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Blended Learning and Math Growth: Investigating the Role of IXL Math in the Growth of 5th Grade Students' Math Fluency Scores

Dan Van Ruler

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Abstract

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Abstract

Because of an increase in usage of online adaptive technology in the classroom replacing much of the paper and pencil work previously given as math homework, this study was designed to compare the growth rates in MAPS (Measurement of Academic Progress) math scores between a control group of 5th grade students who did not have access to online practice and a treatment group of students who were assigned online practice throughout the school year. If growth rates were greater in the treatment group, this study could support the movement of decreasing the amount of traditional homework and implementing more online practice in its place. This study concluded that the treatment group out-performed the control group in overall scores and growth rates.

According to a recent Harvard study (Hanushek, Peterson, & Woessmann, 2012) of trends in student performance, the United States trails behind 24 countries in the improvement of math scores. For Iowa educators, the study bears even more bad news. Iowa ranked last in growth rate among the states in the study with some states doubling and even tripling the growth rates of students in Iowa (p. 6). It is essential, then, that a rural Iowa school district that prides itself in developing a growth mindset in its students examines the growth rate of its students' math scores in light of these developments.

A position statement on the strategic use of technology in teaching and learning mathematics from the National Council of Teachers of Mathematics (National Council of Teachers of Mathematics, 2015) stated that "It is essential that teachers and students have regular access to technologies that support and advance mathematical sense making, reasoning, problem solving, and communication." A meta-analysis of online learning versus traditional classroom instruction (Means, Toyama, Murphy, Bakia, & Jones, 2009) conducted by the U.S. Department of Education suggested that blended learning produced some of the most favorable results. A second meta-analysis (Cheung & Slavin, 2013) concluded that supplemental educational technology typically produced "positive, though modest, effect in comparison to traditional methods" (p. 1) and a recent study (Nelson, Parker, & Zaslofsky, 2016) has indicated that math fact instruction has a larger effect size in early elementary grades than in middle school grades such as grades 7 or 8.

In 2015, the Sioux Center Middle School purchased a license from IXL.com, an online educational technology company, that allowed students to practice standards-aligned math problems online. The program provides students with examples of how to complete the problem and provides immediate feedback with supplemental instruction if the students answer a question

incorrectly. The program also offers instructors feedback on the amount of student time spent practicing, student accuracy, and potential areas of improvement for each student. Anticipating that this blended technology might help improve math fluency and comprehension, in 2016, a 5th grade math teacher began using IXL.com as a way to supplement math practice and instruction.

The purpose of the research conducted in this study was to determine if this mandatory practice improved the growth rate on math MAP testing for the 5th grade class of 2016 compared to previous growth rates of the 5th grade class of 2015. This study also sought to determine if there is a positive correlation between growth on MAPS testing and the time spent on IXL Math per week. It was this author's hypothesis that the study would show that the average class growth would surpass that of the previous year's growth as a result of the extra math practice. Additionally, this author believed that the study would show that students who spent more time practicing IXL Math beyond the required minimum would see higher growth scores than students who only completed the minimum requirements. It was this author's hope that this data would be made available to stakeholders at Sioux Center Community Schools as evidence that online practice can measurably improve math fluency and comprehension growth.

Definitions

For the purpose of this research, the following definitions were used.

Blended Learning – the thoughtful fusion of face-to-face and online learning experiences (Garrison & Vaughan, 2008).

Educational Technology - a variety of technology-based programs or applications that help deliver learning materials and support learning process in K-12 classrooms to improve academic learning goals (Cheung & Slavin, 2013).

MAP Test – Measures of Academic Progress. This standardized assessment is produced by Northwest Education Agency (NWEA) and is administered to all students in grades 3-8 in the fall and spring.

Computer Assisted Instruction - a program of instructional material presented by means of a computer or computer systems (Encyclopedia Britannica, 2016).

Literature Review

The infusion of online learning into traditional educational settings is apparent throughout the nation. Kahn Academy is now a household name. According to SRI International (2014), students have solved over 1.8 billion math problems on Kahn Academy already. Other competing platforms such as ST Math, SimCalc, and Math IXL offer similar supplemental online practice. And the benefits of such programs are evident. Many online programs offer instant feedback to students on their reading, math, and writing practice resulting in data for teachers that allow them to make adjustments in individual or whole-class instruction.

