The last group, Regular, had an average diagnostic score (BOY, MOY, EOY) of 436.56, 471.78, and 437.22, an improvement of .66 points from BOY to EOY, and at a third-grade level. By comparing the difference in averages of the diagnostic scores from BOY to EOY, we can identify that only the Honors group had a gain in average diagnostic scores. A paired sample t-test was completed on the averages for all groups, separately, and the Honors group was the only group that had a significant difference in i-Ready Diagnostic averages from BOY to EOY, p-value of <.001. The other two groups did not show a significant difference in i-Ready average scores.

Table 5. Paired Sample t-Test of i-Ready Diagnostic Scores by Class

	Honors (n = 11)		Sheltered (n = 11)		Regular (n = 9)	
	One-Sided p	Two-Sided p	One-Sided p	Two-Sided p	One-Sided p	Two-Sided p
BOY - EOY	<.001	<.001	.256	.512	.488	.975
BOY - MOY	.338	.676	.184	.368	.094	.187
MOY - EOY	<.001	<.001	.307	.615	.048	.095

To answer the question of what influence, if any, using an online math adaptive program has on students' math attitudes, students completed a math attitude survey at the beginning and end of the school year. Each response to the survey questions was coded using the numbers 1 to 5, strongly disagree = 1, disagree = 2, neural = 3, agree =

4, and strongly agree = 5, with questions worded negatively coded backwards. Questions that addressed the same math attitude were grouped together, a sum of the points was calculated, and the means of the scores were completed, pre- and post-. After pairing each participant's responses from the pre- to post-math attitude survey, there were 28 student participants who completed both surveys at the beginning and end of the school year. The survey measured several math attitudes, but for the purpose of this study and the research question, the following math attitudes were analyzed: feelings about math, use of technology, and total math attitude.

The means of feelings about math pre- and post-survey showed an increase, 15.07 to 15.46, and the paired sample t-test showed no significant difference between the means (see Table 6). The use of technology revealed a slight increase in the means pre- to post, survey, 17.71 to 17.96, and the paired sample t-test showed no significant difference between the means (see Table 6). Overall math attitude had a decrease in mean, 84.04 to 83, and the paired sample t-test showed no significant difference between the means (see Table 6).

Table 6. Participant Descriptives and Paired Sample t-Test on Pre- and Post-Math Attitude Survey

N = 28	Mean (Pre)	Mean (Post)	One-Sided p
Total Math Att Score	84.04	83	.288
Feelings About Math	15.07	15.46	.283
Use of Technology	17.71	17.96	.348

Summary

The results from the data analysis of the Diagnostic Score averages revealed that although as a group of participants there was an increase in Diagnostic score averages from BOY to EOY, the only group of students that had a significant increase in Diagnostic scores was the student participants in the honors class. The math attitude survey revealed no significant difference in students' math attitudes from the beginning to the end of the school year.

Discussion

The participants in the study from the Honors class had an average grade level of seventh grade at the start of the study and an average of eighth grade at the end of the study. They were the only group who demonstrated an improvement in their grade level, similar to the study by Stacy et al, 2017, where half of the participants improved in their grade level after the use of an OAMIP. Students in this class attended class regularly and had less frequent absences. They were able to better work on the computer independently. This class had fewer students earning a D or Fail in their math classes, Math 8 and Math Intervention, which meant more students were working on completing their minimum of two i-Ready lessons a week, in comparison to the Sheltered and Regular, since completing two i-Ready lessons each week was a classwork assignment for the students. Perhaps students took their assignments more seriously and wanted to earn a passing grade of at least a "C" or higher to be eligible for

culmination, since students needed at least a C to participate in culmination, and eighth graders want to be a part of it.

