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Supporting Elementary Teachers with Technology Integration Within the Mathematics Curriculum

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
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2024

Abstract

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MA, Concordia University, 2019

BA, University of Providence, 2017

Project Study Submitted in Partial Fulfillment

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Abstract

Students are entering the classroom with more technological knowledge than ever before, and to provide enriching learning opportunities, teachers need to be ready to use that background. Elementary mathematics teachers are often provided with technology to use with their mathematics curriculum. However, they do not always receive any guidance or supports on how to best incorporate the technology into mathematics instruction. The purpose of this basic qualitative study was to explore what challenges teachers in Grades 2–6 face when attempting to utilize educational technology to support the mathematics curriculum. The conceptual framework for this study was Magana's T3 framework for innovation. The three research questions focused on how teachers use technology in their classroom and what guidance and supports teachers feel they need to be better able to integrate technology into the mathematics curriculum. Semistructured interviews were conducted with 12 participants who were elementary mathematics teachers in an urban public school district in the Northwestern United States. Coding and thematic analysis showed that participants were using technology in the classroom but not often in the area of mathematics. A project of professional development curriculum was created based on the results where participants shared that they were willing to integrate technology into their mathematics instruction if they received the guidance and supports necessary. The results of this study may contribute to positive social change by providing teachers with hands-on training with lesson modeling, which could then provide students with additional learning opportunities where technology is more seamlessly integrated within the elementary mathematics courses.

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Dedication

This study is dedicated to my family for their unwavering support through this journey. To my children, Lindsey, Tyler, and Austin, who have never stopped encouraging me. To my husband, Steve, for your love and non-stop support through long days and lifting me past the frustrating times. To my mom and stepfather, Debbie and Phillip, for being my biggest fans. Finally, to both my father, Mike, and father-in-law, Rick, who both started this journey with me but are watching me complete it from heaven.