Almost all use of technology in the traditional classroom setting can fall under the umbrella of the definition of blended learning. VanDerLinden (2014) noted that blended learning is a broad term used to describe a wide variety of technology integration:

> Blended learning exists on a continuum with minimal online activities on one end and minimal face-to-face activities on the other end. Most institutions do not prescribe a definition of blended learning and acknowledge that it has different meanings for different disciplines and can fall anywhere in the continuum. (p. 75)

A research study illustrating the potential benefits of blended learning was conducted in 2012 at Spring City Elementary Hybrid Learning School (Powell, Watson, Staley, Patrick, Horn,

Fetzer, Hibbard, Oglesby, & Verma, 2015.) One hundred and thirty students in grades K-4 participated in a model of blended learning that included three, 20-minute station rotations of individual, collaborative and direct instruction. During the individual station, students used online curriculum. The data collected from this practice determined what type of direct or collaborative instruction would benefit the student the most. The study compared the percentage of students who scored proficient or advanced on the Pennsylvania System of School Assessment (PSSA) during the year before the implementation of blended learning and the number of students who scored proficient or advanced after the first year of implementation. In the traditional system, 61.4% of students scored proficient or advanced in mathematics. The following year, after the blended learning program was implemented, 85.4% of students scored proficient or advanced, marking a 24% increase in students meeting or exceeding educational goals. Students also realized gains in proficiency of 19% and 27% in reading and science, respectively (p. 10).

In the Powell study (2015), students spent nearly 100 minutes of instructional time per week using an online platform called ST Math. The data collected from the math platform served as a formative assessment tool that guided instructional choices for teachers. The practice of using formative assessment to plan individualized direct instruction likely played a large role in the increased scores at Spring City Elementary.

A more comprehensive study of the SimCalc math program (Roschelle, Shechtman, Tatar, Hegedus, Hopkins, Empson, Knudsen, & Gallaher, 2010) explored if the integration of technology, curriculum, and professional development could assist middle school students in learning complex and difficult mathematics. The study compared scores of students who used the SimCalc program in conjunction with traditional classroom curriculum versus students who

were exposed only to traditional classroom methods of instruction. One study was conducted on a 7th grade mathematics class and the second was done with an 8th grade mathematics class. The experimental groups that used the SimCalc program realized effect size gains of .63, .50, and .56 (p. 93).

In another blended learning study conducted by Emperical Education (2011) further evidence of the potential benefits of this technology were explored. The Oregon study was designed to compare achievement of 4th and 5th grade students who were exposed to IXL Math in a blended environment to 4th and 5th grade students who were instructed in a traditional environment. Data collected in this study included the total time spent on the IXL Math program, the number of problems attempted by each student, the number of problems that each student correctly answered, and the number of logins for each student. Four hundred and forty-seven 4th and 5th grade students who participated in the IXL program realized a five-percentile gain on the OAKS (Oregon Assessment of Knowledge and Skills) math test compared to the control group of 1,780 students who did not participate in the IXL Math programs. The study noted that this gain is equivalent to over six weeks of traditional instructional time. Furthermore, the 5th grade students who used IXL Math outperformed their peers who did not use the IXL program by a seven-percentile gain equating to 9.5 weeks of traditional instructional time (p. 3).

In addition to comparing math scores between the control group and the blended learning group, the Oregon study also surveyed teachers who used IXL Math in their classrooms. This survey illuminated how IXL Math was used in the classroom. Over 85% of the 14 respondents reported that they used the program for allowing advanced students to move ahead, for re-teaching, practicing new topics, and for general practice of various topics (p. 8). Fifty-seven

percent of respondents reported that they used IXL Math as an intervention for students who are far below grade level (p. 9).

The gains indicated in the Oregon study are consistent with the meta-analysis conducted by the United States Department of Education (Means et al., 2009). This meta-analysis analyzed 50 empirical studies of online learning to compare online learning to traditional face-to-face learning and to measure student learning outcomes in light of the type of instruction provided. The meta-analysis concluded that blended learning has a positive effect size of +.35 when compared to traditional face-to-face instruction. Forty-three of the 50 studies conducted in this meta-analysis were of older leaners in college or graduate school (p. 17).

A second meta-analysis of the effectiveness of educational technology in the classroom (Cheung & Slavin, 2013) sampled studies conducted on K-12 students. It attempted to delineate some of the ambiguity surrounding blended learning instruction by defining program intensity by minutes spent per week on programs similar to IXL Math. The results of the meta-analysis indicated that the most positive effect size, + 0.20, was realized when students spent between 30 and 75 minutes on online practice per week (p. 98). This effect size is also consistent with the Oregon study that indicated increased effect sizes were observed when the number of problems and the number of minutes per session were increased.

A third meta-analysis (Slavin, Lake, & Groff, 2009) had almost identical results to the Cheung and Slavin study. In this study, Slavin, Lake and Groff analyzed studies that met strict criteria guidelines including a 12-week minimum of treatment duration, studies that included pretest data, studies that included random assignment, and studies that had at least 15 students per treatment group. In 18 studies where supplemental computer-assisted instruction was used (defined as 10 – 15 minutes of practice per day), the average effect size was +.19 (p. 91).

Previous meta-analysis of blended learning studies indicated that moderate growth can be expected from using the IXL Math program and that the majority of students will have a favorable opinion of the program over traditional instruction. The exact improvement in growth compared to the previous class without IXL Math could very well be motivation for teachers, parents, and students to continue, extend, or modify the use of the IXL Math program in 5th grade.