Not every group of student participants in research studies have demonstrated a significant improvement after using an OAMIP (Hollands & Pan, 2018). The students in the Sheltered Math class had an average grade level of third grade at the start of the study and an average of second grade at the end of the study. The average Diagnostic scores of the student participants in the Sheltered class showed a decrease of 11.45 points from BOY to MOY, and then an increase of 3.72 from MOY to EOY. The average for the BOY for the Sheltered class was higher than the MOY because one of the students' diagnostic scores dropped almost 100 points from BOY to MOY, making their score an outlier, and increasing the average for the BOY. Students in this class were absent more frequently, and required monitoring and frequent reminders to get to work. Perhaps this was due to being on average more than 4 years behind in math and requiring more one-on-one help to complete the lessons. Although some students worked the minimum amount of time i-Ready recommends, more students in this class didn't complete the recommended number of lessons each week. The school monitored each math class's use of i-Ready and they questioned if we gave students more time to work on i-Ready. I do believe students not at grade level do take longer to complete the lessons and need one-on-one support to get lessons done. From my 18 years of teaching experience, I've noticed students who are three or more years behind in math lack basic fluency skills and are not confident in their math skills. Although sometimes they may be able to identify which skill they need to apply to solve a problem, they make errors and are not able to apply them successfully. So they sometimes avoid the task altogether (Hilz, Guill, Roloff, Sommerhoff, & Aldrup, 2025).

In the third group of participants, the regular class, the means for the Diagnostic test, BOY, MOY, EOY, were 436.56, 471.78, and 437.22. Although there was a 35.22-point increase from BOY to MOY, the average was not statistically significant. From the BOY to EOY, the average had a .66-point increase and the difference in mean was not statistically significant. One of the reasons the average in BOY was lower than the MOY was because one of the participants in the class had a low score on the i-Ready BOY Diagnostic test, they scored at the Kindergarten grade level and when they retook the Diagnostic test the second time, they scored at a much higher level, over 200 point increase; their test score was an outlier in the sample. Of the nine students in the sample, only two students in the Regular class showed an increase in Diagnostic scores from BOY to EOY and three had an increase in score from MOY to EOY. The use of digital math tools in the classroom does not automatically mean students will demonstrate an improvement; "formal studies of digital math tools indicate that impact on students' math achievement is mixed" (Hollands & Pan, 2018, p. 2). Research by i-Ready says students who spend at least 45 minutes a week working on the lessons will show improvement in their diagnostic scores (Curriculum Associates, 2019). I provided students with at least 45 minutes of class time each week to work on the lessons, but not all the classes had a significant improvement in their Diagnostic scores. The Diagnostic scores are used as a measure to determine if their was improvement in their math understanding. A reason students did not show an improvement in Diagnostic test scores could be because students did not try their best on the i-Ready Diagnostics. The last i-Ready Diagnostic of the school year was completed after the eighth-grade students took the state tests for three subjects, so maybe the students had testing fatigue, and they just did not want to try anymore. Or students who are behind three or more years in math need different supports than working on math lessons for 45 minutes

a week.

During the year-long study, students completed a math attitude survey at the beginning and end of the school year, and 28 of the 31 students who agreed to participate in the study completed both. A paired sample t-test revealed no significant difference in overall math attitude, feelings about math, or use of technology. Students were asked to complete two personalized i-Ready lessons a week to help them improve their math skills, as identified from their i-Ready Diagnostic assessment, and were provided with at least 45 minutes a week of recommended class time to complete the lesson (Curriculum Associates, 2019). Although there was a small improvement in averages on the attitude of feelings about math, it was not significant. Using this program in a math intervention class for one school year didn't translate into a change in students' math attitudes or feelings about Math for the students in the sample. Student's math attitudes can change over time, as found in Hodges & Kim (2013), but a possible reason there was no significant difference in math attitudes in this study could be that the majority of the students are several years behind in math. The grade level equivalent for two of the classes at the beginning of the school year was at a third-grade level, more than four years behind their current grade-level, and at the end of the school year there was not much change in their grade level equivalent. Hwang and Son (2021) found that lower-performing students did not have positive attitude towards math, which is similar to the results from this study.

