Third-grade multiplication fact fluency

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**Abstract**

Utah state standards require that by the end of third grade, students must know their multiplication and division facts to 100; many third-grade students struggle with fact fluency. I conducted an action research study to determine if implementing technology such Rocketmath online game would impact fact fluency among third-grade students. The participants were 25 third-grade students in my homeroom class. I used quantitative data by giving a pretest of 100 multiplication facts, added in daily rocket math online game for 15 minutes, and integrated more technology into each lesson. After the ten days of lessons, rocket math, and other technology, I gave a post-test. Once I had the data from both the pre and post-test, I compared the mean from both tests, and it was determined that the mean increased by 12.76. The data showed that 80% of my students improved, and the other 20% either stayed the same or their scores decreased. It was determined that the students who dropped or stayed the same did not complete all ten days due to absences. The data has proven that the implementation of rocket math increased students' fact fluency.

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# **Chapter 1 - Topic and Problem**

**Topic**

I have taught 3rd and 4th grade for four years; I have noticed that when students struggle with fact fluency in third grade, they find fourth grade more complicated and often feel defeated. According to The Common Core State Standards (2010) CCSS.MATH.CONTENT.3.OA.C.7 "Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that 8 × 5 = 40, one knows 40 ÷ 5 = 8) or properties of operations. By the end of Grade 3, know all products of two one-digit numbers from memory." The Utah State standards can seem overwhelming to third graders who have just entered third grade; they have just left second grade, where they started to do some repeated addition and have not yet applied it to multiplication. While teaching my third-grade students, I ensure they understand they will need to know this information for higher grades. The students must gain fact fluency; according to Reed et al. (2014), "Poor fact fluency thus has direct consequences for mathematical learning and performance. As well as affecting problem-solving, research has shown that inefficient solving of basic facts depletes resources needed for acquiring more advanced computational skills, such as those required for multi-digit sums." The lack of fact fluency affects the students in third grade and will continue to affect them in higher grades, causing them significant consequences. The topic is relevant to my field of education because students must be fluent in multiplication math facts by the time they enter fourth grade.

**Problem Statement**

There is a significant problem with third-grade students who struggle to become fluent with their multiplication facts. Utah students must be proficient in their math facts by the end of third grade. Teachers must find the most beneficial strategy to teach third-graders their facts to automaticity. Suppose students are not proficient and automatic in multiplication facts by the time they enter fourth grade. In that case, they risk falling behind with multiple-digit multiplication, long division, and multiplying and dividing fractions. Students are stating that they use technology while at home, such as YouTube, online games, and tablets; this research aims to determine the impact of using technology in the classroom in influencing the students' ability for multiplication fact fluency and automaticity.

**Problem Discussion**

The memorization approach to math facts is now outdated, with digitalization becoming more popular, allowing teachers to use technology to assist with teaching. With technology, teachers can use online games, YouTube songs, virtual manipulatives, and much more. According to KURVINEN et al. (2020), "Traditional mathematics teaching with exercise books is built on the idea of practicing and drilling. This is also backed by research, which states that practicing mental arithmetic develops number sense and helps finding flexible and adaptive strategies in mathematics." The research will still utilize this approach, just adding more technology-based instruction. When students use online games or lessons, they receive immediate feedback by using technology-enhanced learning (TEL) instead of waiting for the teacher's feedback; this allows the students to have personalized feedback without the teacher's intervention. (KURVINEN et al., 2020) Immediate performance feedback is essential for students, according to Duhon et al. (2014), when students are given detailed information regarding their academic performance, and it has been shown to improve math fluency when combined with math interventions. Immediate performance feedback is more accessible when computer-based technologies have developed a way to immediately increase math fluency and calculations as opposed to a teacher trying to give immediate feedback to each student. Teachers can't provide immediate feedback to a whole class as quickly as technology can.

# **Research Question(s)**

What impact will integrating technology in math instruction have on third-grade students in assisting them to be fluent in their multiplication facts?

# **Topic and Problem Conclusion**

I am currently a third-grade math teacher and will loop with my students to fourth next year. I have seen students who struggle with fact fluency in the third fall even more behind in fourth grade. The solution I am proposing is to add a Rocketmath online game each morning for ten to 15 minutes to determine if adding technology will impact students' fact fluency. Rocketmath online provides immediate feedback to students while they are playing the game. By improving fact fluency, students will have the basic skills they need to be proficient in higher grades. In fourth grade, students must do multi-digit multiplication and division.

# **Chapter 2 - Review of the Literature**

# **Overview of the Literature**

The literature review will examine different technologies that can assist students in becoming automatic in their multiplication facts, interventions that can be reproduced to help those who need tier 2 interventions, and other strategies to incorporate into teaching. When students learn multiplication facts, some may learn them faster than others. Depending on the student's background knowledge of repeated addition, students may need additional help to understand the multiplication facts.

