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The Effects of IXL Practice on Geometry and Fraction Achievement

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Abstract

The purpose of this action research was to examine the effects of technology-based mathematics practice on student achievement in comparison to more traditional practice methods. The research took place in both a fourth-grade and a sixth-grade classroom in the same school. Technology-based practice was done using an iPad program called IXL and traditional practice was completed with paper and pencil on worksheets. Data was collected in the form of pretest and posttest scores, assignment completion rates, student behaviors, teacher reflections and student surveys. The data did not show any conclusive evidence that one practice method is better than the other. It is concluded that a combination of both practice methods may be most beneficial for student learning. After completing this research, a next possible step would be to further examine the influences on student learning based on grade level and mathematical concept when using technology and traditional practice methods.

Keywords: technology-based practice, iPad, mathematics, traditional practice

Educational technology is becoming a regular member of the public school classroom. More today than ever before, schools and districts are implementing technological devices that assist in teaching and learning. Laptops, computers, and smartphones fill the spots where notebooks and pencil boxes used to sit. New programs are replacing old curriculum materials. Large, bulky textbooks no longer fill classroom shelves as digital textbooks become more widely available. As access increases, today's students are more technologically literate than any other generation. Technology advancements give teachers opportunities to enrich their instruction in new ways. However, technology does not come without its challenges. One of those challenges is assessing the benefits and effectiveness of each technology-based program in comparison to more traditional techniques. Educators should ensure that their teaching methods are put in place only to benefit the students.

During the last three years, administration has increasingly endorsed the use of technology in our classrooms. From small group sets of computers to personal devices for students, there has been an increase in technology availability and therefore an increase in the expectation on classroom teachers in our district to use that technology. With the technology comes various software and applications that teachers may choose to use to enrich their instruction. In our experiences, some programs have appeared to be successful while others seem to cause distraction. In our district, student devices have a set of preinstalled applications. Teachers can also request for specific applications to be installed. One of the preinstalled applications is IXL. Students in our district, from kindergarten to twelfth grade, have paid accounts on IXL.

IXL is an adaptive learning program that our district uses to enrich student learning in both mathematics and reading. IXL offers educators a wide range of skills to choose from for students to practice. The mathematical skills on IXL are grouped by grade level as well as skill sets. When students begin practicing a skill, the problems are simple and presented a beginning level. As they proceed through the questions, they progressively get more difficult and require a higher level of thinking, skill mastery, and problem solving. This makes IXL an adaptive program that tailors to each student's progress. As students continue to practice the skills and achieve mastery, their score, known as the "SmartScore", climbs toward 100. Students receive instant feedback on each question, indicating if they have answered correctly or incorrectly. When students answer incorrectly, IXL provides an explanation of their errors and lowers their SmartScore. According to the IXL Help Center (n.d.),

> The SmartScore is based on IXL's proprietary algorithm and is the best possible measure of how well a student understands a skill … the SmartScore is not just based on the percentage of questions correct. It is calculated using many factors, including the number of questions completed, question difficulty, and consistency, and offers superior accuracy in assessing student achievement. (para. 1-2)

The district's purchase and suggested use of this program created inconsistency of practice techniques across our district. Some teachers use IXL to practice almost every skill while others don't use IXL in their classrooms at all. These inconsistencies raise the question of what is most valuable for increasing student learning. Our research looks at the effectiveness of IXL when compared to more traditional practice mediums, in order to determine the value of using IXL in our classrooms. Data for this research was collected in a fourth and sixth-grade mathematics classroom in a small, rural school in the Midwest area of the United States that houses pre-kindergarten through twelfth grade students in one building. The fourth-grade group included 42 students, 17 girls and 25 boys. Four fourth-grade students included in this study have

Individualized Education Plans (IEPs). The sixth-grade group also included 42 students, 23 girls and 19 boys. Four sixth-grade students included in this study have IEPs.

In order to collect data for our research, we split our classes into two separate groups. One group of students practiced skills using solely IXL for the first half of the unit, while the other group practiced skills using worksheets. Halfway through the unit, the groups switched their practice methods, in order to ensure equal opportunities to all students. Data collection occurred throughout the unit in both classrooms. Before beginning with instruction, students completed a pretest to show current understanding of concepts. After instruction and practice was complete, using both traditional and technology-based forms, students completed a posttest to show growth in conceptual understanding. This occurred twice within the unit, giving both groups the opportunity to achieve with traditional and technology-based forms of practice. In addition to these pre- and posttests, we also completed observation sheets, indicating how many students from each group were on task or off task. Assignment completion rates were also tracked as well as teacher comments about the effectiveness of the lesson. Finally, students submitted answers to a student feedback survey to share their ideas and opinions with us at the end of the action research.

The purpose of this study is to compare student achievement using traditional and technology based practice methods. The action research takes a look at student feedback, motivation, and engagement given by both IXL and paper based practice. Through the analysis of each of these important aspects of mathematics practice, the study is aiming to answer questions about the value of IXL in our district. To what extent will implementing a technology based practice program, IXL, improve student achievement in the 4th and 6th grades?

Review of Literature

Many schools across the Midwest have implemented technology into classrooms with goals of increasing student achievement. Otero et al. (2005) observed, "Current educational reform efforts in the United States are setting ambitious goals for schools, teachers, and students. Spanning across all of these goals is the recommendation that meaningful uses of technology be incorporated in all areas" (p. 8-9). With so many forms of technology, software programs, and methods of implementation to choose from, schools have big decisions to make when using technology and spending budgeted funds. This wave of technology brings a new generation of learners. Educators are being asked to reach these students through the use of digital devices. The International Society for Technology in Education (ISTE) (2016) recommends that students learn to be responsible digital citizens, successful computational thinkers, and global collaborators. However, the implementation of technology may raise the question of the effectiveness of digital practice mediums versus traditional mediums.

Both practice and drill can be used to ensure that students understand and have computational fluency. According to Morgan, Farkas, and Maczuga (2015), "The largest predicted effect for a specific instructional practice was for routine practice and drill" (p. 184). When teaching mathematics, practice, and then repeated practice, also known as drill, helps lead to mastery and fluency. The repetition creates opportunities for understanding, confidence, and fluency of mathematical concepts. Through repeated practice, students have the chance to ask questions, make connections and correct misconceptions, all aspects that lead to a greater understand of mathematics concepts (Morgan, Farkas, & Maczuga, 2015).

Many school districts are investing in technology and software programs that provide a medium for repeated practice to replace traditional practice methods (Lim et al., 2013). Kiger, Herro, and Prunty (2012) found that coupling ‘business as usual’ curriculum with a mobile device may be a cost-effective lever to improve student achievement” (p. 76). When digging deeper into understanding how technology builds higher student achievement, consideration must be given to many aspects of technology implementation. Four aspects with significant impact on the success of technology implementation include motivation, engagement, feedback, and individualization of the curriculum.

Motivation

Brophy (2004) defined motivation as “a theoretical concept used to explain the initiation, direction, intensity, persistence, and quality of behavior, especially goal-oriented behavior” (p. 3). Student motivation directly correlates with technology use in mathematics (Rush, 2012; Torff & Tirotta, 2010). As found by Rush (2012), “Technology is of high interest and the incorporation of technology in the classroom increases motivation” (p. 11). Students are often excited when technology is incorporated into daily lessons, and thrive when asked to show their knowledge with technology. Rush (2012) suggested that the excitement of incorporating technology leads to higher student motivation and task completion.

While many students find traditional practice methods, such as written pencil and paper worksheets, disheartening, technology often sparks student’s drive to practice concepts. In a 2015 study, Corbett recognized, “Technology has helped to motivate students who have historically struggled in the more traditional classroom setting” (p. 24). The U.S. Department of Education conducted studies and surveys on the subject of technology in the classroom, and found that the most common teacher-reported effect on students was an increase in motivation (U.S. Department of Education, 1995). Technology provides a new medium for students to practice the same skills that are motivating to today’s learners.

Along with this increase in student motivation using technology, there are also drawbacks to motivation that can be tied with technology. Although some students thrive with a new way to practice content, some students prefer the traditional practice methods. As highlighted by Kuiper and de Pater-Sneep (2014), “In the interviews, many students also mentioned they made less effort when working with the software, arguing that it was “less real” and less important than making sums in their exercise book” (p. 232). Providing students time to become comfortable with technology, and explaining the reasons for practice using technology could lead to higher student motivation.

Engagement

Attard (2013), stated “The concept of engagement can be characterised as the actions and behaviours that are the result of a student’s motivation. Engagement is linked to the individual’s relationship with school, curriculum, and pedagogy” (p. 570). Technology implementation during mathematical practice time in an elementary classroom helps increase student engagement. A study done by Franklin (2011) found, “Learning requires intellectual engagement and interaction with the context of the learning outcomes” (p. 264). With higher levels of student engagement come higher levels of task completion. Haydon et al. (2012) discovered that students who are engaged in the content complete more practice problems in an allotted time than they would when using paper practice, thus leading to higher levels of understanding and mastery. Carini (2006) identified that student engagement when completing a task is a predictor of learning and is positively linked to achieving learning outcomes. Haydon et al. (2012) investigated the effects of worksheets and iPads on the percentage of correct responses given by seven high school students on various mathematical problems such as coins, fractions, patterns and operations. The study also analyzed student engagement during mathematics class and took place in a high school classroom during mathematics instructional time. Haydon et al. (2012) found that students were able to answer more mathematics problems correctly in less time, demonstrating higher levels of engagement. The data collected by Haydon et al. (2010) in a study that analyzed the mean number of correct responses per minute, revealed that "...all iPad data points (100%) exceeded the highest worksheet data point across all phases of the study" (p. 239). Haydon's data revealed that student achievement increased with engagement when technology was implemented.