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Table of Contents

List of Tables iv

Section 1: The Problem 1

The Local Problem 1

Rationale 4

Definition of Terms 5

Significance of the Study 6

Research Questions 7

Review of the Literature 8

Conceptual Framework 9

Review of the Broader Problem 11

Implications 21

Summary 22

Section 2: The Methodology 23

Introduction 23

Qualitative Research Design and Approach 24

Participants 26

Criteria for Selecting Participants 26

Procedures for Gaining Access to Participants 27

Establishing a Researcher–Participant Relationship 28

Protection of Participant Rights 29

Data Collection and Analysis 30

Interview Protocol 30

Sufficiency of Data Collection 33

System for Keeping Track of the Data 33

The Role of the Researcher 34

Evidence of Quality 34

Data Analysis Results 37

Research Question Findings 42

Research Question 1: Technology Integration 42

Research Question 2: Guidance Needed 53

Research Question 3: Supports Needed 57

Limitations 62

Proposed Project 63

Summary 63

Section 3: The Project 65

Introduction 65

Rationale 66

Review of the Literature 66

Teacher Professional Development 67

Teacher Mentoring 69

Instructional Coaches 70

Teacher Preparation Programs 72

Project Description 74

Necessary Resources 75

Possible Barriers and Solutions 76

Implementation Proposal 76

Roles and Responsibilities of Researcher and Others Involved 78

Project Evaluation Plan 78

Project Implications 79

Section 4: Reflections and Conclusions 80

Project Strengths and Limitations 80

Recommendations for Alternative Approaches 83

Scholarship, Project Development and Evaluation, and Leadership and

Change 84

Reflection on the Importance of the Work..86

Implications, Applications, and Directions for Future Research 87

Conclusion 89

References..90

Appendix A: The Project 104

Appendix B: Interview Protocol and Questions 183

List of Tables

Table 1. Alternative Qualitative Methods Considered and Reasons for Rejection 25

Table 2. Alignment of Research to Interview Questions.. 32

Table 3. Emergent Themes, Related Codes, and Research Question Alignment 40

Table 4. Projected Timeline for Project Implementation.. 77

Section 1: The Problem

The Local Problem

The problem is that elementary mathematics teachers are being provided with technology to use in conjunction with their mathematics curriculum; however, they are not receiving any guidance or supports on how to best incorporate the technology into the educational setting. Elementary mathematics teachers in the study district acknowledged that they were struggling with how to incorporate the technology being provided. As a result, technology generally becomes a classroom ornament rather than a tool for learning. These technology issues are troubling, considering that most teachers have a positive outlook and appreciation of how important technology in the classroom can be (Drossel et al., 2017; Safitry et al., 2015; Tariq et al., 2023). Further, Drossel et al. (2017) recognized that while teachers' attitudes are critical in the effective use of technology in the classroom, teachers also require school supports to successfully incorporate technology into the mathematics curriculum.

While many researchers have concluded that incorporating technology into the educational setting has been shown to improve academic performance, additional research is necessary to understand the practice gap that exists regarding teachers' implementation of best practices for incorporating technology into the mathematics curriculum. In this study, I explored what supports and guidance mathematics teachers in the study district need to successfully integrate technology into their mathematics curriculum.

Technology use has grown exponentially in the recent past. All aspects of life have been changed by technology in some way, and this especially includes the world of education. The problem addressed through this study is that technology is being introduced into classrooms with the expectation that the technology will be used to support the curriculum to make learning more efficient and effective. However, second through sixth-grade teachers are experiencing challenges in integrating educational technology to support the mathematics curriculum in an urban public district in the Northwest region of the United States.

In the local setting for this doctoral study, students in second through sixth grade have access to a Chromebook that can be used within the classroom and taken home in the event of remote learning. Additionally, every second through sixth-grade classroom has a Promethean ActivPanel. When these smart boards were placed in classrooms, teachers were only provided a 30-minute training session. As a result, many teachers in the study district report using the smart boards as nothing more than a fancy television screen or not using them at all and simply storing them in the corner of the classroom, some not even plugged into an outlet. While the school district has provided several types of technology for students, teachers are not being guided on best practices for using the technology to support student learning. Teachers report a desire to utilize technology in the classroom, especially within the mathematics curriculum. Still, they are unfortunately unable to understand the best ways to begin using technology and, therefore, fall back on known practices of working strictly from a textbook or worksheets. The purpose of this basic qualitative study is to explore what challenges second through sixth-grade teachers face when attempting to utilize educational technology to support the mathematics curriculum at an urban public school district in the Northwestern United States.

As technology becomes mainstream, children are entering the classroom with extensive knowledge regarding technology use. This prior knowledge is undoubtedly due to their exposure to technology from a very young age (Bacak et al., 2022). In the past, an average American classroom included desks, chairs, chalkboards, maybe some posters, textbooks, an educator, and students. An average American classroom today will generally present a similar image with one exception. Most of today's classrooms have some type of technology. As technology continues to be interwoven into all aspects of education, it is essential to acknowledge how technology is affecting student learning and teacher performance (Atwa et al., 2022). Additionally, as the world continues to navigate the ongoing COVID-19 pandemic, technology has become a necessity in the education world, as many students and teachers were forced to adapt to a remote learning model when schools abruptly closed. As a result, many schools have developed plans and implemented best practices for learning with technology, while others have lagged (Liu et al., 2021).

The study district for this project is a PreK-12th grade public school district that consists of one preschool building, 15 elementary school buildings, two middle school buildings, two traditional high school buildings, and one alternative high school building. Additionally, the district has partnered with the local 2-year college campus to provide adult learning opportunities. The district serves approximately 10,000 students with just over 700 educators. The vision and mission statements for the study district focus on preparing students for their future. With the current world climate, students will encounter a future that includes technology. The study district has acknowledged this future, and as a result, technology has been purchased for classrooms. For example, each elementary classroom now has a Promethean ActivPanel and a class set of Chromebooks. However, there has been little guidance on how best to implement the use of technology in the classroom, specifically how to integrate technology into the mathematics curriculum.