**Teaching strategies**

Students in the third grade are expected to multiply and divide by 100 according to The Common Core State Standards (2010) [CCSS.MATH.CONTENT.3.OA.C.7](http://www.corestandards.org/Math/Content/3/OA/C/7/) "Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that 8 × 5 = 40, one knows 40 ÷ 5 = 8) or properties of operations. By the end of Grade 3, know all products of two one-digit numbers from memory."(p.1) There are many different approaches teachers can take to ensure students meet these standards. The following research will focus on multiplication, not division, because as a teacher teaches multiplication, they continue to teach that they are inverse operations of each other.

The woodcock Johnsen Battery is an excellent assessment to measure a student's background knowledge of math facts. This would be a practical assessment to see what students already know. This test consists of multiple steps. The first step would be a paper and pencil with 151 questions with all four math facts, then a sequence completion; this will be beneficial for teachers because they can see what multiples students can skip count. The quantitative part of the test assesses if they can recognize each operation symbol. The last is an advanced computation test to evaluate if students can complete more challenging questions. The other part of this assessment is the Ben-Gurion University Math Fluency (BGU-MF) assessment. According to Gliksman et al., (2022)

"The BGU-MF is a computerized test for examining math fluency. The test includes math facts of the four basic operations: addition and subtraction (with answers or operators up to 20; e.g., 14 − 7), and multiplication and division taken from the multiplication table (up to 10 × 10; e.g., 4 × 8). Problems are selected randomly from the full set of trials (see Supplementary Materials for the full set of problems). The problems appeared one by one on a screen, and participants were instructed to type in their answers inside a square and press the Enter key in order to proceed to the next trial (see Figure 1). The length of the test was 180 s."

Using both assessments would be an excellent baseline assessment to implement before a teacher begins lessons.

When students are learning mathematics, it is standard practice that they know three different types; first, we teach conceptually, then procedurally, and last we teach factually. In research conducted by (Reed et al., 2014), they found that fluency in math facts can be achieved through semantic practices, meaning when students know the reason and meaning for the math, they can become more fluent. The quantitative data research is essential because they took two approaches to fact fluency: to have students practice traditional fact recall of simple facts. The other is called the choice condition when they would give the students a chance to say if a fact was correct or incorrect. This method could be done verbally or written on paper, according to Reed et al. (2014). "Children answered more items correctly during choice practice than recall practice. Given that accuracy in both conditions was comparable and high (i.e., children were not simply guessing more successfully in the choice condition), the choice method thus appears to produce more frequent repetition of correct problem–answer connections than recall practice."

This research shows that giving students the choice method is more impactful than recall practice. This analysis will ensure that teachers know where to start with each student and their ability level. Many students are taught to memorize facts, not learn the why behind what they are learning. According to Kusuma & Sulistiawati (2014), three stages used by the GASING method are concrete, abstract, and mental calculation.

To teach the concrete stage, teachers will introduce students to multiplication using manipulatives such as counters and beads and then show them that 5x7 is five circles with seven beads in each circle. According to Kusuma & Sulistiawati (2014), "Concrete objects help students to understand the mathematical concepts and thus students could do the mathematical calculations easily" (p.2). The next stage is the abstract stage when teachers will show the students the symbols and show them that they can switch the factors around and still get the same product. Lastly is mental calculation, where students are "During the final stage students are encouraged and expected to be able to do mathematical calculations mentally without using any aid such as calculating or recording device and produce the answers instantly" (Kusuma & Sulistiawati, 2014). Based on this research, teachers should not teach multiplication facts in numerical order but the above-specified order.

There is other steps process for teachers to follow. First, they will ensure that their students know that multiplication is repeated addition; second, they are teaching the following numbers in this order, 1, 10, 9,2, and 5. The third step will be for teachers to teach them to multiply numbers against themselves, for example, 2x2, 4x4, 5x, and so on. The fourth step will be for teachers to have them do multiples of 3 and 4. If this method helps, teachers will conduct a pre and post-test to see what facts they know at the beginning of each step. The pretest will be a baseline of the facts they know before instruction.

Every student must learn multiplication facts; they are fundamental for students throughout their education. "Unfortunately, students are not meeting the academic targets put in place by the Common Core or National Council of Teachers of Mathematics Council of Teachers of Mathematics" (Baker & Cuevas, 2018)

The importance of automaticity is critical for student success. Each year, students learn more math and need to know their multiplication facts to succeed in higher mathematics. Along with the above on what order teachers will teach the facts, students will also have additional visual support around my room. Teachers should add the mnemonic strategy approach; this approach will assist students who need additional interventions. The mnemonic method is when teachers add some sort of word or pictures for each fact. For example, Minecraft uses the inventory, which is 8x8, so a teacher can call 8x8 the Minecraft number. Most students these days play that and know they can only hold 64 of each item.

Being able to remember each fact is the goal when teaching multiplication facts. Working memory is crucial for students to memorize and recall facts with automaticity. The working memory is the most critical part of the memory system, and the temporary storage and manipulation of information are the main functions of the working memory. The working memory consists of three components, "central executive (CE), the phonological loop (PL), and the visual-spatial sketchpad (VSSP) component." (BOZ & ERDEN, 2020).