When given choice, some students will select technology as their engagement medium. Given a choice between an outdoor activity and screen time, many students may choose the screen time and focus so sharply on their device that everything around them becomes inconsequential. Teachers can use this student preferred engagement method to their advantage by using technology to engage students in academic activities. According to Attard (2013), "The incorporation of a wider variety of interactive, problem solving based websites, learning objects, and other mathematics software … may be of benefit and result in higher levels of engagement for these students" (p. 585). In comparison to traditional practice methods, today's digital devices have the potential to increase student engagement when practicing mathematical skills.

Technology can bridge the learning gap between boredom and engagement. Deris (2016) determined, "In order for students to be able to learn, they need to have attention to task or engagement with materials and with the teacher. A variety of digital technology has been used by teachers to increase engagement and student learning" (p. 21). When first introducing technology to students, engagement on tasks may improve. However, student engagement does not increase based on technology implementation alone. With repeated, long-term use of technology, student engagement may decrease. Students' attention spans may also suffer from the use of digital technology (Corbett, 2015). Within a study done by Common Sense Media (2012), teachers were asked if the use of entertainment media has hurt their students' academic performance. One elementary school teacher reported, "Attention spans seem to be decreasing, as does students' abilities to persist through difficult tasks" (Common Sense Media, 2012, p. 7). Increased engagement may be a temporary benefit of technology implementation.

Feedback

In an elementary classroom, feedback is regularly given to students as they complete and participate in classroom activities. Technology implementation allows teachers to provide good feedback. Goodwin and Miller (2012) identified three characteristics of good feedback as targeted, specific, and timely. Computers provide immediate feedback on correct responses and show students how to correctly answer questions so as a result, students are less likely to practice wrong skills. Haydon et al. (2012) affirmed that students tend to choose to engage in assigned work that results in the presentation of more immediate and higher rates of feedback.

An increase in targeted, specific and timely feedback for students can lead to higher student achievement. Goodwin and Miller (2012) found that "Feedback ranked among the highest of hundreds of education practices" (p. 82). Technology provides students with qualities of good feedback. Software programs allow students to know instantly if their problem is done correctly instead of waiting for a teacher to correct a traditional form of practice. Goodwin and Miller (2012) found that feedback provides support for increased engagement, motivation, and perseverance. Technology offers teachers a more productive road to targeted, specific and timely feedback.

While technology can assist teachers in giving feedback, sometimes feedback given by a software program may seem impersonal and unimportant to students. Hattie & Timperley (2007) determined that, “Simply providing more feedback is not the answer, because it is necessary to consider the nature of the feedback, the timing, and how a student ‘receives’ this feedback” (p. 101). Students need to learn how to process feedback given by technology successfully. Only reading the feedback will not be enough; students need to process how that feedback should change their understanding of a particular concept and what thinking errors that feedback identifies. Educators may want to teach students how to use feedback given by technology programs.

Individualization of Curriculum

Individualized learning is an important part of any classroom. Kaufman (2015) concluded, “Students have a better chance of experiencing academic success when they learn through multiple modalities throughout their educational career. This is because all students have different multiple-intelligences and acquire information uniquely” (p. 10-11). Kaufman’s research (2015) found that when catering to the unique needs of each student, there is an increased opportunity for student achievement.

Technology often provides an opportunity for a more individualized approach to instruction. The learning environments on the digital medium are convertible and are adaptable for each student. In a 2012 study, Duhon, House, and Stinnett identified, “Computers provide the unique advantage of delivering individualized instruction to a whole classroom of students” (p. 336). When electronic learning is individualized, students are completing practice that is leveled to their ability, giving them the capacity to progress academically. The differentiation offered in a digital learning environment is “tailored to the student’s unique learning path” (Kaufman, 2015, p. 35).

While some technology can provide abundant opportunities for individualization in the mathematics classroom, others do not. Kuiper and de Pater-Sneep (2014) established, “Many students’ arguments illustrate their need for more flexibility than most drill-and-software packages offer” (p. 232). Kuiper and de Pater-Sneep (2014) also determined technology needs to provide more than just a predetermined set of questions. It needs to adapt to student responses, changing in difficulty based on the learner’s needs. Perhaps IXL provides more flexibility in practice than previous drill software options. Technology that does not provide an opportunity for individualized instruction may not be the best choice to increase student achievement.

Discussion and Conclusion

Many factors lead to successful implementation of technology which may lead to higher student achievement in comparison to traditional practice in an elementary mathematics classroom. Specific devices and programs selected for use in the mathematics classroom can have a great impact the effectiveness of using technology in an academic setting. Motivation, engagement, feedback, and individualization are all aspects of technology that lead to increased student achievement (Franklin, 2011; Goodwin & Miller, 2012; Kaufman, 2015; Rush, 2012). Selecting a program that positively develops all of these aspects may lead to the greatest student achievement.

When implemented with motivation, engagement, feedback and individualization in mind, technology may have the potential to be more beneficial for student success than traditional practice methods. Student willingness to complete tasks, focus on tasks, and the reaction and results of attempted problems can all lead to increased student learning, and technology can provide a medium for all of these aspects to occur regularly in a classroom

(Corbett, 2015; Haydon et al. 2012). How technology is implemented, may influence its effect on student achievement. Technology needs to have a particular purpose, students need to be comfortable with the technology but not inundated with it, and students need to be methodically taught how to use the technology to change misconceptions (Hattie & Timperley, 2007).

Because of the recent trend of technology implementation, additional research may help educators determine the benefits of technology use on student achievement. Current research on this topic covers a variety of technological devices which are used in classrooms. Some research was carried out using mobile devices, such as iPads and tablets, while other studies were completed using laptop or desktop computers. Studies also discuss a variety of programs used for research. Only one article cited used the program IXL, while others used a variety of different programs.

The effectiveness of technology implementation depends on a variety of factors including device, software, and teacher experience. Additional research may help schools identify the efficiency of a particular program in a given setting. While there are many benefits to implementing technology in an elementary mathematics classroom, there are concerning factors that must be taken into consideration before allocating funds towards the purchase of classroom technologies and software (Kiger, Herro, & Prunty, 2012; International Society for Technology in Education, 2016). It is important for schools to determine if the benefit of traditional practice may still outweigh the cost of technology practice.

Before beginning our data collection, background research of literature indicated that educational technology can impact on student growth. The purpose of the action research was to determine what impact IXL has on student achievement when learning mathematics skills in an elementary classroom. More specifically, we looked at the benefits of technology-based practice methods in comparison to the benefits of traditional practice methods when fourth-grade students were learning about fractions and when sixth-grade students were learning about geometry.

Methodology

This study was a collaborative effort amongst two teachers to determine the impact of IXL practice on student achievement in an elementary mathematics classroom in comparison to more traditional methods of practice. To accomplish this, we, as action researchers, each studied the effects of IXL in our own classroom. We collected data from our own students and lessons, analyzed our own data, and then compiled our results to discover trends.

When idea for research had been established, we looked at our current curriculum plans to map our research with concepts that were already in our curriculum plan. Based on the time of year and topics that were to be covered, fourth-grade's topic of study was fraction and decimals. Sixth grade's unit of study was geometry. We continued to teach our students with no major changes to instructional strategies. When an appropriate time to practice a skill arose in our lessons, we matched an IXL topic with a paper and pencil practice worksheet. Students practicing concepts using technology were practicing the exact same skills as students practicing concepts with traditional pencil and paper. Within the study, students were able to practice using both methods at different times.

Before we began our research, all students were given an assent form (Appendix A) giving their parents and guardians an overview of the research that we were conducting in their child's classroom. If the parents did not want their child to be included in the data that we collected, they had the chance to opt out by signing the assent form and returning it to us. The form also provided contact information for our advisor and the Chair of the St. Catherine

University Institutional Review Board in case they had questions. We both explained the form to our students and told our classes about the research that we would be doing.

In the fourth grade, there are two mathematics classes of 22 and 20 students. All fourth-grade students participated in the lesson activities and data for all 42 students was included in our research. In the fourth grade, 25 students were boys and 17 students were girls. In the sixth grade, there are also two mathematics classes of 20 students and 23 students. All sixth-grade students participated in the lesson activities, however, one family signed an assent form to exclude their child's data from our research. Therefore, data was collected on 42 students in the sixth grade. In the sixth grade, 19 students were boys and 23 students were girls.