Eighth-grade students find math to be challenging, and although eighth graders believe students can be successful in math, that doesn't always mean students' math attitudes will improve (Ortega, 2016). Students who are behind in math lack skills to support their grade level instruction and may get frustrated when learning new material. Students completed the i-Ready lessons on their Chromebooks and online, so it was important to know what students' attitudes towards technology were and if using technology to complete math lessons would influence students' math attitudes. Students who participated had been using devices for years and were familiar with logging on to their learning management system and the i-Ready application. The i-Ready lessons include videos that teach students skills, with practice problems, and a quiz at the end of how students earn credit for passing the lesson. When responding to the statement, "Technology can make mathematics easier to understand," 17 of the 28 student participants agreed or strongly agreed with the statement at the beginning of the school year while 18 students agreed or strongly agreed with the statement at the end of the school year (see Figure 1). Students understand that technology can help them in their math learning, but using the i-Ready program did not help them "make mathematics easier to understand." Statement 27 of the survey indicated, "I am not comfortable using technology in math class," (see Figure 2). On the pre-math attitude survey, 20 students said they strongly disagreed or disagreed with the statement, and on the post-math attitude survey 19 students said they strongly disagreed or disagreed with the statement. Five students on the pre-math attitude survey said they were neutral, while six students on the post-math attitude survey selected neutral; 25 of 28 students appear to be comfortable with using the technology, or Chromebook for their class. The i-Ready program provides students with lessons be completed individually on the internet/computer, but students had the option to ask for help from the teacher or team mates during the class time. Students like interacting with others and talking out loud. As mentioned in Ortega (2016), eighth-grade participants who were interviewed shared interacting with the teacher and their classmates is what helps them learn math, so students who are behind in math four years or more may require interaction with the teacher and students. Kelly (2011) mentioned students need one-on-one interaction with the teacher to have an

influence on student math attitude. Students need to be motivated to work independently on their own with i-Ready and one teacher providing one-on-one support to all the students where the majority of the class is four or years behind is unfortunately not able to be accomplished in the classroom due to time constraints; students would need to attend after school tutoring to get that type of support.