According to BOZ & ERDEN (2020) "showed that the central executive (CE) component of working memory plays a significant role in multiplication skills of 3rd grade children while its visuo-spatial sketchpad (VSSP) and phonological loop (PL) components play insignificant roles in multiplication skills of 3rd grade students. In the light of the findings, it could be suggested that math instruction should include modified instructions increasing working memory capacity and different working memory strategies suitable for students' developmental features should be implemented." These findings can assist teachers when they create their plans, the central executive is in charge of retrieval and problem solving, so when teachers are doing activities with students, they will be assisting in having them rich in problem-solving to retrieve the multiplication facts.

**Technology in the classroom**

The research problem is for teachers to determine if using technology with their students will impact their student's retention of multiplication facts. Many online videos, songs, and games can be utilized for instruction.

Many children love playing computer games and playing on a tablet, so why not take what they love and try to add some math to it? Teachers should be looking for online games to assist their students in multiplication fact fluency. In a qualitative study (Mavridis et al., 2017), they hypothesized that incorporating online educational games could improve students' attitudes toward math and the outcome as opposed to traditional methods. According to Mavridis et al. (2017), "analysis revealed that students who played the game had significant higher scores on the value, enjoyment and motivation dimensions of the attitude questionnaire." Research shows that most students will choose the online game when given the option of an online math game or a worksheet; most students enjoy learning while playing online. Some games that I have researched are rocket math and imagine math facts.

Rocket math is an adaptive online game; students go at their rate and move on when they have passed their facts off. According to Smith et al. (2011), "This program gives a sequence of learning facts that students master. Prior to the implementation of the program, current level of performance is established using a pretest that evaluates the writing speed of each student. Twenty-six different worksheets, progressing from simple to more difficult, are provided consisting of four levels of addition, subtraction, multiplication, and division problems". Rocket math is an online program that teachers can use in their classrooms for up to 15 minutes; this program will only move students up once they have mastered the fact sequence; this is beneficial for students who need additional help and can be used as an intervention.

Imagine math has a game called Timez Attack; according to Berrett & Carter (2018), "programs such as Timez Attack by Imagine Math Facts may be viable, supplementary options for math facts education." During the 12-week study, the researchers found that even students who needed interventions could use the maintenance phase of this game. It is suggested that students play this game for at least 15 minutes a day; this is also an adaptive game and will only move students to the following sequence of facts once they have mastered the facts from the placement assessment.

There is a long history of research and the effectiveness of learning math. Many teachers always look for the most effective way to teach students multiplication. Finding a game that my students enjoy playing and that is beneficial can be challenging; finding a game that is guided by the cognitive load theory by minimizing the extrinsic load and maximizing the student's intrinsic load. Games with more animation can cause students to become overwhelmed; Es-Sajjade & Paas (2020), "studies have found that worked examples impose a lower cognitive load and facilitates knowledge construction and transfer performance better than actually solving the problems." Research suggests that when teachers are looking for an effective online game to assist their students with multiplication facts, they should look for a game that does not have so many animations.

Something to keep in mind is the student's attitudes toward online games. Many students like playing games online; however, not all prefer this method. The way that students perceive math could be why they do not enjoy an online math game; Mavridis et al. (2017) stated, "there are several students with negative attitude towards mathematics, which results in low performance." Students who struggle with math may feel like a math game is more frustrating because they want to play it and go to the next level, like their peers. When choosing an online game, it is essential to select a game that is flexible and universal to genders, as males typically have a better attitude toward video games than females. Research shows that females usually have a more difficult time with math than males (Mavridis et al., 2017). Creating a survey before teachers introduce online math games will give insight into the general feeling of a third-grade class, their feelings toward playing games, and how they feel about online math games.

**Interventions**

When a student is behind their math learning level, teachers can do interventions with them to assist them in closing the gaps. Some interventions that can be done with math are using differentiated and individualized math instruction, playing games on the student's level, trying songs that help the student retain math facts and skills, using calculators, and online games.

According to Maki et al. (2020), "Early intervention targeting math facts is imperative for students demonstrating those needs; however, determining which intervention to implement is necessary to ensure that students' needs are appropriately targeted. Conceptual frameworks provide a useful approach to guide research on and implementation of academic interventions in schools." To know what the student is struggling with, teachers must conduct assessments; interventions are not one-size-fits-all; teachers have to ensure that each intervention is individualized to each student's needs.

Differentiated and individualized math instruction can be done using the detect, practice, and repair. Teachers should use this process to determine where their lower students are missing information. According to Poncy et al. (2013),

"The detect phase uses a paced pretest to identify items that each student will use to practice. Specifically, an apparatus (e.g., a metronome) is used to prompt student responding to each math problem at a predetermined rate (e.g., one problem every 1.5–2 s). After the defined time period elapses, students are prompted to go to the next problem, until all of the items have been attempted. The paced assessment was designed to differentiate between items that could be completed with automaticity (i.e., under 1.5–2 s) and items that a student would complete accurately but slowly (i.e., more than 2 s). To successfully complete the detect phase, students need to automatically respond to each problem. Problems that cannot be automatically completed are identified and practiced during the next phase. After the detect phase is completed, each student identifies the first five uncompleted problems on his/her particular pretest and uses these targeted facts in the practice phase."