We began our research by administering pretests (Appendix B) in our own classrooms on the topics that were going to be covered in our mathematics classes for the following four weeks. Pretests for both the fourth and sixth-grade classes were given before any instruction was provided. The pretests were scored and recorded using the Pretest and Posttest Recording Chart (Appendix C). Instruction for the concepts that were on the first pretest was taught for approximately two weeks. During this time, our students were split into two separate groups. One group of students (Group A) practiced these concepts using the traditional paper and pencil practice method. The other group of students (Group B) practiced the same concepts using the digital mathematical tool, IXL. After two weeks of instruction and student practice, the first posttest was given (Appendix B). Those posttest scores were recorded on the Pretest and Posttest Recording Chart (Appendix C).

After completion of the first posttest, student groups then switched practice methods and then took pretests (Appendix B) on the content for the second half of the unit. During the second half of our research period, Group A practiced the concept using IXL, after instruction was given. At the same time, Group B used traditional paper and pencil practice methods. Upon completion of two weeks of instruction and practice, students completed the second posttest (Appendix B). The results were recorded in the Pretest and Posttest Recording Chart (Appendix C).

The grade 4 pretests and posttest for each half of the unit were the same test. The pretest and posttest for the first half of the unit consisted of ten open-ended questions. For the second half of the unit, the pretest and posttest consisted of five open-ended questions. The grade 6 pretests and posttests each asked 15 questions. The pretest and the posttest for each half of the unit were the same test. The questions asked on the grade 6 tests were all open-ended questions other than three multiple choice questions on the first pre/posttest.

Throughout the four weeks of instruction and practice, we observed students during work time. We identified on task and off task behaviors throughout these observations and noted any significant details about the practice being completed by students. Those observations were recorded on the Observation Tracking Sheet (Appendix D). To establish a consistent understanding of on task and off task behaviors, we identified some examples of each. The lists are not extensive, but give a baseline of student conduct for on task and off task behaviors. Off task behaviors include, but are not limited to: students talking with peers about other topics (not subject related), students away from their assignment (iPad or traditional), students focusing on objects other than their assignment, students refusing to work, and students selecting an answer at random. On task behaviors include, but are not limited to: students focused on current assignment, students talking with peers and adults for practice support or correction, students checking answers with peers and discussing differences, and students applying effort to successfully complete the assignment. Observation times within the fourth and sixth-grade classrooms varied from assignment to assignment. These observations only occurred in class periods where students were completing concept practice activities. Times and dates for those observations were based upon flow of curriculum and instruction.

In conjunction with the observations, we also completed teacher reflections (Appendix E) after each lesson and practice time. Lesson reflections included a detailed description of the practice being done by both group A and B. We also identified what went well for each group as well as any challenges based on student ability to independently practice the concepts. The last piece of the reflection were items to be changed for future lessons. Just like the observation forms, these reflections did not happen every class period. Any time we filled out an observation form, we also completed a reflection form.

As the students completed practice problems in their respective groups, we kept track of assignment completion rates for both group A and B. We noted how many students completed their work before class time was over. We then noted how many students finished the assignment outside of class time. Also, if any students completed the practice late, we kept track of that as well. This tracking form (Appendix F) gave us an overall picture of assignment completion rates for each group.

Our final piece of data collection occurred when all lessons and practice had been completed. At the conclusion of our research period, we had all students complete a student feedback survey (Appendix G). This survey, which was created using Google Forms, asked the students seven questions about their experiences practicing mathematical concepts with both IXL and the paper/pencil method. This was an opportunity for students to express their preferences, thoughts and opinions about each practice style.

After our research was complete, we gathered the data and compared the fourth-grade with the sixth grade. When looking at the combined data, we looked for trends across both grades in each of the data collection forms. We examined each data collection form independently as well as across multiple data collection forms to see if there were trends. As we discovered patterns and consistencies in the data, we had discussions that will continue to shape our instruction to better meet the needs of learners.

Analysis of Data

The purpose of our research was to examine the achievement made by students when using technology-based practice in comparison to paper and pencil practice methods. Five different data were collected: pretest and posttests, teacher observation of on task and off task behavior, assignment completion tracking, teacher reflections and student surveys.

Students completed pretests before instruction was given within the classroom. A pretest was given before the first half of the unit and the second half of the unit, matching the instructional concepts covered in the time frame, in both classrooms. The first fourth-grade pretest consisted of ten questions with a total of 21 possible points. Questions were a combination of fill in the blank, short answer, and placement of points on a line graph. Question 3 and 8 required more than one response from the student. Each student response was weighted the same, one point. The second fourth-grade pretest consisted of five questions with a total of five possible points. Each of the questions required one student response, each response was weighted one point. The first and second sixth-grade pretests each had 15 questions for a total of 30 points. Each question required students to compute the area, volume, or degree of angle based on images. The posttests were administered after each period of instruction and practice and were identical to the pretests. Figures 1 and 2 show the percentage of possible points earned by each group in fourth and sixth grades from the pretest to the post test.

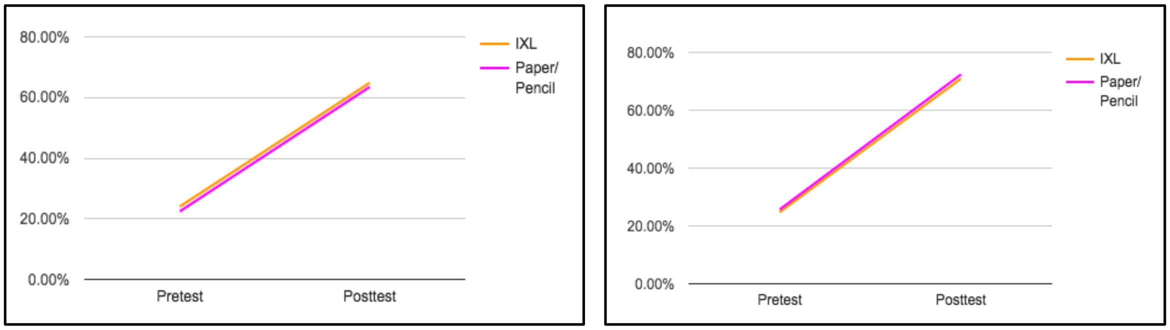
A  B

Figure 1. Fourth Graders' Achievement Score Differences for Fractions and Decimals. A) First Half of Unit and B) Second Half of Unit.

As shown in Figure 1, fourth grade student achievement using IXL was paralleled by the achievement using paper and pencil. Students in both groups demonstrated growth in in their scores, without indicating a single practice method was more beneficial. These results may be due to a variety of factors, including student age and mathematical concepts taught.

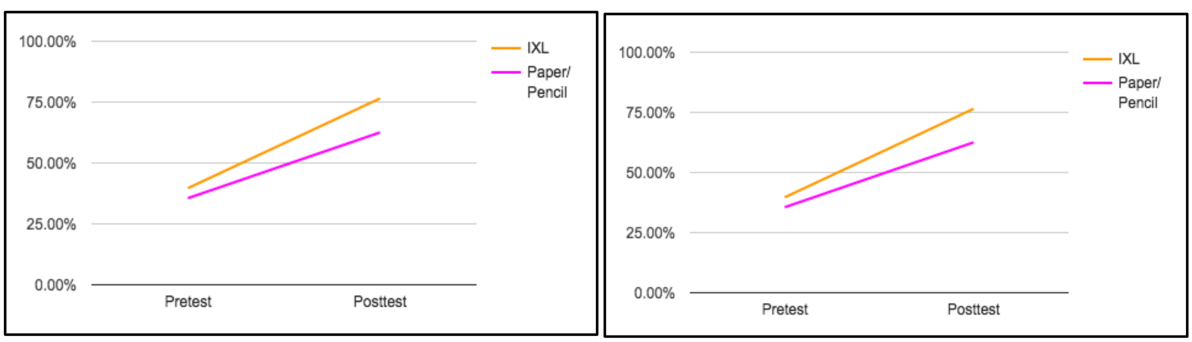
A  B

Figure 2. Sixth Graders' Achievement Score Differences for Geometry. A) First Half of Unit and B) Second Half of Unit.

Figure 2 shows that sixth grade students using IXL to practice geometry concepts demonstrated higher achievement levels than students practicing using paper and pencil. Both the first half of the unit and second half of the unit highlighted a higher achievement trend with IXL based practice. While students that used paper and pencil practice did make adequate growth, the growth rate using IXL practice showed a steeper rate of growth, indicating more concept mastery. In the first half of the unit, the fourth grade IXL group had a growth of 40.81%, while the paper and pencil group had a growth of 41.04%. These similar rates of growth suggest that students increased learning using both methods. At the same time, in the first half of the unit the sixth grade group using IXL had a growth of 36.83% while the paper and pencil group had a growth of 26.98%. The sixth grade students who were using IXL made more growth than the paper and pencil group. In the second half of the unit, the fourth grade students who were using IXL had a growth rate of 46.19%, while the paper and pencil group had a growth rate of 46.67%. Again, this suggests that both methods produced similar results for the fourth grade students. In the sixth grade during the second half of the unit, the group using IXL had a 49.52% growth rate while the paper and pencil group had a growth rate of 34.92%. Again, the sixth grade students made more growth when using IXL than paper and pencil.