Research Methods

Participants

The participants in the study were 206 5th grade students from Sioux Center Community School District in Sioux Center, Iowa. The participants were composed of 51% female students and 49% male students. Thirty-five percent of the students were on free and reduced lunch programs (low SES). Fifty-eight percent of the students were white, 34 percent of the students were Hispanic, 5 percent were African American, and 3 percent were American Indian.

The 2015-2016 group included 101 students, (46 boys, 55 girls) 17 students that were English Learners, 12 students on IEPs or 504s, and 31 Hispanic students (31%). The 2016-2017 group included 105 students, (54 boys, 51 girls) 17 students that were English Learners, 10 students that were on IEPs or 504s, and 39 Hispanic Students (37%).

Materials

The participants took a computer adaptive interim assessment called the Measure of Academic Progress, or MAPS test. This assessment is a tool used by the Sioux Center Community School District to track academic growth for students as they advance through the school year and through the grade levels. Students take the assessment in the fall and spring of

each school year. This allows educators and parents to track growth in reading, math, language usage, and science. This adaptive assessment increases the difficulty of the questions if students answer correctly and decreases the difficulty if students answer incorrectly. The MAP test has been used by educators to identify areas of strength and areas of growth for each student. It has also been used to identify students who are in need of extra support as well as students that are ready for more challenging tasks. Scores are reported out in the Rausch Unit, or RIT, which is an equal interval scale that indicates a student's instructional level.

Design

This quasi-experimental study compared the growth on math MAPS scores between two different classes of 5th grade students. The control group consisted of 95 students from the 2015-2016 school year. This group of participants did not have access to IXL Math and received traditional face-to-face instruction from the same math teacher as the 2016-2017 class. The treatment group of participants consisted of 105 5th grade students from the 2016-2017 school year who participated in blended learning that consisted of mandatory weekly math practice on the IXL Math program. The independent variable in this study was the time spent on IXL Math. The time spent on IXL Math was only analyzed within the 2016-2017 group of participants since they were the only group to receive that treatment. The dependent variable was the average growth in math scores on the MAPS assessment for the 2015-2016 and 2016-2017 groups. Besides the treatment, there were no obvious changes made to the curriculum or to the pacing used by the instructor.

Procedure

In order to determine the effect of IXL Math practice, the study compared the average growth of math scores of the control group to the average growth of the treatment group. The control group had already received its traditional face-to-face instruction in the 2015-2016 school year. The pre-test was given to the control group in September 2015 and the post-test was conducted in May 2016. Instruction was aligned to the 5th grade Common Core math standards. It is noteworthy that the Sioux Center Community School District uses standards-based grading practices where students have multiple opportunities to re-learn and re-assess on any given standard. Differentiation practices for students were used extensively with the control group as well as with the treatment group. The same 5th grade math teacher instructed four groups of 5th grade students in the control group and five groups of 5th grade students with the treatment group. The control group averaged 25.5 student per class and the treatment group averaged 22.5 students per class. Both of the groups were tracked by math ability. The control group had one high-functioning class, two classes of students slightly below to slightly above grade level ability, and one class of lower-functioning math students. The treatment group was tracked in a similar fashion with three slightly below to slightly above grade level classes instead of two. All first or second year English Learning (EL) students were removed from the study because in the treatment group, they received an additional 30 minutes of daily direct instruction from the 5th grade math teacher but the EL students in the control group did not receive this additional daily direct instruction.

The pre-test was administered to the treatment group in September 2016 and the post-test was administered in May 2017. Throughout the 2016/2017 school year, the 5th grade math teacher assigned online IXL Math practice every two weeks. This allowed students without

computer access at home to complete the work at school during study hall time. The math teacher also assigned lessons that are aligned to the same 5th grade Common Core math standards that he was teaching in the same given time period. The IXL Math practice was not optional. Students who do not complete the practice before the assigned date had to attend the after-school program until the practice was completed. The only uncontrolled variable with the treatment group was that students were able to complete more IXL Math practice than was required by the math teacher.