Rationale

Two things are necessary for teachers in Grades 2–6 to begin using technology to support the mathematics curriculum. First, districts need to provide guidance in the form of training geared toward using technology in the classroom. Second, ongoing support must be provided in the classroom with job guides and technology coaches that can model or co-teach lessons that integrate technology into the mathematics curriculum (McBride, 2023).

Phan et al. (2021) recognized that when teachers are provided with effective training in understanding how to teach with technology, teacher self-efficacy in using technology increases, which in turn leads to technology being used in the classroom more effectively and efficiently. Similarly, Hall et al. (2019) highlighted how teacher self-efficacy levels improved when teachers were provided with personalized training plans geared towards using technology in the classroom to support student learning. Finally, Magana (2017) used a tiered approach to implementing technology in the classroom to identify the importance of utilizing technology above simple, translational ways to maximize student learning. School districts that use the T3 framework for innovation to guide the development of training plans set teachers up for success in using technology in the classroom (Magana, 2017).

The T3 framework for innovation is designed to help educators implement educational technology tools by enhancing the current instructional practices (Magana Education, n.d.). This framework works as a hierarchy with three categories: translational, transformational, and transcendent. Translational uses technology in education for automation and consumption, transformational uses educational technology for contribution and production, and transcendent uses educational technology for inquiry design and social entrepreneurship. Each level requires a different range of abilities for educators (Magana Education, n.d.).

Definition of Terms

The following terms are defined and cited to provide clarity for readers of the research study.

Educational technology: "the technological tools and media that assist in the communication of knowledge, and its development and exchange" (Lathan, 2023, para. 5).

One-to-one model: The practice of a school district providing electronic devices to students so that all students have access to their own devices (Peled et al., 2022).

Substitution, augmentation, modification, and redefinition (SAMR): A model developed to tie content into technology integration through the tasks of substitution, augmentation, modification, and redefinition (Drugova et al., 2021).

T3 framework for innovation: A framework for technology integration using a hierarchy of three stages, translational, transformational, and transcendent, to bring value to education through technology integration (Magana, 2017).

Technological pedagogical content knowledge (TPACK): A framework that ties together content, pedagogy, and technology to build best practices for technology integration into education (Drugova et al., 2021).

Significance of the Study

Technology made its way into education as far back as the 1920s when the radio found its way into the classroom (AGiRepair, 2021). Despite the extensive time that technology has been in the school setting, research has continued to highlight a gap that exists between the innovation of technology and the implementation of technology in schools (Ruiz, 2020). While technology is increasingly present within classrooms, teachers are continuing to report that technology is not playing a role during instructional time (Antonietti et al., 2022; Doğan & Adams, 2018). This study explores how mathematics teachers perceive the role of technology in the classroom and practices related to integrating technology into the mathematics curriculum.

This study addresses a specific PreK-12 public school district that has been increasing the amount of technology that is available for students' use. This increase was partially propelled by the Elementary and Secondary School Emergency Relief funds, which have been provided to allow schools to meet student needs during the ongoing COVID-19 pandemic. In making these purchases, the school district has adopted a one-to-one model where every student has access to a Chromebook that they can use for both in-person and remote learning. While the technology has been purchased and placed into classrooms, teachers in the district are not being provided with guidance to integrate the technology into the curriculum effectively. The ongoing COVID-19 pandemic is changing the way teachers are teaching and students are learning daily (Irwin et al., 2022). The study is necessary to determine how to help teachers in the study site navigate these challenges. Additionally, during the study, I looked at the need to develop the training programs required to ensure that students are receiving the high level of education they deserve. Providing the high level of education deserved will help ensure students will be prepared to enter college or the workforce following completion of their time in the study district.

Research Questions

The research questions that steered this qualitative study explore what guidance and supports second through sixth-grade teachers feel they need to be able to successfully integrate technology use into the mathematics curriculum. These guiding questions have been developed based on the gap shown to exist in teachers' perspectives regarding integrating technology into mathematics curriculum. Additionally, these questions were developed based on Magana's (2017) T3 Framework, which focuses on moving the use of technology along the continuum from translational uses, past transformational, and into the highest integration level of transcendent.