As shown in Figures 1 and 2, overall student achievement increased. While the fourth-grade growth trends are very similar when comparing paper and pencil practice with technology-based practice, the sixth grade shows a different trend. Figure 2 shows the sixth-grade growth rate was accelerated for both groups when students using technology-based practice.

We then combined the possible points from students in the first half and second half that practiced with IXL. This process of combining possible points based on practice method was repeated for paper and pencil practice score. These results were then analyzed to see if there was an overall trend across the whole unit, based on practice method. When total earned points were combined we found the trends identified by examining each half of pretests and posttests continued when the data was combined. Figure 3A shows the whole unit comparison of IXL and paper and pencil practice for the fourth grade and Figure 3B shows the results of sixth grade.

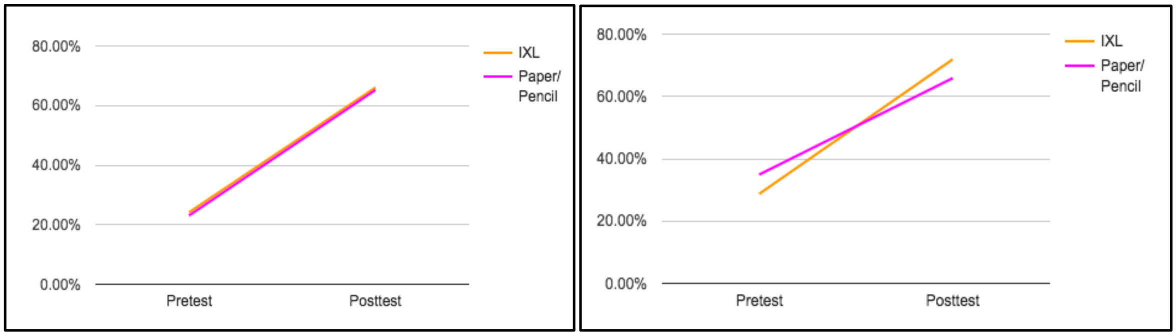
A  B

Figure 3. Student Score Growth. A) Fourth Graders' Growth and B) Sixth Graders' Growth.

As shown in Figure 3A, the growth of the fourth-grade IXL group paralleled the growth of the paper/pencil group. The results indicate that no one group made more growth than the other. However, as shown in Figure 3B, the sixth-grade IXL group did make more growth than the paper/pencil group. The steeper line on that chart shows that those students who practiced using IXL made more gains on their posttest than the other group. This was the most significant change in data that appeared from our research in terms of student achievement.

Throughout our data collection period, student behaviors during work time were observed and recorded. Both on task and off task behaviors were recorded. Figures 5 and 6 show the percentage of students who were on task or off task during work time.

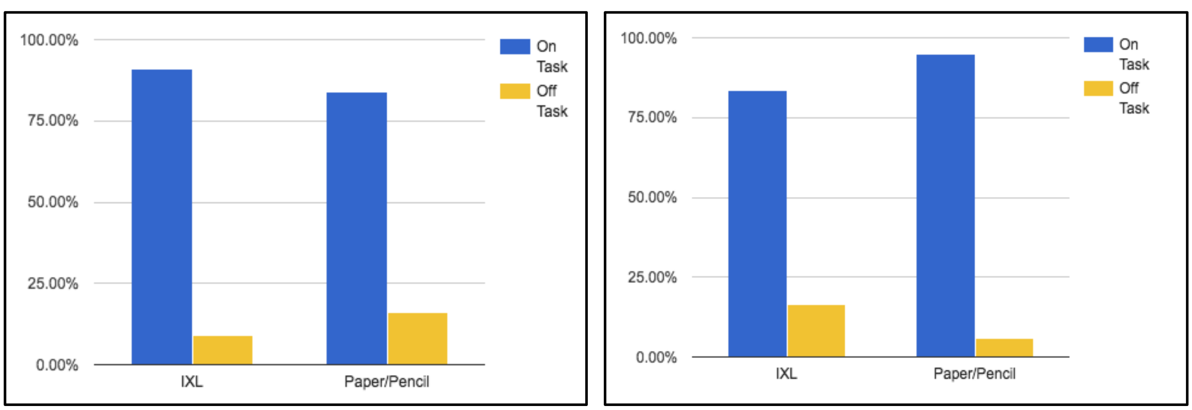
A  B

Figure 4. Student Behaviors A) Fourth Grader's Behaviors and B) Sixth Graders' Behaviors.

As seen in Figure 4A, the fourth-grade students displayed 7.14% more on task behaviors when working with IXL. In the sixth-grade classroom, 11.37% more students were on task when using traditional paper/pencil practice methods. These differences may be due to student age or student preference. In our school, we've noticed a general trend of student preference, younger students seem more motivated to practice using IXL. As students progress into the older grades, students voice more resistance to IXL. For example, when an IXL lesson is assigned, the older students will often voice complaints about having to use this practice method, while the fourth-grade students voice excitement. These preferences could be the reason for the difference in on and off task behavior results.

Another data collection process that was used in our action research was the tracking of assignment completion for both groups. Figure 5 shows what percentage of students completed their practice assignments during class, outside of class, late, or not at all.

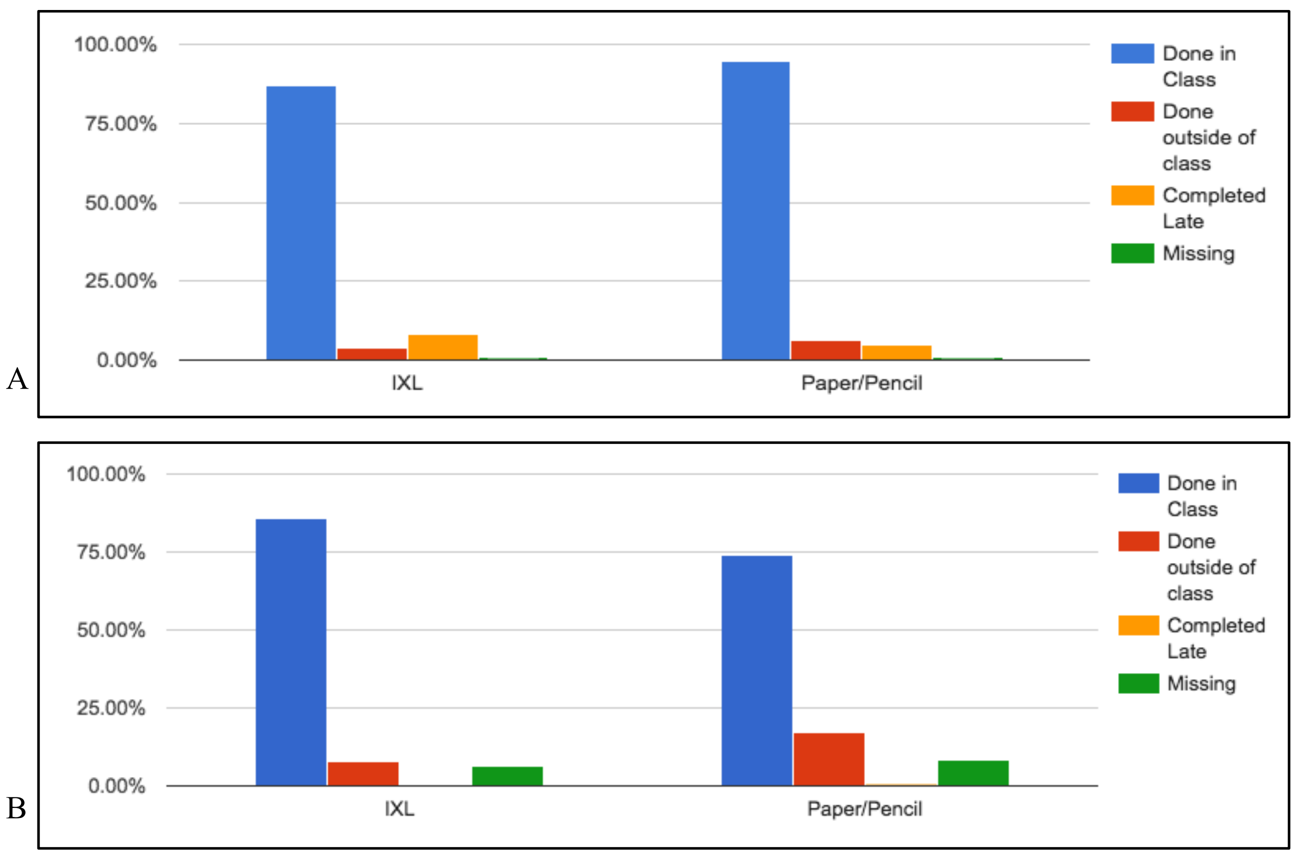


Figure 5. Student Assignment Completion. A) Fourth Graders' Assignment Completion and B) Sixth Graders' Assignment Completion.

In the fourth grade, paper and pencil assignments had a higher completion rate than IXL. The opposite was true in the sixth grade where more IXL assignments were completed than paper/pencil assignments. However, in both grades, more paper/pencil assignments were completed outside of the class as homework. In the fourth grade, all assignments were completed, either during class time or outside of class. Sixth grade students were missing 6.55% of IXL assignments and 8.33% of paper and pencil assignments. This suggests that fourth grade students were willing to use time outside of school to complete their assignments.