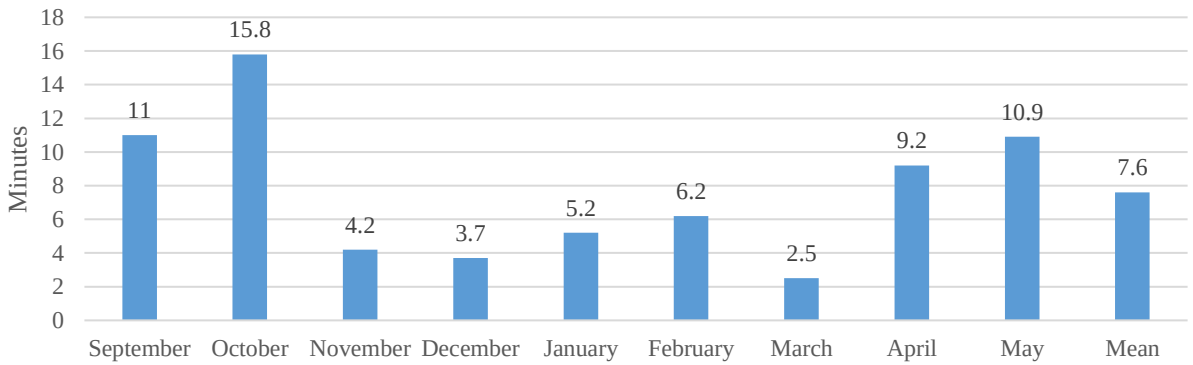
Data Analysis

Since this study compared two different groups of participants, it would be insufficient to simply compare the spring MAPS scores between the two groups. One of the groups could simply have been higher functioning than the other. In order to determine if mandatory practice improved the growth rate on math MAP testing for the 5th grade students, this study analyzed and compared the average math MAPS growth rates for the control group and the treatment group. In addition, this researcher grouped students by the total time spent on IXL Math (independent variable) and compared the growth rates (dependent variable) of each of these groups. This comparison helped to determine if there was a positive correlation between the time spent on IXL Math and the growth rate. Since it was nearly impossible to estimate the time that students spent on IXL Math by the end of the year, the groupings were determined in the spring.

Results

Before examining the results, it should be noted that the treatment group was expected to receive assigned Math IXL work throughout the entire school year. After receiving complaints from students and parents about having too much math homework as well as seeing an increase in students with late work, the 5th grade math teacher significantly decreased the amount of required Math IXL work from November through March. During these months, students averaged only 4.4 minutes of online practice per school day which is well below the recommended 10 to 15 minutes of practice per school day. The decrease in IXL Math practice can be seen in Figure 1.

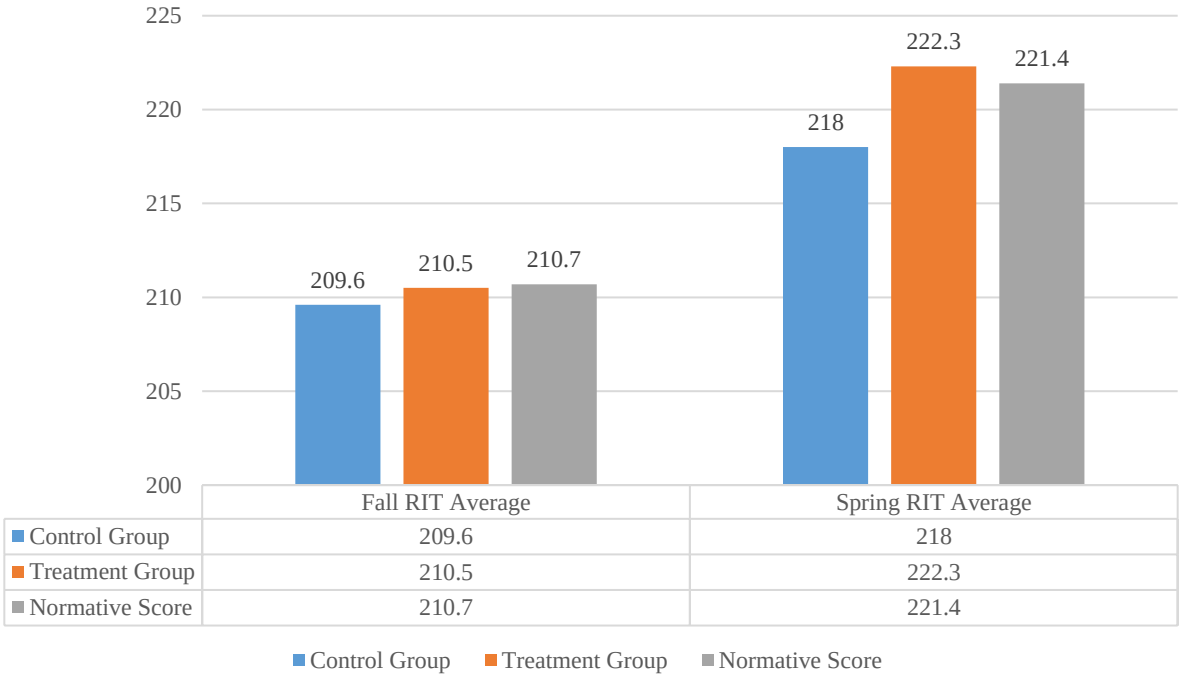
Figure 1: Average Minutes of Individual Math IXL Practice per School Day



The first question posed by the researcher asked if this mandatory practice improved the growth rate on math MAP testing. The results of the spring math MAPS scores are illustrated in Figure 2. As mentioned before, it would be insufficient to compare the two groups of students' final scores when making any conclusions about the effectiveness of the treatment. It is, however, notable that the treatment group of students out-performed the control group of students in the overall math scores. The control group of students scored one point below the

normative value in the fall but fell behind the expected score by 3.4 points in the spring.