RQ1: In what ways are teachers in the study district currently incorporating technology into their mathematics curriculum?

RQ2: What guidance is needed to ensure teachers are prepared to use technology within the mathematics curriculum?

RQ3: What supports are needed to ensure teachers can utilize technology to support the mathematics curriculum?

Review of the Literature

Technology has continued to progress at a momentous rate. This progression has led to many changes in everyday life, and schools have not been exempt from experiencing these changes (Yanwar et al., 2022). Teachers are working to prepare students for life beyond the school building, and this includes preparing students for a career that may require skills such as communication, problem solving, collaboration, and critical thinking (Aizenkot et al., 2023). While many school districts have embraced this challenge and worked to incorporate technology in meaningful ways in the classroom, others have lagged. Those districts that are resistant to making necessary changes are leaving their students at a disadvantage as they complete their compulsory education (Lythreatis et al., 2022).

In this literature review, I begin with a discussion of the conceptual framework, a review of the literature related to the broader problem, the inconsistencies of technology integration, the benefits of technology integration, and the challenges of technology integration. This review includes sources that discuss the conceptual framework, how schools are currently using technology to prepare students for their future, how technology standards are an essential element in successfully using technology in the classroom, and the consequences of neglecting to incorporate technology into the classroom.

The purpose of the literature review is to provide a critical analysis of current research on the area of technology integration within the second through sixth-grade mathematics curriculum. This review highlights the barriers faced by teachers when attempting to integrate technology into the teaching of mathematics. Magana's T3 framework for innovation theory is the framework for understanding best practices for successful technology integration into the mathematics classroom.

Conceptual Framework

The conceptual framework for this project study is the T3 framework for innovation developed by Magana (2017). The T3 framework for innovation is an advancement on the well-known technological, pedagogical, and content knowledge (TPACK) and the substitution, augmentation, modification, and redefinition (SAMR) models and was conceptualized by Sonny Magana (Magana, 2017). Both the TPACK and SAMR models have been well established in the educational community and served education and the integration of technology into the classroom well (Umutlu, 2022). However, as technology has continued to change, it has become apparent that both the TPACK and SAMR models have significant limitations, and therefore, a shift was required (Magana, 2017). From that necessary change, the T3 framework for innovation has emerged.

While TPACK and SAMR have provided the baseline necessary for introducing technology into classrooms, the T3 framework for innovation allows educators, administrators, and stakeholders to view technology objectively based on the value it brings to education (Magana, 2017). The T3 framework for innovation is laid out in three stages: translational, transformational, and transcendent. Each stage plays an important role in understanding how to develop and reinforce best practices in technology integration in the mathematics curriculum.

The first stage, translational, occurs when assignments and activities that are analog or non-digital in nature are moved to a digital format (Magana, 2017). The assignment or activity could still be completed without the use of technology. In the translational stage, educators provide automation to learning by incorporating technology, and students are the consumers of the technology. An example of the translational stage is moving a worksheet to a Google Doc. Despite the simplicity of the translational stage, it is an important first step for many educators and districts, as this stage can help break the traditional model of teaching by incorporating technology in a way that teachers feel comfortable with using.

In the second stage, transformational, the assignment or activity is changed considerably when compared to the non-digital or translational stage. In this stage, production and contribution are addressed. Students use technology to create or produce examples of their learning. Additionally, students are expected to contribute to the learning of their classmates by sharing what they have created. In this stage, technology is required to show mastery of the content and learning is student-centered (Magana, 2017). For example, students might use an app such as Flipgrid to solve presented math problems that are then shared with their classmates digitally for collaborative-based work.

In the third stage, transcendent, students demonstrate inquiry design and social entrepreneurship. In this stage, students are the leaders, and they are responsible for producing solutions to a real-world problem they are passionate about. Students are immersed in technology and digital tools as they create new technologies or platforms and test and revise their solutions with guidance from their teachers (Magana, 2017). This stage might look like a Makerspace-based classroom, with students using the digital whiteboard app Jamboard to create and solve math equations collaboratively or students using the game-based learning tool Minecraft EDU to develop a livable habitat for humans to survive on Mars. In the transcendent stage, technology tools are at the forefront of education. This stage is a highly disruptive innovation for most classrooms but is the model that provides the most effective and efficient methods for incorporating technology into the mathematics curriculum.