In the practice phase, teachers will choose five problems at a time that students did not show fluency in, then practice those with each student. Teachers will start by conceptually showing them what the fact looks like with counters and the repeated addition with each problem. Next, each fact will be shown using the correct multiplication symbol in the multiplication sentence. Lastly, they will practice each problem until the student can tell that fact fluently; this will assist in the repair stage when the student is given those five facts along with other facts they may have answered correctly. Then teachers will test again to gauge fluency on those five problems. Five new facts can complete the repair stage as often as needed. While assisting the student to become fluent in math facts through interventions, we can use flashcards; if the student does not say the answer within 2 seconds, it is considered nonfluent, and we can use the card again. Using flashcards gives students immediate feedback, stated Karnes et al. (2021). "This technique enables students themselves to monitor whether a given answer is correct or incorrect and, therefore, to correct errors." Games can also assist in small groups with students; this game is called racetrack, and it is made up of 28 cell gameboards, with 14 multiplication facts that the student has mastered and 5-7 facts that they have not mastered; these are repeated twice. The facts are all on small pieces of paper, and the student pulls one from the stack; if they know the fact, they place it down in a cell; if they do not, it goes back in the stack. This game is the same concept as regular flashcards but has a game approach so that, hopefully, students will feel less stressed.

In my classroom, we listen to songs that help assist in math fact fluency and retention of other concepts. According to Korkmaz & Doğan Temur (2022), "When the relationship between music and mathematics considered, it is seen that musical activities can offer children different opportunities to support basic mathematical skills" teachers can use this as a whole group experiment. Teachers can add this to their tier 2 interventions and use this as an activity. The research conducted by Korkmaz & Doğan Temur (2022) is fascinating; they had students take a pretest, then did 12 weeks of math-related songs, then did a post-test to determine if the intervention was successful. While the study was going on, the researchers had the students hooked up to an electroencephalogram (ECG) before then after each training module. The research concluded that the training with math songs increased student success with fact fluency.

Math interventions are not always actions that the teachers take; they can be different tools that can be used in addition to the activities. Students can use additional handouts to assist them in remembering steps and what vocabulary means. Calculators can be used as an intervention tool for students who are struggling. Long & Bouck (2022)When implementing calculators in the classroom, it is essential to utilize them correctly, not just to have students use them to find the answer. Students should first write down the equation, solve it independently, and then use the calculator to check their work. This skill can be utilized when students go on to higher grades and do more complex math.

**Conclusion**

The research concluded that many students struggle with multiplication fact fluency; there are multiple ways to use technology in my classroom. First, teachers must use formative assessments with their students to ensure a baseline, then another assessment after the facts have been taught. Research shows a few games teachers can play with their students and effective interventions. Third-grade students must display multiplication fact fluency, so they can have multiplication automaticity when they enter higher level grades.

**Chapter 3 - Research Methodology**

# **Research Design**

I will be using action research, which uses quantitative data. Using this approach will assist me in evaluating the students and their beginning knowledge and automaticity of multiplication facts. I will collect quantitative data as a pre and post-test; this adheres to action research to best determine my research question of the impact technology will have on my students and the learning of multiplication facts. The test will have 100 multiplication problems, and students will complete as much as possible in 5 minutes. By collecting this data, I will have a baseline for each student and then see their growth with the post-test after using technology in the classroom.

# **Research Questions**

What impact will integrating technology in math instruction have on third-grade students in assisting them to be fluent in their multiplication facts?

# **Participants**

The participants that I will be using are my third-grade class. In this class, I have 24 students. Out of the 24 students, I have one student with an IEP for math, three who receive speech, two ESL, and one who has a 504. All students' guardians will be selected to obtain informed consent, and if they agree, all will participate in this study. These students are just beginning to learn multiplication; they have been introduced to repeated addition, equal groups, skip counting on a number line, and arrays. The researcher will be the math teacher, while the students selected are from the homeroom class. In a whole group open conversation, most students expressed they are highly motivated by having screen time in the classroom and achieving higher game levels.

# **Data Collection Instruments and Methods**

The instrument used to collect the quantitative data will be from pre and post tests worksheets that I retrieved from TLSbooks.com. The worksheet is a five-minute drill with 100 questions covering multiplication facts from 0 to 12 (Appendix B). Students will be encouraged to complete as many as possible within the time required; then, when the time is up, they will turn them in so I can grade them. This data will then go into an excel worksheet so I can easily record the collected data. This data aligns with the research question to set a baseline of what facts students are fluent in before we begin our ten days of technology in the classroom. By collecting pre and post-test data, I can see the exact percentage of growth each student experienced.