Figure 2: Fall and Spring RIT Averages in Overall Math MAPS Scores



	Fall RIT Average	Spring RIT Average
Control Group	209.6	218
Treatment Group	210.5	222.3
Normative Score	210.7	221.4

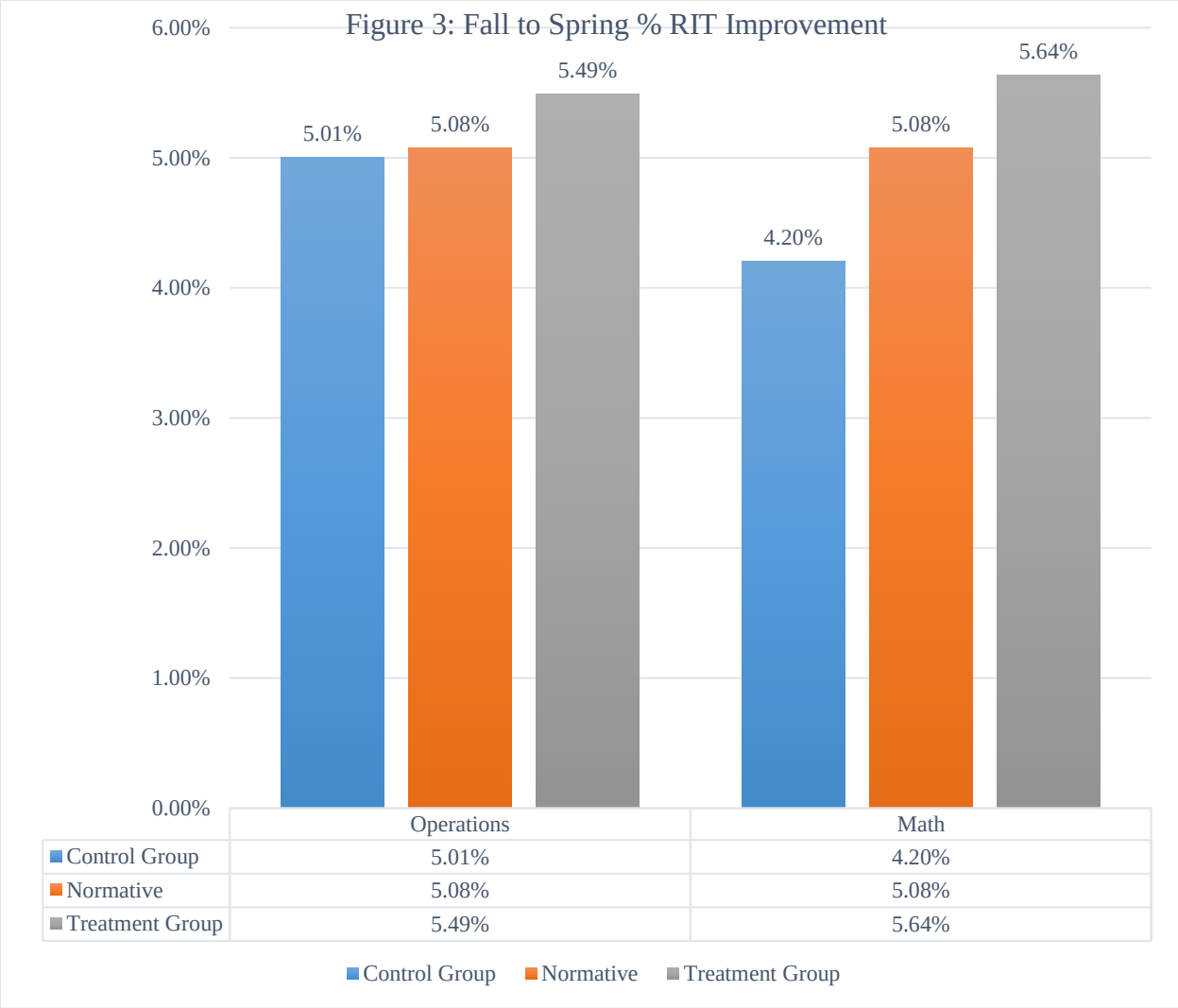
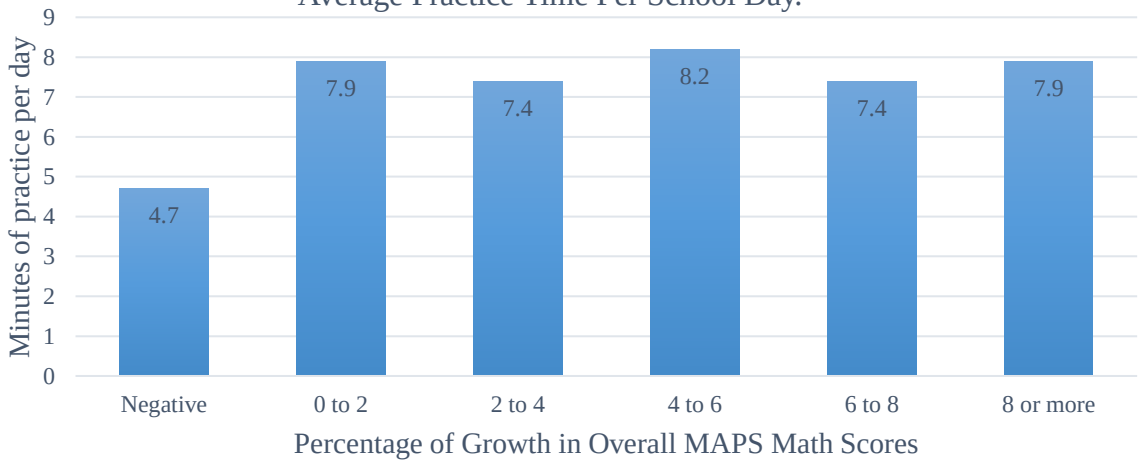