Review of the Broader Problem

The purpose of this review of the current literature is to provide insight into the current research of technology integration, specifically with an emphasis on technology integration into the second through sixth-grade mathematics curriculum. This review sheds light on the lack of a common language for educational technology, the benefits of integrating technology into education, and the barriers teachers face when attempting to integrate technology into teaching mathematics. The study district has made efforts to integrate technology into the classroom; however, teachers in the study district report not knowing the best ways to integrate technology into the mathematics curriculum. Therefore, this area of study must be addressed as the study district moves forward with the goal of helping produce students who are prepared to enter college or the workforce with the appropriate and necessary 21st century skills.

The study district is not the only school district that has been affected by the changes brought about by technology. Technology has infused the world. Each step forward in technology, no matter where the breakthrough occurs, sends ripples around the world, and those ripples are being felt in the realm of education (Yan, 2022). Students are entering preschool and kindergarten with more technology knowledge than ever before. Students' brains are hardwired to perform better when learning is augmented by technology (Taylor, 2012). For these reasons, it is crucial to capture students' ingrained talent and utilize it in the classroom.

It has been well established that technology has been present in the classroom for an extended time. Moreland and Spector (2023) highlighted this fact by reminding readers that even the slide rule, a handheld tool used in classrooms for decades, is a type of educational technology. Despite this long-running presence of technology in the classroom, little is being done to ensure that technology is being successfully incorporated within the mathematics curriculum of the elementary classroom (Perienen, 2020). Many reasons have contributed to this lack of progress, including a lack of a standard definition for educational technology and a myriad of problems that plague schools and educators as they attempt to navigate the use of technology in the classroom.

To address the purpose of this study, I conducted a review of the current literature on technology integration. The research was conducted primarily through the Walden University Library and Google Scholar. Additionally, some educational websites were utilized in the research. Throughout the research, I referenced a wide variety of sources, including peer-reviewed journals, scholarly books, and dissertations. I accessed research from a variety of educational databases, including Education Source, ERIC, SAGE Journals, Taylor and Francis Online, and Academic Search Complete, in order to achieve appropriate saturation of the current literature regarding technology integration into the mathematics curriculum. I utilized the following key terms in the search for peer-reviewed, scholarly articles: *integration of technology, technology integration and elementary education, technology integration, and mathematics instruction, technology in the classroom, benefits of technology integration in education, TPACK, SAMR, and T3 framework for innovation*. Several major themes emerged in the literature review, including the lack of a definition for educational technology, the benefits of technology in education, and the challenges to technology integration.

Definition of Educational Technology

Technology is a highly fluid concept with rapid shifts and changes. This constant change adds to the challenge of pinning down a consistent definition of educational technology (Dishon, 2022). This lack of definition is evident in daily conversations with teachers and in reading the literature (Zengin, 2023). For example, when typing "educational technology" into Merriam-Webster, no results are found. Bond et al. (2020) acknowledged the struggle to find a standard definition of educational technology. This lack of a common language has led to many problems integrating technology into the classroom; therefore, it is essential to have a common definition moving forward.

The first step in defining something is to break it down. For example, looking at education, Encyclopedia Britannica provides the well-established idea that education "can be thought of as the transmission of the values and accumulated knowledge of a society" (Nakosteen et al., 2023, para. 2). Moving on, technology is described as "the application of scientific knowledge to the practical aims of human life or, as it is sometimes phrased, to the change and manipulation of the human environment" (Technology, 2023, para. 1). Finding common ground between these two ideas is the next necessary step. Looking at both terms concurrently results in some themes beginning to emerge, and a definition starts to take shape.