As a part of our data collection, we also did teacher reflections during any mathematics lessons where practice was assigned. A trend that we both noticed in our IXL practice is that the practice lessons did not match exactly the Minnesota standard/concept that we were teaching. In one example, a fourth-grade standard states that students should be able to round decimals to the nearest tenth. The IXL lesson that matches with this concept is titled, “Round Decimals.” In this IXL lesson, students are asked to round decimals to the nearest whole number, tenth, and hundredth, skills that are not required by the Minnesota State Standards for a fourth-grade student. While this IXL did have students practice the concept they were learning, it also created some confusion because students were asked to extend their understanding.

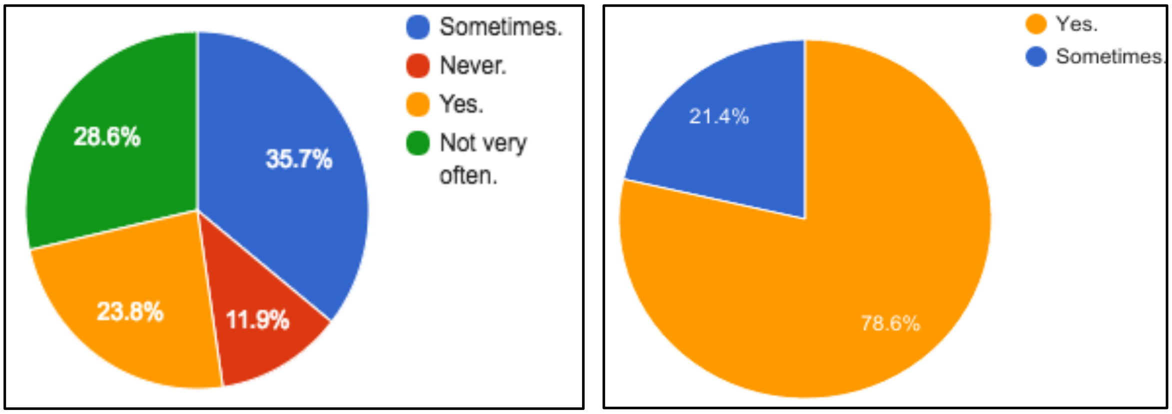
Another teacher reflection noted was that when sixth-grade students were studying the area of polygons and the volume of prisms, it was difficult to match up the IXL practice assignment with what was taught on any particular day because of the way they grouped together the shapes. For example, there is an IXL lesson on the area of trapezoids and parallelograms, but there are not individual lessons on each of those shapes. In comparison, the teacher could create a paper/pencil practice assignment that covered exactly the concepts taught in class that day.

This happened a few different times throughout the unit, making it difficult to present the IXL group with appropriate practice problems.

Also mentioned in the teacher reflections was IXL does not provide the teacher with example questions from each lesson. Therefore, it is hard to know how far into the IXL lesson that the questions will become too difficult for the students. On some IXL assignments, the teacher asked the students to reach a certain SmartScore and then later had to adjust that number to a more reasonable and achievable level. In our teacher reflections, we noted that we would change or adjust SmartScore expectations before teaching the lesson again.

The final piece of data that was collected were student surveys. Students were asked seven questions that had them reflect on their practice experiences with IXL, and paper and pencil methods. Students were asked their opinions on which method seemed faster, was preferred, helped them understand the concepts, made it easiest to focus on practicing, and if they reviewed the feedback given by each method.

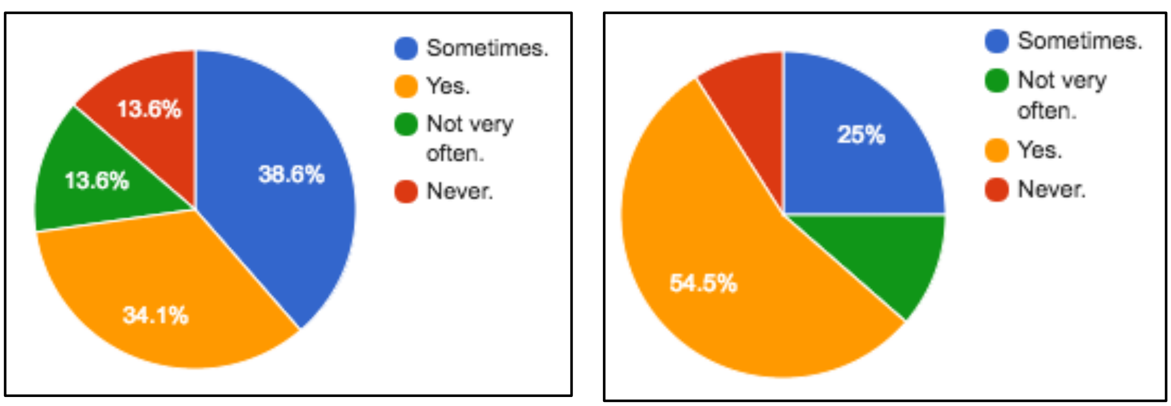
Figure 6 indicates fourth-grade students' opinions about the feedback given from both IXL and teacher comments. The results show that the fourth-grade students seem to review their feedback more often when given by the teacher in comparison to the IXL feedback. When the students were asked if they looked at the suggestions given by IXL, 40.5% of the fourth-grade students responded with "never" or "not very often" indicating they do not review IXL feedback. Those two responses were not selected by a single fourth-grade student when reflecting upon teacher feedback, meaning that all fourth-grade students read teacher feedback.



A B

Figure 6. Fourth Grade Feedback A) I take time to read the suggestions made by IXL and B) I look at my score, mistakes, and comments made by my teacher on paper assignments.

Sixth-grade student responses, as shown in Figure 7, indicates students still value teacher feedback made on paper and pencil assignments. In addition, 72.7% of grade 6 students take time to review IXL feedback at least some of the time, which is only slightly lower than those who take time to review teacher comments given on paper assignments. 13.6% of grade 6 students admit to not reviewing IXL feedback very often and another 13.6% say they never review IXL feedback. 9.1% of sixth grade students say they never look at teacher feedback. This result suggests that sixth grade students ignore feedback on IXL more often than on paper and pencil assignments with teacher feedback.



A B

Figure 7. Sixth Grade Feedback A) I take time to read the suggestions made by IXL and B) I look at my score, mistakes, and comments made by my teacher on paper assignments.

Figure 8 shows grade 4 students' responses sharing their opinions on practice methods on IXL and paper. While more fourth grade students always like to practice on IXL, all students like practicing on paper sometimes or all of the time. 4.7% of students never like to practice on IXL. These results suggest that grade 4 students prefer a combination of practice methods.

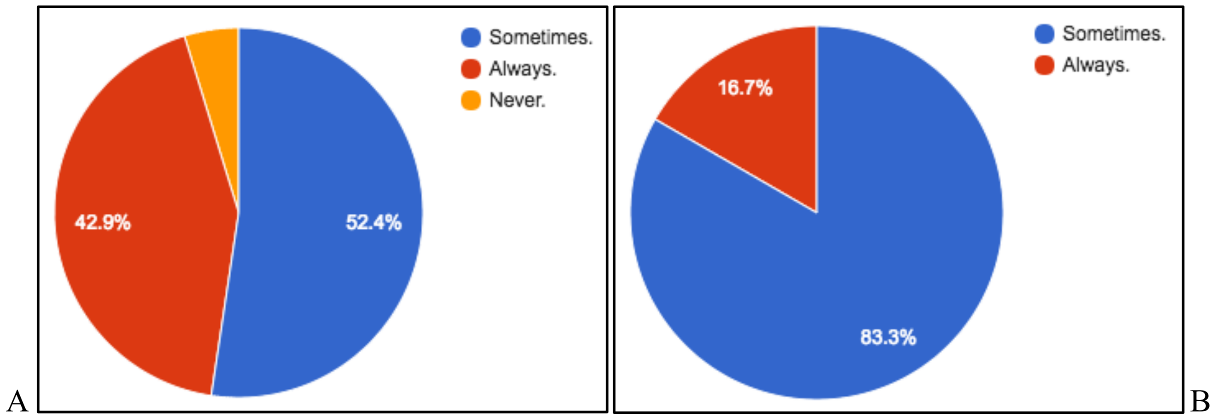
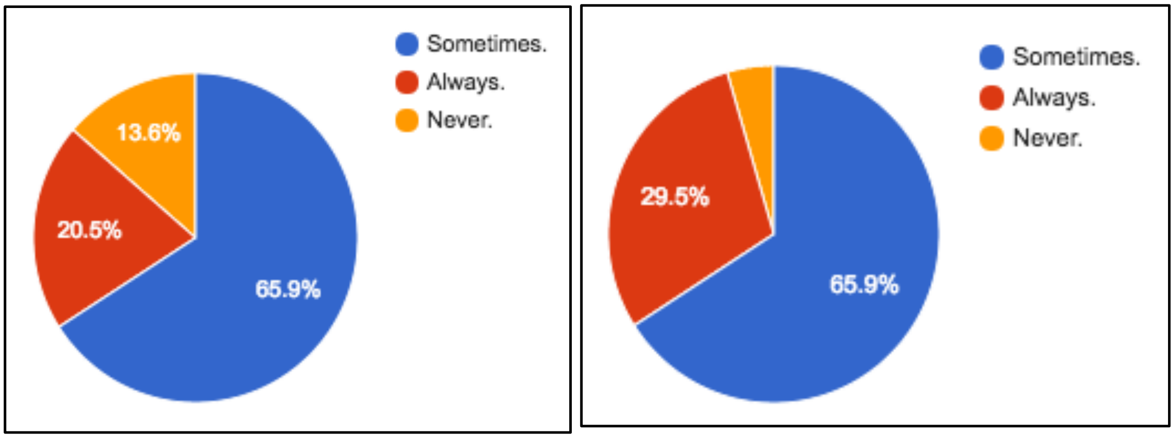


Figure 8. Fourth Grade Opinion A) I like practicing math on IXL and B) I like practicing math on paper.