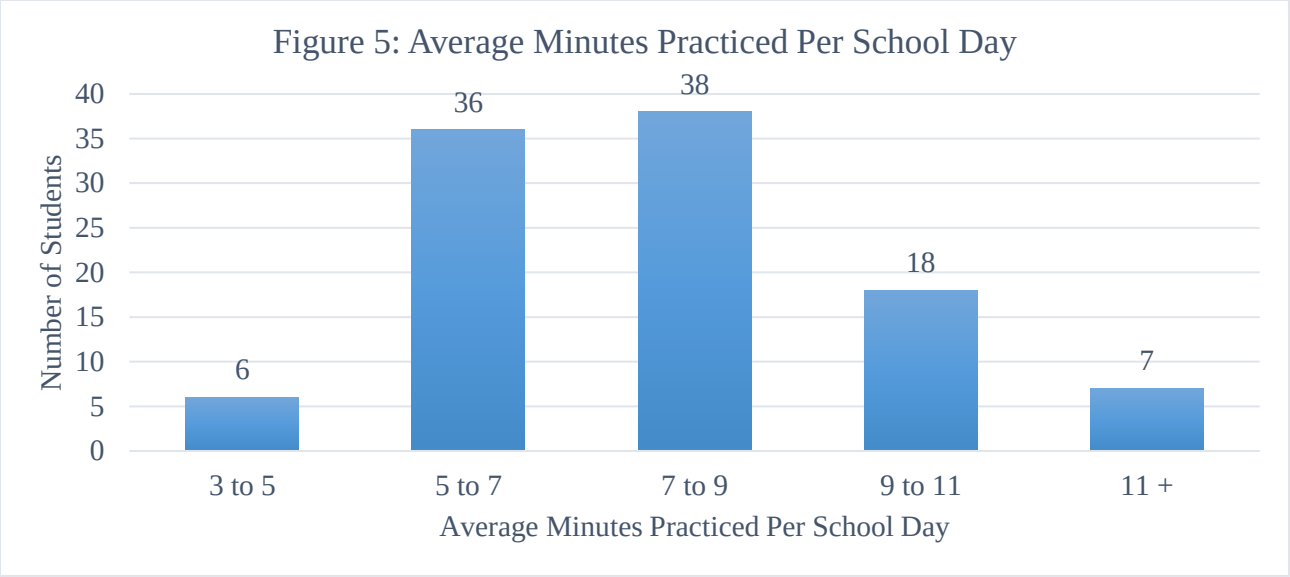
Figure 3 compared the RIT growth rates of the control group and treatment group to the normative growth rates of all 5th grade participants who took the MAPS test in the United States. The treatment group out-performed the control group by .48% in numbers and operations while also out-performing the control group by 1.44% in overall math improvement. The calculated effect size of this growth was +.09 which was less than expected when the study began. However, when analyzing the practice time spent per day, the results are not surprising. It can be reasonably inferred that if the treatment group received an average of 10 to 15 minutes of online

practice per day instead of the actual average of 7.6 minutes of practice per day, the effect size would have been much larger.