# **Data Security and Confidentiality**

Students' data must be kept private; I must take all measures possible to keep their data confidential. Students will be assigned a class number, the number they will put on their tests. When I input their scores in excel, it will be by number only; no names will be recorded. The pre and post-test will be in my locked filing cabinet, and only I have the key. This data will be kept securely until the three-year frame is up, then shredded.

# **Summary**

In summary, implementing RocketMath online games daily and using action research will determine if this intervention impacts fact fluency. Data collected will answer my research question, "What impact will be integrating technology in math instruction have on third-grade students in assisting them to be fluent in their multiplication facts? "

The quantitative data will be analyzed using descriptive statistic techniques to determine the class mean (Appendix E) using pre-and post-test data by tracking how many questions out of 100 students could answer within five minutes. The data received from the five-minute test will be recorded in a spreadsheet in excel(Appendix D), this spreadsheet will have each student's baseline and post-test scores, and the percentage of increase will be recorded.

# **Chapter 4 - Results**

# **Results Overview**

This action research was conducted to see technology's impact in the classroom. I completed this research within my 3rd-grade classroom with 25 students; I received a new student the day before the study started. After ten days of playing the Rocketmat online game and integrating more technology in the classroom (Appendix A), students were given the same post-test test (Appendix B). Overall the results showed a positive correlation between the rocket math online game and the student's fact fluency. I found by analyzing the pre and post-test data that 80% of the students in this research improved their fact fluency.

# **Data Analysis**

After starting each day with 15 minutes of rocket math and teaching lessons with more technology integrated, I was able to have students complete a post-test. I scored the tests and entered the scores into the excel worksheet, allowing me to compare the data from the pretest to the data from the post-test.

After reviewing the data, I saw that The class mean for the pretest was 21.52, and the post-test was 35.16, with a total change of 12.76(Table 1).

Out of the 25 students, 20 showed growth in their math facts, one remained unchanged, and four went backward with their facts. While examining the pretest, I saw that 64% of my class could only correctly answer 25% of the math facts, 32% could answer 26%-50%, and 4% could answer 51% or more (Table 2).

The post-test data shows that after the ten days, 80% of my students made growth with their math facts; only 24% of my students could only answer 25% or less correctly on the test, 60% correctly answered 26%-50% of the test, and 16% answered 51% and above (Table 2).

Table 1

|  |  |  |  |
| --- | --- | --- | --- |
| **Student Number** | **Pretest** | **Post-test** | **Change** |
| **2** | 10 | 34 | 24 |
| **3** | 10 | 36 | 16 |
| **4** | 34 | 30 | -4 |
| **5** | 23 | 56 | 23 |
| **6** | 9 | 13 | 4 |
| **7** | 31 | 50 | 19 |
| **8** | 16 | 37 | 21 |
| **9** | 10 | 23 | 13 |
| **10** | 28 | 57 | 29 |
| **11** | 28 | 59 | 31 |
| **12** | 9 | 25 | 16 |
| **13** | 5 | 23 | 18 |
| **14** | 26 | 26 | 0 |
| **15** | 19 | 27 | 8 |
| **16** | 15 | 30 | 15 |
| **17** | 13 | 11 | -2 |
| **18** | 42 | 34 | -8 |
| **19** | 23 | 38 | 15 |
| **20** | 38 | 48 | 10 |
| **21** | 24 | 35 | 11 |
| **22** | 31 | 52 | 19 |
| **23** | 17 | 23 | 6 |
| **24** | 16 | 35 | 19 |
| **25** | 51 | 47 | -4 |
| **26** | 10 | 30 | 20 |
| **Mean** | 21.52 | 35.16 | 12.76 |

Table 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Pretest** | | **Post Test** | |
| **Fluency** | Students | %of class | Students | %of class |
| **0%-25%** | 16 | 64% | 6 | 24% |
| **26%-50%** | 8 | 32% | 15 | 60% |
| **51%-75%** | 1 | 4% | 4 | 16% |
| **76%-100%** |  |  |  |  |

# **Answers to the Research Questions**

My research question was, "What impact will integrating technology in math instruction have on third-grade students in assisting them to be fluent in their multiplication facts?" This data supports my research question by proving that implementing technology impacted my third-grade students to improve their math fact fluency. The pre and post-test data show that 80% of my students improved their math fact fluency.

# **Chapter 5 - Discussion and Conclusion**

# **Overview**

This action research was implemented to determine if technology in the classroom would increase fact fluency in the third-grade class. The students took a pretest, completed ten days of rocketman online game, and introduced more technology into each lesson' then, students completed a post-test. The data from the pre and post-test means were then compiled into an excel worksheet and compared, showing that 80% of students had increased fluency in fact in ten days. Rocket math online game has impacted students' fluency, and they request to begin each day with the game even after the research is completed.

# **Problem Solutions**

My research problem was that Utah requires Third graders to be proficient in multiplication and division facts to 100 by the end of the school year. Many students struggle with their fact fluency which causes them to struggle in higher-grade math. Adding in Rocketmath has proven to increase fact fluency in my third-grade class, and I believe with the continued use of Rocketmath, students will increase their fact fluency.