When grade 6 students were asked if they like practicing mathematics on IXL or on paper, 65.9% of students responded with "sometimes" to both, as seen in Figure 9. This indicates that there are no large gaps in preferences between the two practice methods. However, the percent of students who said that they "never" like practicing mathematics on IXL was larger than the percent of students who said they "never" like practicing mathematics on paper by about 10%. This result suggests that sixth grade students slightly prefer paper and pencil practice over IXL practice.

A 

B

Figure 9. Sixth Grade Opinion A) I like practicing math on IXL and B) I like practicing math on paper.

After looking at data across both groups and grades, some interesting points were highlighted. Practice methods seem to impact sixth grade students more than fourth grade students, although this trend may be due to the mathematical concept, student age or teacher instruction practices. Students' preferences for practice mediums change as they move into higher grades. In the next section, we will discuss how analyzing this data helps us continue to improve instruction in our own classroom and create professional dialog with our colleagues.

Action Plan

The purpose of this study was to determine if technology-based practice is more beneficial to student learning than paper and pencil practice in an elementary mathematics classroom. The information we found through our literature review, as well as our teaching experiences, indicated that technology has the potential to increase student engagement, motivation, personalized learning opportunities, and feedback. We were expecting to see these ideas show up as trends in our data.

Through our data analysis, it is clear that almost all students made adequate gains from pretest to posttest. We were pleased to see that most of the students were showing growth on the concepts taught. However, looking closer at IXL practice versus paper/pencil practice, our data did not show any conclusive evidence of student growth for one practice method. Although pretest and posttest results did not create the strong trends that we had anticipated, they did show some trends in the sixth grade indicating that the IXL practice was more beneficial for student learning. These trends were not matched in the fourth grade which leads us to ideas for further research, such as differences in growth based on age, mathematical concepts, and duration of study. Because the change in growth in the sixth grade was not particularly significant, we concluded that a combination of the two practice methods is most beneficial for student learning.

Knowing one method does not create a higher rate of student growth, we will continue to use a blend of practice activities for our students. As we continue teaching, we will continue to identify technology based lessons that increase student achievement and modify those that don't. Based on the differences in student opinions, it could be beneficial in the future to provide students the choice of practice methods. In both classrooms, students expressed excitement and apprehension for both approaches. Not surprisingly, there was not one way that all students preferred. Finding a balance of the two practice methods seems to be the best option to keep students engaged and motivated. In terms of assignment feedback, both the fourth and sixth grade student surveys revealed that more students pay attention to feedback when teachers write it on paper/pencil assignment versus IXL feedback. That indicates that digital suggestions on how to improve at a concept may not be the best method of providing feedback to students.

When lesson planning for mathematics units, we will ensure that we are providing opportunities for students to practice skills using both methods. When using the guided mathematics approach in our classrooms, we have students rotating through stations that involve multiple practice methods. For example, we might schedule three different activities for one class period: small group practice with the teacher, independent practice, and a game practicing mathematical skills. One activity may include paper and pencil practice, while another station on the same day would ask students to practice the same concept on IXL. This use of both methods seems to match our research results, where we expose students to a variety of practice opportunities. Our research reinforces this teaching approach as an efficient way of using district resources.

One of the reasons we were intrigued by this topic was wondering if our district was using funds wisely for this purchased practice program. Our research suggests that IXL is beneficial to students. By purchasing this program for students, they are given another medium to practice skills. As we continue to use this program, we will work to teach our students to use the feedback provided by IXL. Students reported not reviewing or seldom reviewing the feedback given by IXL, while students considered feedback given from the teacher more often. If students valued the feedback provided by IXL like they valued teacher feedback, they might learn to examine their mistakes and build greater conceptual understanding. Our recommendation would be to continue to use IXL as an option for supplemental skill practice.

After drawing conclusions from this research, it became evident that further research would need to be done to find more specific or universal trends. The impacts of the grade level of students should be looked at to see if different ages excelled more with one practice method than the other. While all research participants had previous experience with IXL, our data showed slightly higher growth in the sixth-grade IXL group than the paper/pencil group whereas the fourth-grade IXL group did not make any more gains than the paper/pencil group. This conclusion opens the door to further research that takes a closer look at grade level and grade level as it pertains to the development of the student.

In addition to grade level, it would be interesting to take a look at the specific concepts being taught. For example, perhaps IXL is more useful when teaching geometry than it is when teaching fractions and decimals. It is unknown whether the fourth-grade IXL group would have also made more significant growth if they had been studying geometry similarly to the sixth grade. Other areas of mathematics, such as algebra, statistics, and fact fluency, could also be researched to see if different rates of growth occur. It is also important to note that each group practiced different topics within the unit in the two halves of the study, creating some limitations to our results. Students using IXL in the first half of the study, were practicing skills different than those using IXL in the second half of the study. While the general unit was the same, for example geometry, the students in the first half practiced area and the students in the second half practiced volume. These differences in skills must be considered when comparing student growth. Additionally, the pretest and posttest for the fourth grade students did not contain the same number of questions, which may lead to a sway in our data. Also, due to the nature of the content on the pretests and posttests, the sixth grade test was worth more points than the fourth grade test, again creating inconsistencies in the data.

Our research was implemented with the use of iPads. Another possible area for further research would be taking a look at the use of different devices. If students use laptops instead of iPads to practice, does that affect their growth? Continued research could be done examining the effect of various devices on student learning.

Another aspect of our research to consider in our conclusion is that this action research did not isolate one variable. IXL provides a technology platform, immediate feedback, an opportunity to make corrections, and individualized learning through the automatic adjustment of question difficulty. Our research did not address which aspect of technology-based practice has the strongest effect on growth. Future research could examine these variables individually to see if one is significantly more influential on student learning. Additionally, our research was conducted using one technology based practice program. Other mathematical practice programs are available free of charge as well as for purchase. Further research could be done comparing the effect each program has on student growth.

The overall experience of implementing technology-based and traditional practice methods was eye opening. The experience provided data that confirmed a balanced approach to teaching benefits students. As there continue to be advancements in educational technology, it would be a valuable use of district funds to keep investing in these programs and devices as well as to continue researching their efficacy in the classroom. However, our results suggest that using technology-based practice methods solely is not the most practical approach to teaching mathematics in an elementary classroom. As technology continues to progress, it needs to be moderately integrated into the elementary mathematics classroom, blending traditional practice methods with technology to meet the needs of students.

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Appendix A
Assent Forms

The Effects of IXL Technological Practice on Elementary Students' Algebra and Fraction Understanding

Assent Form

January 9, 2017

Dear Parents/Guardians,

In addition to being your child's fourth-grade mathematics and science teacher, I am a St. Catherine University (St. Kate's) student pursuing a Masters of Education. As a capstone to my program, I need to complete an Action Research project. For my project I will be studying the impact of digital practice on student achievement using an iPad program called IXL. IXL is an individualized program in which teachers can assign specific skills and the program will adapt math questions to each student's ability level. Digital mathematics practice is an alternative to traditional paper and pencil practice. This study will determine the effectiveness of IXL in my classroom.

In the coming weeks, I will continue to teach math lessons as expected, but I will be adding in opportunities to practice skills using both IXL and paper/pencil. These activities will be a regular part of my math class periods, and therefore all students will participate as members of the class. In order to understand the outcomes, I plan to analyze the results of both practice methods to determine the effectiveness of each in comparison to one another.

The purpose of this letter is to notify you of this research and to allow you the opportunity to exclude your child's data (pre- and post-assessments, assignment completion rates, teacher observations, and student feedback) from my study.

> **If you decide you want your child's data to be in my study,** you don't need to do anything at this point.
>
> **If you decide you do NOT want your child's data included in my study,** please note that on this form below and return it by January 17, 2017. Note that your child will still participate in the IXL practice but his/her data will not be included in my analysis.

In order to help you make an informed decision, please note the following:

- I am working with a faculty member at St. Kate's and an advisor to complete this particular project.
- This study will benefit teachers and students by guiding instruction in the math classroom based on what is effective and what is not effective. The results of the study will ensure that the practice methods used in my classroom are beneficial to the students.
- I will be writing about the results that I get from this research. However, none of the writing that I do will include the name of this school, the names of any students, or any references that would make it possible to identify outcomes connected to a particular student. Other people will not know if your child is in my study.
- The final report of my study will be electronically available online at the St. Kate's library. The goal of sharing my research study is to help other teachers who are also trying to improve their teaching.