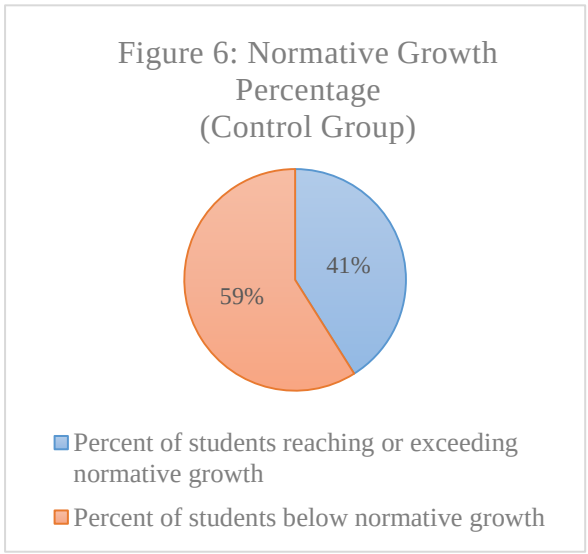
The second research question asked if there was a positive correlation between MAPS Math growth and time spent practicing. When comparing the percent growth on overall MAPS scores with the average number of minutes of practice per day for the students in that group, one cannot make a direct correlation between minutes per day practiced and percentage growth. In Figure 4, students were broken down into 2% growth rate increments beginning with a small group of students (4) who demonstrated negative growth. There is not a significant difference in average Math IXL practice time per school day between the groups of students that performed above the normative growth rate (5.08%) and below the normative growth rate. One of the reasons for the lack of difference could be the fact that 88% of the students (Figure 5) practiced between five and eleven minutes per day which is likely not a significant enough difference to see meaningful results on growth rates.

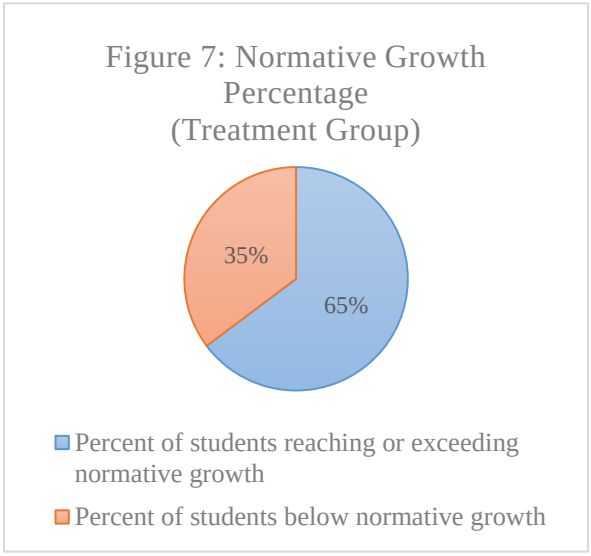
Figure 4: Comparison of Percent Growth on Overall Math RIT Scores to Average Practice Time Per School Day.





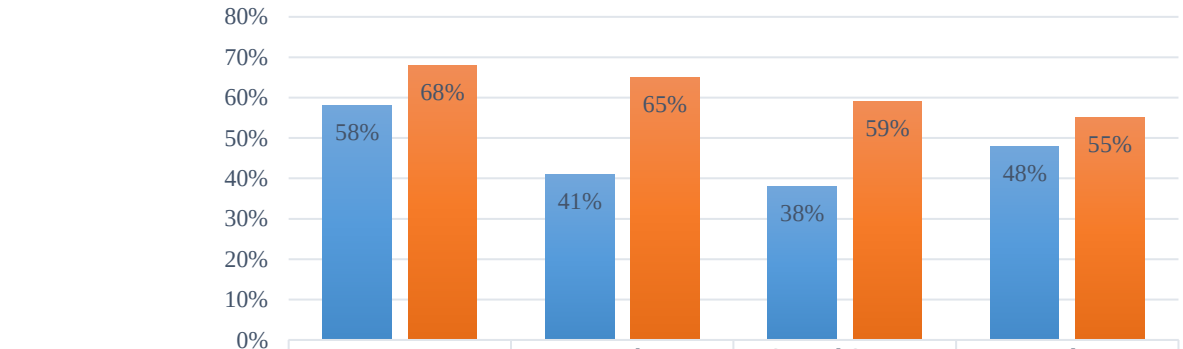
Figures 6 and 7 illustrate the increase in the percentage of students from the control group to the treatment group that reached or exceeded the normative growth rates on the overall MAPS Math scores. Only 41% of the control group reached or exceeded the expected growth rates while 65% of the treatment group reached or exceeded the expected growth. One possible reason for this growth could be that gaps in student understanding are more readily closed with adaptive online practice.





While this increase in the percentage of students reaching or exceeding normative growth from the control group to the treatment group was evident in all four MAPS tests taken (Figure 8), math is clearly an area where the percentage increase was among the greatest. It should also be noted that the treatment group also received extra online practice in language arts IXL that met or exceeded the amount of online practice time that the students received in math.