# **Strengths and Weaknesses**

As with any research, there were strengths and weaknesses. This research did present a few weaknesses. One was that my students had to learn their login information and how to log in. The game took 15 minutes; some students took around 5 minutes to log on the first few days; this may have caused them to become stressed and frustrated before the game started. Another weakness was that the students played the game first thing in the morning, so when they were late, they had to play longer in the morning while the other students were finished reading a book while waiting for everyone to complete the game. While students were playing the game, I could see a few become frustrated at the fast pace and become worried. I did talk with them after to assure them that they were doing great and to try to have fun.

The strengths of this research were that once my students got in the habit of coming in and logging on, they were excited to play the game and enjoyed learning to resite their facts quickly and advancing to the next level. I believe the greatest strength was that 80% of students increased their scores on the post-test.

# **Influential Factors**

Some influential factors would be that some students were sick and unable to attend school, so they did not receive the ten full days of instruction. When looking at appendix D, you can see that student #18 had a pretest score of 42 and a post-test score of 34, going down by 8 points; this student was absent for 4 out of the ten days of instruction; I believe this is why this students score went backward. We had assemblies for two of the ten days, and I had to change the time of day we played the online game, which could have affected the student's motivation levels while practicing math facts.

# **Further Investigation**

I would recommend taking more than ten days for this research in the future. Even though 80% of students showed growth, I believe if I did this for 30 days, I would see a tremendous increase in fact fluency. Another recommendation would be to ensure that students are proficient in logging onto the computers before starting the research.

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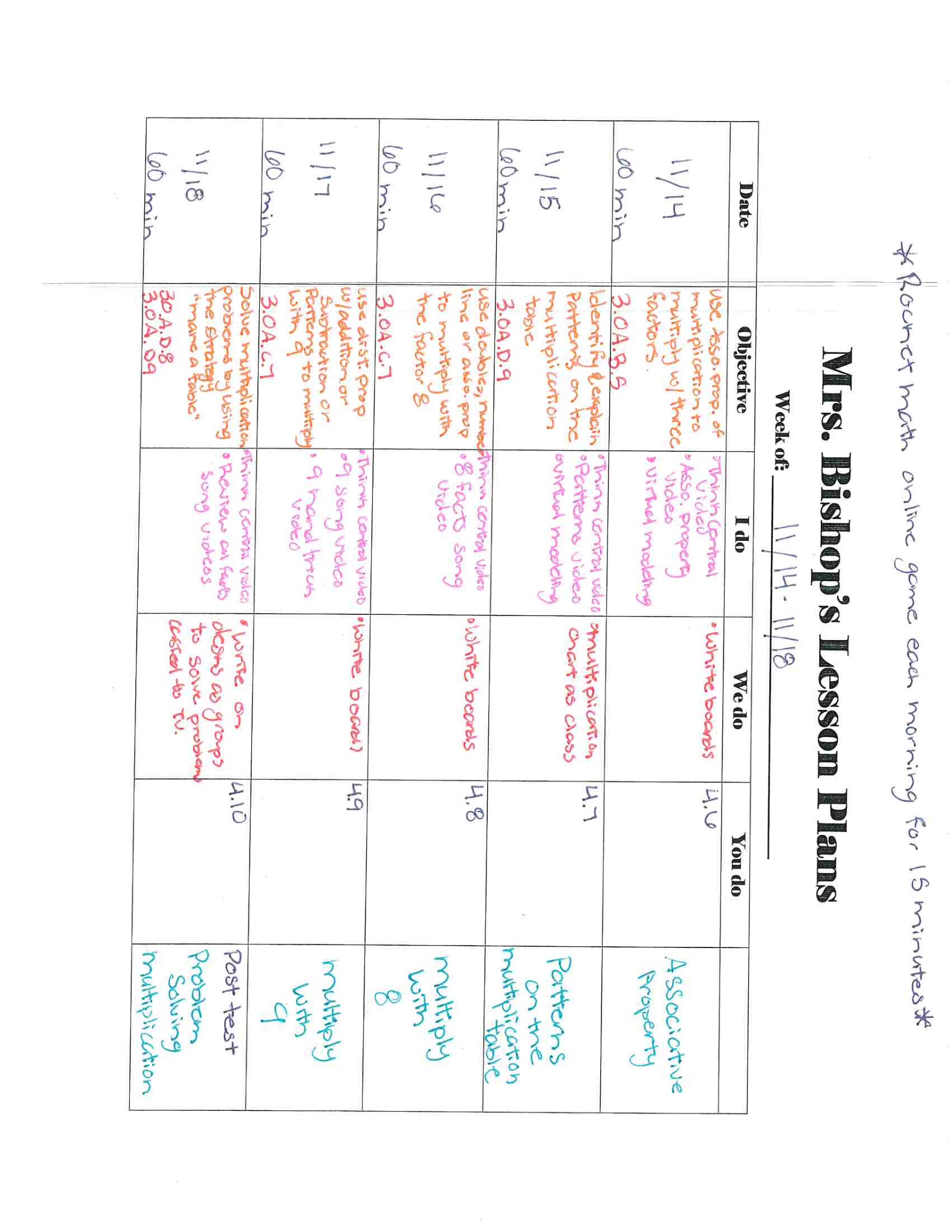
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# **Appendix A**



Students will use Rocket math online games as a warm-up each day; this is an adaptive game after the students complete the placement assessment. Each lesson in the curriculum has an interactive online lesson that the teacher/researcher will cast to the television and have students help answer questions. The teacher/researcher will utilize the manipulative application on the Ipad, mirrored on the television; this will be used for each lesson to show equal groups and skip counting on a timeline and arrays.