For the purpose of this study and to ensure cohesiveness throughout the study, educational technology included the available technological tools and the theory and practice of scholarly approaches to learning with those tools. Therefore, in this study, I used a definition provided by Dr. Joseph Lathan at the University of San Diego that educational technology is "the technological tools and media that assist in the communication of knowledge, and its development and exchange" (Lathan, 2023, para. 5).

Benefits of Technology Integration

Dishon (2022) discussed the idea that technology is ever-changing, and considering technology makes human life more accessible, there must be many benefits to including technology in the classroom. Some of these benefits are well known, such as increased student achievement, increased student engagement, enhanced creativity, improved communication, and collaboration. With the potential of these great benefits, schools must understand and utilize technology within the classroom.

Increasing student achievement has been the driving factor of many changes within the classroom and continues to be a high point of educational research. Unlocking the mystery of helping students learn and perform better has spilled into the technology section. For example, Lu et al. (2020) completed a study that used a game-based learning format to increase student achievement. One group used an augmented reality (AR) based design, while the other group of students used a paper method of a similar game. While both groups showed knowledge acquisition and retention, the researchers found that students' test scores were significantly higher when using the AR learning model than were those of their peers using a paper model to learn the same material. Similarly, Sökmen et al. (2023) found that students using an AR-enhanced learning environment showed higher academic achievement and participation levels.

Many aspects of teaching can help develop a fully prepared student to enter college or the workforce. One of the areas that is often overlooked is the development of the skill of creativity in students. The Harvard Business School highlights the importance of creativity to encourage innovation, boost productivity, allow adaptability, and foster growth (Boyles, 2022). However, the traditional teaching model of lecture does not generally provide for the inclusion of creativity. Hwang et al. (2022) recognized the significance of creativity and researched how using technology in the classroom can affect student creativity. Using technology-based programs in forensic science, digital therapeutics, and artificial intelligence (AI) humanities with elementary and middle school students, Hwang et al. found that both student satisfaction and creativity were increased.

Humans are generally social creatures that thrive on communication and collaboration. This desire to interact with others is also true for students in the classroom. The traditional teaching model of lecturing does not tend to foster any collaboration between students; the communication is one-way from teacher to student. When technology enters the classroom, the teaching model shifts and communication becomes a back-and-forth between student and teacher as well as between student to student (Ricke, 2022). Students already use technology to communicate and collaborate with their peers outside of school, so bringing that into the classroom is a natural transition. Using ed tech tools such as Flipgrid, Pear Deck, Prezi, and Screencastify to foster student collaboration increases student participation and engagement, leading to higher student achievement (Sanders, 2016).

Allowing students to have additional opportunities to practice communication and collaboration is one beneficial step forward, but technology still brings so many additional opportunities to elementary students. Infusing technology into the classroom has shown to be a cost-effective method for teaching students (Haleem et al., 2022). Additionally, bringing technology into the classroom affords disadvantaged students opportunities to explore the world around them in a way that might not have been possible without technology integration. Students have been taken around the world on virtual reality field trips, and expert guests can speak and interact with classes over Zoom

(Huh, 2020). In addition to benefiting disadvantaged students, technology integration can bring benefits to culturally inclusive classrooms. Integrating technology in this setting can bring awareness, relevance, and a supportive environment with equitable access and flexibility (Prabhu, 2020).

To capture these benefits, teachers must understand and use best practices when integrating technology into the classroom. The benefits will mean increased student achievement and ensure that all students get the education they deserve to reach their highest ability level. While the benefits are numerous, it is essential to note that there are also challenges to integrating technology into the classroom.

Challenges of Technology Integration

The benefits of technology integration are numerous, but that does not mean that technology integration does not come along with challenges. Technology is a highly fluid concept with constant changes and fluctuations. When incorporating technology into the classroom, some of the more common challenges include students misusing the technology, lack of teacher knowledge, and the cost of new technology.