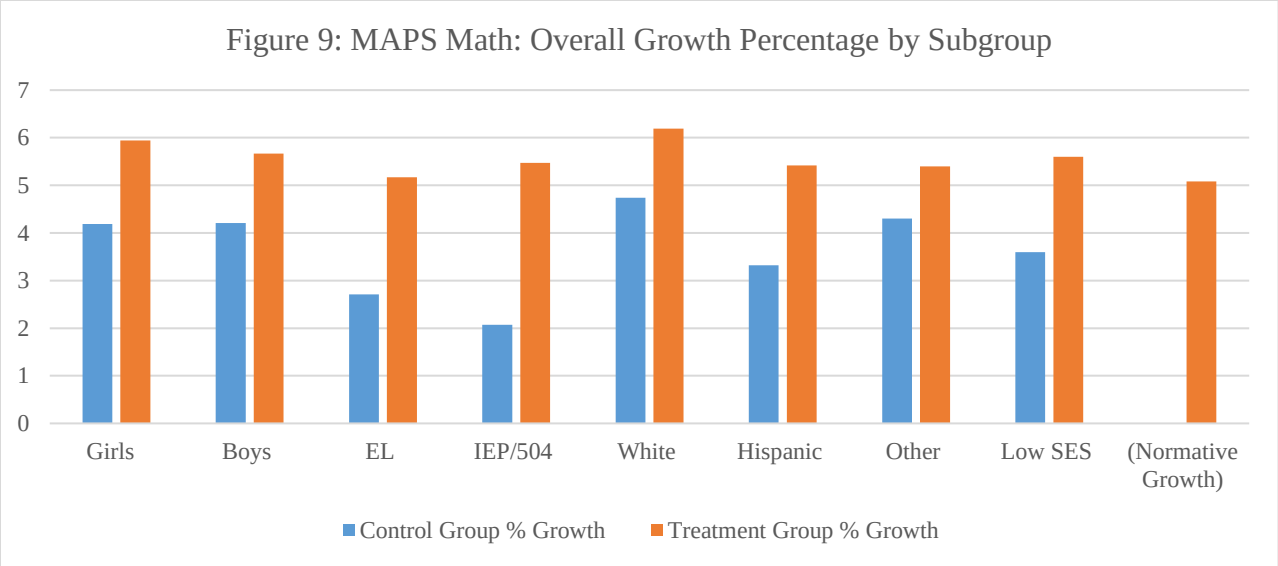
Figure 8: Percent of Students Meeting or Exceeding Projected Growth in MAPS Testing



	Language Usage	Math	General Science	Reading
Control Group ('15-'16)	58%	41%	38%	48%
Treatment Group ('16-'17)	68%	65%	59%	55%

A close analysis of subgroups within the treatment group (Figure 9) showed some very slight differences. White students grew at a slightly higher rate (+ 0.77%) than Hispanic students. This likely had much to do with the fact that English Learners make up 43.5% of the Hispanic subgroup. English Learners had the lowest growth rate (+ 5.17%) while still out-performing the normative growth.

Students on IEPs or 504s saw the most improvement compared to the control group. It also must be noted, however, that the treatment group had a different special education instructor than the control group.



Discussion

Overview of the Study

The purpose of the study was to determine if mandatory online Math IXL practice improved the growth rate on math MAP testing for the 5th grade class of 2016-2017 compared to previous growth rates of the 5th grade class of 2015-2016. To answer this question, the treatment group received an average of 7.6 minutes of online Math IXL practice per school day. In addition, this study attempted to determine if there is a positive correlation between growth on MAPS testing and the time spent on Math IXL per week by comparing growth rates to average time spent per day on Math IXL practice.

Summary of Findings

When comparing the growth rates between the control group and the treatment group, it is evident that the treatment group significantly out-performed the control group. While the effect size (+.09) was smaller than anticipated, it is reasonable to assume that if the average minutes of online practice were doubled, the effect size could have increased into the range (+.15

to +.20) seen in other blended learning studies (Cheung & Slavin, 2013; Slavin, et al., 2009). While a 1% to 2% increase in growth rate seems rather insignificant, the increase in the percentage of students who met or exceeded the expected normative growth rose dramatically in math where adaptive online practice was implemented.

The comparison between growth rates and time spent practicing did not produce any telling results likely due to the fact that the average time spent practicing was quite uniform throughout the entire grade. While it appears that the practice increased the growth rates, one would likely need to see a larger difference in time spent practicing in order to see a meaningful correlation between the time spent practicing and the increased growth rates.

Recommendations

Based on the results of the study, the researcher suggests that online math practice produced a positive result and should continue to be used as supplemental practice. The online practice had a measurable impact on all subgroups that were tested. This researcher believes that increasing the average daily practice from 7.6 minutes per day to 15 minutes per day would have an even greater impact on the growth of student math proficiency. In order to accomplish more online practice per day, it might be necessary to decrease the amount of paper and pencil homework given in the classroom. The benefit of more online practice is that it is adaptive so students who are struggling with a concept will receive more practice and students who are proficient will be able to move on to more difficult concepts. Another option for more online practice is to maximize extra online practice through existing incentive programs.

Limitations of the Study

The major limitation of this action research study is that the treatment group was a different group than the control group. While the instructor and the methods of instruction were the same in both years, there were variables that were uncontrollable. Classroom climate, pacing, and class size are all examples of small variations that could have had slight impacts on the growth rates of the two groups.

More research could be completed on future classes to see if an increase in online adaptive practice per school day results in a greater growth rate for students. More research could also be done to see if there is a correlation between the growth rate on language usage, math, general science, and reading and the group of students that is being tested.

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