The teacher/researcher will also use technology in the classroom to show multiplication songs from YouTube.

After the eight days of instructions integrating technology, students will take the post-test. Data will be entered into an excel spreadsheet to calculate the growth if any.

Day 1- Students will be given the pretest. Students will be informed that this is not part of their grade, and this will be used as a tool to see how much they have improved during the next two weeks. When handed the pretest, students will be instructed to write their names and turn the page over, and they can draw if they wish. Once every student is ready, the time will be set for 5 minutes; the teacher/researcher will then have the students hold up their pencils to show they are ready, then the teacher/researcher will say begin, and students will turn the page over and start. The teacher/researcher will start the timer. When the time is up, the teacher/researcher will collect the paper, and the students will wait quietly.

Students will then watch a "Basic training for players" from rocket math. Students will then be given their information cards at their desks. The lesson of the day is to multiply by 2 and 4. The teacher/researcher will play the lesson video of the day from the online curriculum. The lesson begins with an interactive video; the teacher/researcher will play the video and have the students assist in selecting the correct answers. The end of the lesson is a video that lasts about 4 minutes. The lesson will include interactive manipulatives mirrored from the iPad to the television. These manipulatives will assist in showing equal groups and skip counting on a number line. Students will then learn the two and four-skip counting songs on YouTube.

Days 2-10 - Students will grab computers and log in to Rocketmath online game. They will be instructed to type in their username, passcode, and account number; this information is on their cards at their desk. They will then be prompted to complete a placement assessment on the application to ensure they are placed at the correct level. The teacher/researcher will play the day's lesson video from the online curriculum. The lesson begins with an interactive video; the teacher/researcher will play the video and have the students assist in selecting the correct answers. The end of the lesson is a video that lasts about 4 minutes. The lesson will include interactive manipulatives mirrored from the iPad to the television. These manipulatives will assist in showing equal groups and skip counting on a number line. Students will learn new skip-counting songs that coincide with the day's lesson.

Each lesson that will be taught during this time will go in this order:

1. Patterns on the multiplication table
2. Multiply by 2 and 4
3. Multiply by 5 and 10
4. Multiply by 3 and 6
5. Distributive property of multiplication
6. Multiply by 7
7. Associative property of multiplication
8. Multiply by 8
9. Multiply by 9
10. Multiplication word problems

Day 11- Students will be given the post-test, and the data from the post-test will be compared to the data from the pretest.

|  |  |
| --- | --- |
| Lesson 4.1 (Multiply with 2 and 4) **Exit Slip**  Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **How could you multiply with 2 and 4? Find the product.**  **9 2**  **x 4 x 8** | Lesson 4.2 (Multiply with 5and 10) **Exit Slip**  Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **How could you multiply with 5 and 10? Find the product.**  **10 5**  **x 4 x 7** |
| Lesson 4.3 (Multiply with 3 and 6) **Exit Slip**  Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **What are some ways to multiply with 3 and 6? Find the product.**  **2 3**  **x 6 x 6** | Lesson 4.4 (Distributive Property) **Exit Slip**  Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Write one way to break apart the array. Then find the product.** |
| Lesson 4.5 (Multiply with 7) **Exit Slip**  Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **What strategies can you use to multiply with 7? Find the product.**  **7**  **X 3** | Lesson 4.6 (Associative Property of Multiplication) **Exit Slip**  Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Write another way to group the factors. Then find the product.**  **(4 x 6) x 2** |

|  |  |
| --- | --- |
| Lesson 4.7 (Patterns on the Multiplication Table) **Exit Slip**  Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Use the multiplication table. Describe a pattern you see.**   * In the row for 7   [Image result for multiplication table to 10](http://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0ahUKEwjdiLLL0bPQAhUBeSYKHag6AdgQjRwIBw&url=http://www.activityshelter.com/free-and-printable-multiplication-charts/&bvm=bv.139250283,d.amc&psig=AFQjCNHFwVoLxarvXqlTT1L85G2Ht4sTMA&ust=1479604247854426) | Lesson 4.8 (Multiply with 8) **Exit Slip**  Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **What strategies can you use to multiply with 8? Find the product.**  **8**  **X 4** |
| Lesson 4.9 (Multiply with 9) **Exit Slip**  Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **What strategies can you use to multiply with 9? Find the product.**  **9**  **X 7** | Lesson 4.10 (Problem Solving: Multiplication) **Exit Slip**  Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Solve and write in a complete sentence.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Shameeka has a new photo album.  She uses pages that holds 6 photos  and pages that hold 3 photos. If  Shameeka has 36 photos, how many  different ways can she put them in  her album? | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Pages with 6 Cards** | 1 | 2 | 3 | 4 | 5 | | **Pages with 3 Cards** | 10 | 8 | 6 | 4 | 2 | | **Total Cards** | 36 | 36 | 36 | 36 | 36 | | |