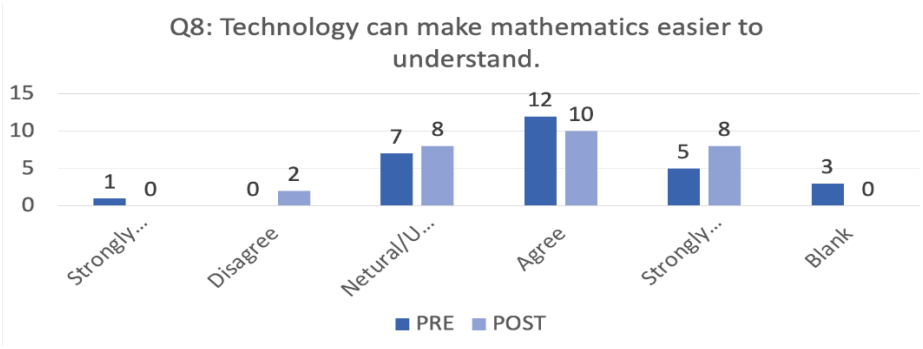

Figure 1. Question 8 of the Math Attitude Survey

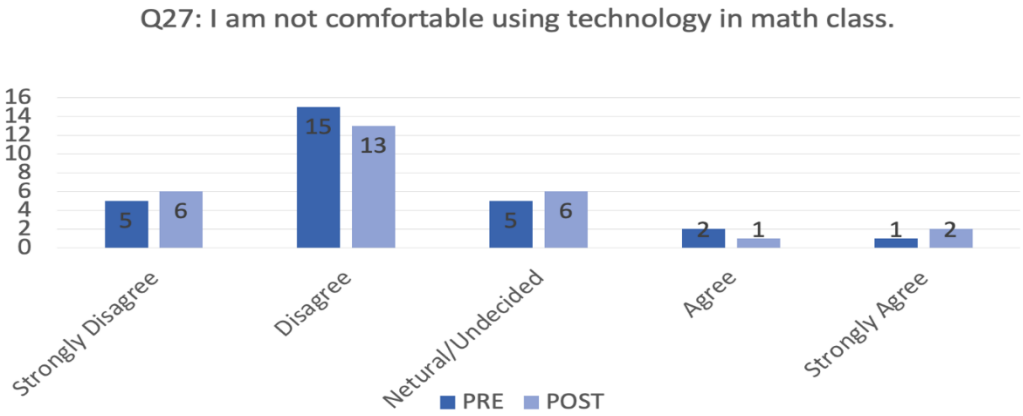

Figure 2. Question 27 of the Math Attitude Survey

Conclusion

The data analysis on the i-Ready Diagnostic scores and math attitude survey results revealed that the use of i-Ready personalized lessons in the classroom supported some students' math learning, but not all. The group who needed the most support were students who were several years behind in math. They did not have a significant increase in math achievement, as measured by Diagnostic Assessment scores. The Math Attitude Survey did not show a significant change in students' math attitudes, between the pre- and post-surveys for the participants. The results revealed the continued need for a program for students who are several years behind in Math.

The participants in the Honors class were the only group of participants where the data revealed a significant improvement in their i-Ready Diagnostics scores. I recommend working with the group of students who did not have a significant improvement in their i-Ready Diagnostic scores, the Sheltered and Regular, as these intervention programs are designed to help students who are behind in Math. If schools could budget for Math teaching assistants to help provide one-on-one support in a math classroom, that could help students who are not

at grade level want to ask questions and get help. Also, from my teaching experience, students who are not in Honors class demonstrate lower levels of motivation to complete the work, therefore I recommend motivation be a factor to consider in future studies. Maybe a program to build students' motivation to get the work completed and self-reflect on their progress would encourage students to continue trying and working, along with i-Ready.

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Appendix. Math Attitude Survey

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APPENDIX A: ATTITUDE SURVEY
SUMMARY OF ITEMS AND ORDER

Circle the appropriate responses based on the key below:

0 Strongly Disagree	1 Disagree	2 Neutral/Undecided	3 Agree	4 Strongly Agree

1. I think mathematics is important in life.	0	1	2	3	4
2. In middle school, my math teachers listened carefully to what I had to say.	0	1	2	3	4
3. I learn more about mathematics working on my own.	0	1	2	3	4
4. I do not like to speak in public.	0	1	2	3	4
5. I prefer working along rather than in groups when doing mathematics.	0	1	2	3	4
6. I get anxious in school.	0	1	2	3	4
7. In middle school, I learned more from talking to my friends then from listening to my teacher.	0	1	2	3	4
8. Technology can make mathematics easier to understand.	0	1	2	3	4
9. Cell phones are an important technology in my life.	0	1	2	3	4
10. I like my own space outside school the majority of the time.	0	1	2	3	4
11. I enjoy being part of large groups outside school.	0	1	2	3	4
12. I do not participate in many group activities outside school.	0	1	2	3	4
13. I do not like school.	0	1	2	3	4
14. I like math.	0	1	2	3	4
15. I feel confident in my abilities to solve mathematics problems.	0	1	2	3	4
16. In the past, I have not enjoyed math class.	0	1	2	3	4
17. I receive good grades on math tests and quizzes.	0	1	2	3	4
18. When I see a math problem, I am nervous.	0	1	2	3	4
19. I am not eager to participate in discussions that involve mathematics.	0	1	2	3	4
20. I enjoy working in groups better than along in math class.	0	1	2	3	4
21. I like to go to the board or share my answers with peers in math class.	0	1	2	3	4
22. I enjoy hearing the thoughts and ideas of my peers in math class.	0	1	2	3	4
23. Mathematics interests me.	0	1	2	3	4
24. I sometimes feel nervous talking out-loud in front of my classmates.	0	1	2	3	4
25. I enjoy using a computer when learning mathematics.	0	1	2	3	4
26. When using technology for learning mathematics, I feel like I am in my own private world.	0	1	2	3	4
27. I am not comfortable using technology in math class.	0	1	2	3	4

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