- There is no penalty for not having your child's data involved in the study, I will simply delete his or her responses from my data set.

If you have any questions, please feel free to contact me at ahudspith@isd2142.k12.mn.us or at (218) 345-6789. You may ask questions now, or if you have any questions later, you can ask me, or my advisor Dr. Yasemin Gunpinar at 651-690-6313 who will be happy to answer them. If you have questions or concerns regarding the study, and would like to talk to someone other than the researcher, you may also contact Dr. John Schmitt, Chair of the St. Catherine University Institutional Review Board, at (651) 690-7739.

You may keep this form for your records. If you would like to opt out of the study, please return the form on the following page.

Amy Hudspith Date

OPT OUT: Parents, in order to exclude your child's data from the study, please sign this form and return it to school by January 17, 2017.

I do NOT want my child's data to be included in this study.

____
Student's Name

______________________________ ________________
Signature of Parent Date

If you are unsure or have any questions or concerns, please contact me at ahudspith@isd2142.k12.mn.us or (218)345-6789 ext. 3116.

The Effects of IXL Technological Practice on Elementary Students' Algebra and Fraction Understanding

Assent Form

January 23, 2017

Dear Parents/Guardians,

In addition to being your child's sixth-grade mathematics and science teacher, I am a St. Catherine University (St. Kate's) student pursuing a Masters of Education. As a capstone to my program, I need to complete an Action Research project. For my project I will be studying the impact of digital practice on student achievement using an iPad program called IXL. IXL is an individualized program in which teachers can assign specific skills and the program will adapt math questions to each student's ability level. Digital mathematics practice is an alternative to traditional paper and pencil practice. This study will determine the effectiveness of IXL in my classroom.

In the coming weeks, I will continue to teach math lessons as expected, but I will be adding in opportunities to practice skills using both IXL and paper/pencil. These activities will be a regular part of my math class periods, and therefore all students will participate as members of the class. In order to understand the outcomes, I plan to analyze the results of both practice methods to determine the effectiveness of each in comparison to one another.

The purpose of this letter is to notify you of this research and to allow you the opportunity to exclude your child's data (pre- and post-assessments, assignment completion rates, teacher observations, and student feedback) from my study.

> **If you decide you want your child's data to be in my study,** you don't need to do anything at this point.
>
> **If you decide you do NOT want your child's data included in my study,** please note that on this form below and return it by January 27, 2017. Note that your child will still participate in the math lessons and practice activities, but his/her data will not be included in my analysis.

In order to help you make an informed decision, please note the following:

- I am working with a faculty member at St. Kate's and an advisor to complete this particular project.
- This study will benefit teachers and students by guiding instruction in the math classroom based on what is effective and what is not effective. The results of the study will ensure that the practice methods used in my classroom are beneficial to the students.
- I will be writing about the results that I get from this research. However, none of the writing that I do will include the name of this school, the names of any students, or any references that would make it possible to identify outcomes connected to a particular student. Other people will not know if your child is in my study.
- The final report of my study will be electronically available online at the St. Kate's library. The goal of sharing my research study is to help other teachers who are also trying to improve their teaching.
- There is no penalty for not having your child's data involved in the study, I will simply delete his or her responses from my data set.

If you have any questions, please feel free to contact me at awood@isd2142.k12.mn.us or at (218) 345-6789. You may ask questions now, or if you have any questions later, you can ask me, or my advisor Dr. Yasemin Gunpinar at 651-690-6313 who will be happy to answer them. If you have questions or concerns regarding the study, and would like to talk to someone other than the researcher, you may also contact Dr. John Schmitt, Chair of the St. Catherine University Institutional Review Board, at (651) 690-7739.

You may keep this form for your records. If you would like to opt out of the study, please return the form on the following page.

Amanda Wood 1/23/17

OPT OUT: Parents, in order to exclude your child's data from the study, please sign this form and return it to school by January 27, 2017.

I do NOT want my child's data to be included in this study.

____
Student's Name

______________________________ ________________
Signature of Parent Date

If you are unsure or have any questions or concerns, please contact me at awood@isd2142.k12.mn.us or (218)345-6789 ext. 3125.

Appendix B
Pretests and Posttests

Fourth grade pre/posttest 1:

Unit 7
Quick Quiz 1

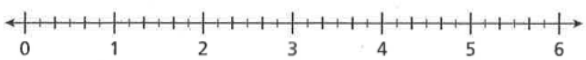
Name ______________________ Date __________

Write >, <, or = to make the statement true.

1. $\frac{5}{8}$ ◯ $\frac{10}{16}$

2. $\frac{3}{5}$ ◯ $\frac{4}{10}$

3. Label the point for each fraction or mixed number with the corresponding letter.



a. $3\frac{1}{2}$ b. $2\frac{1}{3}$ c. $\frac{2}{3}$ d. $5\frac{5}{6}$ e. $1\frac{1}{6}$

Which fraction or mixed number is closest to 1?

____

Solve. *Show your work.*

4. Cory ships two paperback books. One weighs $\frac{3}{8}$ pound and the other weighs $\frac{3}{4}$ pound. Which weight is greater than $\frac{1}{2}$ pound?

____

5. A farmer has 8 horses and 12 cows. He put $\frac{1}{4}$ of the horses in the barn and $\frac{1}{4}$ of the cows in the barn. Did he put more horses or cows in the barn? Explain.

____

____

Unit 7
Quick Quiz 2

Name ______________________ **Date** ______________

Write the correct answer.

1. Write 5 fractions that are equivalent to $\frac{1}{4}$.

____

Simplify the fraction.

2. $\frac{40}{100} =$ _____

3. Use the fraction strips to compare the fractions $\frac{5}{8}$ and $\frac{7}{12}$. Write a true statement using one of the symbols >, <, or =.

$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$

$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{12}$

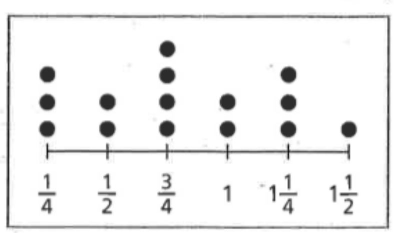
____

4. Ethan plans for $\frac{3}{10}$ of the plants in his garden to be tomatoes. He wants $\frac{2}{5}$ of the plants to be peppers. Will Ethan plant more tomato plants or pepper plants?

Show your work.

____

5. The line plot shows the numbers of cups of cornmeal used in different cornbread recipes.



Cups of Cornmeal

How much less cornmeal is in a recipe with the least cornmeal than in a recipe with the most cornmeal?

____

Fourth grade pre/posttest 2:

Unit 7
Quick Quiz 3

Name ______________________ Date __________

Write the correct answer.

1. Mark has 100 marbles. Eight are bumblebee marbles. What decimal number shows the fraction of marbles that are bumblebees?

____

2. An insect egg can be as small as two hundredths of a millimeter long. What is this number written as a decimal?

____

3. On a tree farm, 0.28 of the trees are oak. Write this decimal as a fraction.

____

4. James ran a race in 2.2 hours. Casey ran the same race in 2.25 hours. Who took less time to run the race?

____

5. Traci rode her mountain bike $2\frac{4}{5}$ miles on Monday. She rode $2\frac{7}{10}$ miles on Tuesday. On which day did she ride a longer distance?
Write the comparison using $>$, $<$, or $=$.

____

Sixth grade pre/posttest 1:

Name: ______________________ Score: /15

Geometry Pre/Post Test #1 (Weeks 1 and 2)

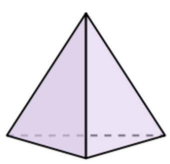
Determine which choice BEST describes the shape shown. Write A, B, C or D on the line.

1.

A. Cone
B. Rectangular Pyramid
C. Triangular Pyramid
D. Cube

1. ________________

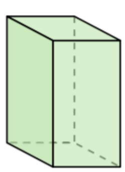
2.



A. Triangular Prism
B. Cone
C. Triangular Pyramid
D. Sphere

2. ________________

3.

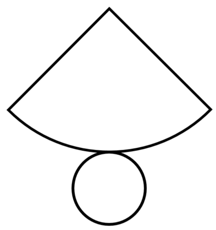


A. Cone
B. Rectangular Prism
C. Triangular Pyramid
D. Rectangular Pyramid

3. ________________

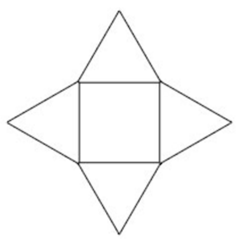
Write the name of the figure that the following nets form.

4.



4. ________________

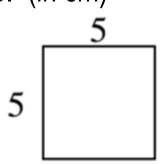
5.



5. ________________

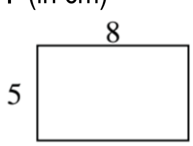
Find the area of the quadrilaterals. Label your answers.