# **Appendix B**

# **A picture containing letter Description automatically generated**

# **Appendix C**

**Parent/Guardian Permission Form**

I am a Student Investigator who seeks your permission for your child to participate in a Capstone Research Project entitled Third grad multiplication fact fluency. The purpose of this Capstone Research Project is to determine if adding an online game called Rocketmath will have an impact on students' multiplication fact fluency. The Capstone Research Project will involve approximately 23 participants. Your child can participate in this project if they:

* Are are currently in my 3rd grade homeroom class.

If you give permission for your child to participate in this project. In that case, your child will be asked to take a pretest to determine the multiplication facts they answered correctly and compare that to a post-test after we take ten days to play the Rocketmath online game during D.E.A.R time.

There is *no more than minimal risk* associated with participating in this research project, which means participation in this project does not involve risks for your child beyond those associated with normal day-to-day living. While there is no individual benefit to your child for participation in the project, findings may provide the overall benefit of implementing Rocketmath online game daily to increase multiplication fact fluency, which will be a continued benefit for higher grades.

Your child's participation in this project is strictly voluntary. Your decision on whether or not to give permission for them to participate will not affect their current or future relations with Leadership Learning Academy. If you initially decide to give permission to participate, you are free to withdraw permission at any time later without affecting those relationships.

In the event your child experiences stress or anxiety during their participation in the project, they may terminate participation at any time. They may also refuse to answer any questions you consider invasive or stressful. Students will be informed of this research and that this is not part of their grade. I will reassure students that their scores on the pre and post-test will only be for me to view and will be kept in a locked filing cabinet.

Any data or records from your child's participation will be confidential. Any identifiable data gathered will be coded to protect your child's identity. Each student will use a new class number on the pre and post-test. The numbers I assign to each student will not be displayed in the open for others to see. All records from this research will be securely stored and only accessible to the researcher.

Please ask any questions related to this permission for your child's participation. If you or your child have questions later, you may contact me via email Sbishop@llacharter.org or the WGU IRB at [IRB@WGU.EDU](mailto:IRB@WGU.EDU)

**Parent/Guardian Permission**

I, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, a parent/guardian of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, a minor-aged child, have read the above information, have been given adequate time to consider the information, and understand my child may stop participation at any point. I have asked questions and received answers. I give permission for my child to participate in this research project. I understand I will be offered a copy of this signed form.

|  |  |  |
| --- | --- | --- |
| Typed Name of Parent/Guardian |  | [Date] |
| Parent/Guardian Signature |  | [Date] |
| Signature of Student Investigator |  | [Date] |

**Parent/Guardian Permission**

I have read the above information, been given adequate time to consider the information, and understand my child's participation is voluntary so they may stop participation at any point. I have asked questions and received answers. I give permission for my child to take part in this project and understand I will be offered a copy of the completed form.

## **Yes**

**No**

# **Appendix D**

# 

|  |  |  |  |
| --- | --- | --- | --- |
| **Student Number** | **Pretest** | **Post-test** | **Change** |
| **2** | 10 | 34 | 24 |
| **3** | 10 | 36 | 16 |
| **4** | 34 | 30 | -4 |
| **5** | 23 | 56 | 23 |
| **6** | 9 | 13 | 4 |
| **7** | 31 | 50 | 19 |
| **8** | 16 | 37 | 21 |
| **9** | 10 | 23 | 13 |
| **10** | 28 | 57 | 29 |
| **11** | 28 | 59 | 31 |
| **12** | 9 | 25 | 16 |
| **13** | 5 | 23 | 18 |
| **14** | 26 | 26 | 0 |
| **15** | 19 | 27 | 8 |
| **16** | 15 | 30 | 15 |
| **17** | 13 | 11 | -2 |
| **18** | 42 | 34 | -8 |
| **19** | 23 | 38 | 15 |
| **20** | 38 | 48 | 10 |
| **21** | 24 | 35 | 11 |
| **22** | 31 | 52 | 19 |
| **23** | 17 | 23 | 6 |
| **24** | 16 | 35 | 19 |
| **25** | 51 | 47 | -4 |
| **26** | 10 | 30 | 20 |
| **Mean** | 21.52 | 35.16 | 12.76 |

**Appendix E**

**Class mean pre and post-test**

|  |  |  |
| --- | --- | --- |
| **Pretest mean** | **Post-test mean** | **Change in Mean +/-** |
| **21.52** | **35.16** | **+12.76** |