6. (in cm)



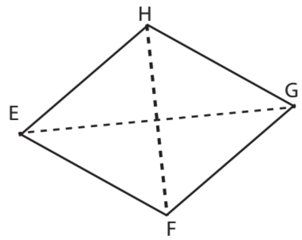
6. ________________

7. (in cm)



7. ________________

8.

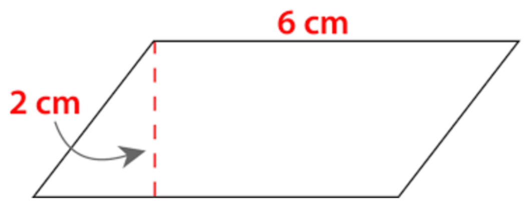


$\overline{EG}$ = 25 m

$\overline{FH}$ = 19 m

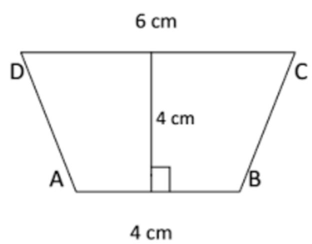
8. ________________

9.



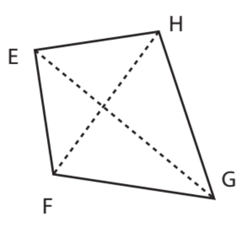
9. ________________

10.



10. ________________

11.



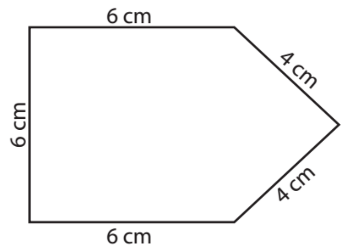
$\overline{EG}$ = 10 m

$\overline{FH}$ = 9 m

11. ________________

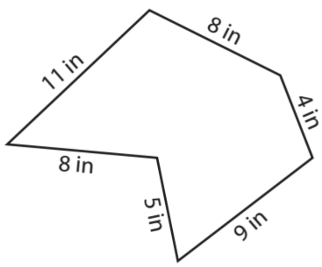
Find the perimeter of each shape. Label your answers.

12.



12. ________________

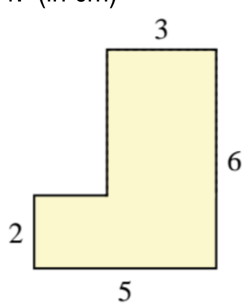
13.



13. ________________

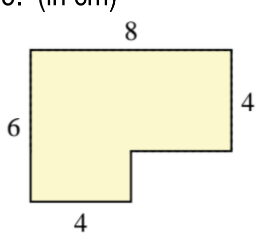
Find the area of each shape. Label your answers.

14. (in cm)



14. ________________

15. (in cm)



15. ________________

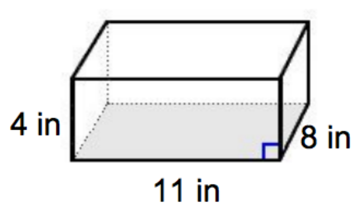
Sixth grade pre/posttest 2:

Name: ______________________ Score: /15

Geometry Pre/Post Test #2 (Weeks 3 and 4)

Find the surface area of the rectangular prism. Label your answer.

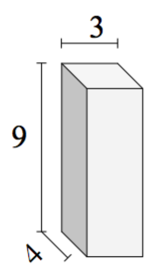
1.



1. ________________

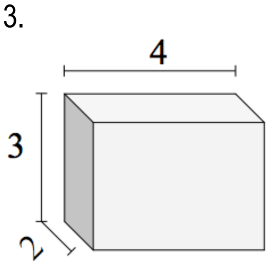
Find the volume of each of the rectangular prisms, measured in centimeters.

2.



2. ________________

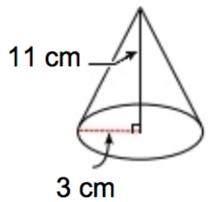
3.



3. ________________

Find the volume of the figure. Label your answer.

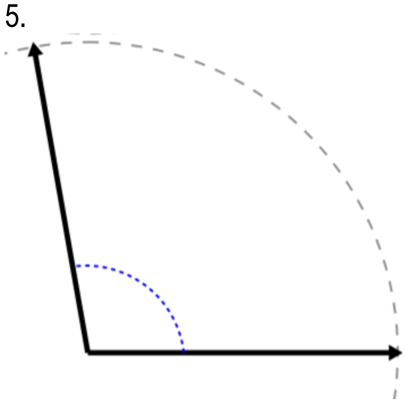
4.



4. ________________

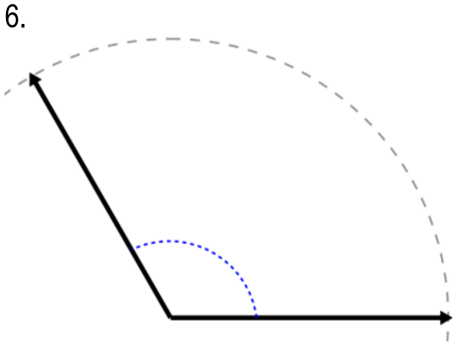
Use a protractor to find the angle shown.

5.



5. ________________

6.



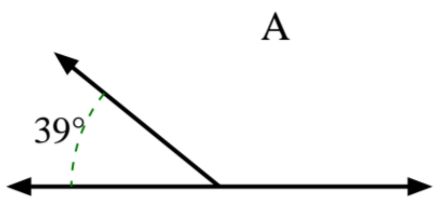
6. ________________

Use a protractor to draw the following angles.

7. 47 degrees

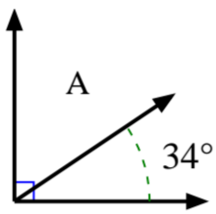
8. 95 degrees

9. Find the value of angle A.



9. _______________

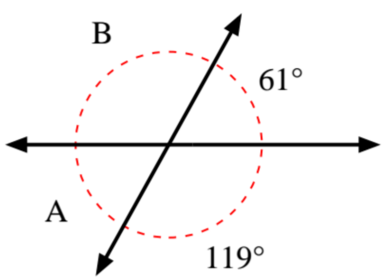
10. Find the value of angle A.



10. _______________

11. Find the measure of angle A below. 11. _______________

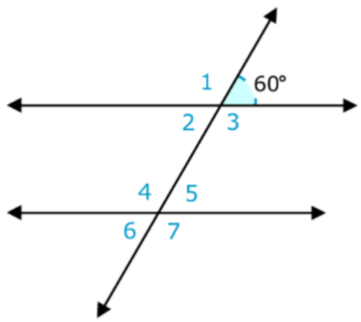
12. Find the measure of angle B below. 12. _______________



13. Find the measure of angle 1 below. 13. ________________

14. Find the measure of angle 5 below. 14. ________________

15. Find the measure of angle 4 below. 15. ________________



Appendix C

Pretest and Posttest Recording Chart:

Student Number:	Pretest 1 Score:	Posttest 1 Score:	Pretest 2 Score:	Posttest 2 Score:

Appendix D
Teacher Observations

Observation Tracking Sheet

Off task behaviors include, but are not limited to: students talking with peers about other topics (not subject related), students away from their assignment (iPad or traditional), students focusing on objects other than their assignment, students refusing to work, students guessing at answers.
On task behaviors include, but are not limited to: students focused on current assignment, students talking with peers and adults for support or correction, students checking answers with peers and discussing differences, students applying effort to successfully complete the assignment.

Observer:			Observer:	
Date:			Date:	
Class:			Class:	
Time of observation:			Time of observation:	
Total students being observed:			Total students being observed:	
Number of students on task:			Number of students on task:	
Special notes:			Special notes:	
Skills practiced:			Skills practiced:	

Appendix E
Teacher Reflection

Teacher Reflection Journal

Date:	
Description of IXL practice work assigned today:	
Description of paper/pencil practice work assigned today:	
Did the students do well with the IXL?	
Did the students do well with the paper/pencil?	
What success were there today?	
What challenges were there today?	
What should be changed for next time?	
Other comments:	

Appendix F
Assignment Tracking

Assignment Completion Tracking Sheet

Assignment Name:	Number completed in class:	Number completed after additional time out of class:	Number completed late:	Number not completed:

Appendix G
Student Feedback Survey

IXL Student Feedback

Students: Please complete the following questions by giving honest answers.

* Required

I like practicing math on paper. *

- Always.
- Sometimes.
- Never.

I like practicing math on IXL. *

- Always.
- Sometimes.
- Never.

I can complete assignments faster with IXL than on a worksheet. *

- IXL is always faster for me.
- Most of the time IXL is faster for me.
- It takes the same time for both
- Most of the time IXL is slower for me.
- IXL is always slower for me.

I learn a concept better by practicing on... *

- Only IXL.
- A mix of practice sheets and IXL.
- Only practice sheets.

I can focus on an assignment better when it's on... *

- IXL
- Paper

I take time to read the suggestions made by IXL. *

- Yes.
- Sometimes.
- Not very often.
- Never.

I look at my score, mistakes, and comments made by my teacher on paper assignments. *

- Yes.
- Sometimes.
- Not very often.
- Never.