As mentioned, today's students generally arrive at school with extensive experience in using technology. The knowledge they bring, however, tends to be geared toward the use of technology for entertainment rather than educational experiences. Additionally, students might use technology in the classroom as a source of plagiarism. Lucky et al. (2019) found that the use of technology in education can increase the rate of cheating by students by more than 12 times compared with a classroom that does not utilize technology. While there are some ways to detect cheating and plagiarism, students continue to find new ways around the systems put in place to discourage and identify this behavior. A simple Google search on how to cheat a plagiarism checker provides over 44 million results, which include some genuine responses on how to paraphrase and rewrite work to avoid plagiarism, but mainly, the search contains tips and tricks for how to get away with plagiarism. New to the plagiarism challenge is the many generative AI tools that students now have access to. Aside from plagiarism, researchers have found that when students use these generative AI tools, such as ChatGPT, they are not gaining the critical thinking skills that will be necessary to be prepared to enter college or the workforce (Ellis & Slade, 2023). In addition to plagiarism, students are also using technology to share and sometimes even sell answers to other students (Smale et al., 2021). Cheating is just one hurdle that needs to be cleared while integrating technology into the classroom. Schools also need to address teacher knowledge and professional development opportunities for teachers in using technology for educational purposes.

While many teachers currently beginning their careers in education do bring some knowledge on the use of technology in the classroom, the majority of teachers are not currently using best practices for integrating technology into education (Zhou et al., 2022). Most teacher preparation programs acknowledge the need to prepare future teachers to use technology in the classroom, but most fall short of meeting the needs of future teachers (Foulger et al., 2019). For example, a nearby teacher preparation program at a university requires students to complete 87 credits to graduate with a bachelor's degree, which leads to teacher certification. Of those 87 credits, only two are devoted to the use of technology in the classroom. Another nearby college that also offers a bachelor's degree in education leading to licensure requires only three credits to be dedicated toward technology integration into education out of a total of 85 credits needed for graduation. Teacher preparation programs are not preparing future teachers for using technology in the classroom. Foulger et al. (2019) identified the need for teacher preparation programs to implement technology infusion into all content and pedagogy courses. Getting technology infused into teacher preparation programs is only the first step in ensuring teachers are prepared for technology integration. Providing continuing education and professional development is also necessary.

Navigating the COVID-19 pandemic and the abrupt shift to remote learning models helped highlight the discrepancy in technology-based professional development options for teachers. Now that we are transitioning out of the pandemic, the professional development pendulum is shifting away from offering numerous technology based options. This current model of professional development leans toward saturation in just a few areas while generally leaving other areas, such as technology integration, behind. The ideal format would be a wide variety of options to provide the most value to teachers (Lockee, 2021). Another option would be to infuse professional development courses with technology integration whenever feasible.

Another major hurdle in technology integration in the classroom is the cost that districts face when attempting to provide technology for student use. A report published by the EdTech Evidence Exchange (Mar. 2021) found that the average amount spent by K-12 school districts in the United States ranges between $26-41 billion annually. For the 2023 fiscal year, the study district allocated a total of $862,353 of the budget specifically to technology. This amount was spread across all K-12 grade levels and accounted for only 0.80% of the total budget. Additionally, the total amount of money budgeted for technology in the study district has decreased yearly for the past four years. This ongoing budget decrease illustrates the district’s attitude toward the importance of technology integration. The cost associated with technology only becomes a more significant hurdle when considering how rapidly technology changes (Dubé & Wen, 2022). Aside from the upfront costs that can keep technology out of reach of education, the rapidly changing world of technology can also lead to teachers not being prepared to keep up with the changes.

Additionally, many districts are not always utilizing the available funds to their fullest potential. Morrison et al. (2019) found that many districts are not utilizing needs assessments when purchasing educational technology and instead are basing purchasing on peer recommendations and pilot try-out programs. Working with large amounts of funds for technology should be seen as an investment for the school district, and the district should be afforded the proper research to ensure the investment is in its best interest.

Funding for a district is a high attention area, but maintaining a safe classroom environment is another area that needs to be addressed in every school district. A lot of thought has gone into the physical safety of schools; however, digital safety does not always get the same level of attention. It is important to address digital safety for students and staff when incorporating technology into the classroom. This process should include a digital citizenship program. Digital citizenship is described as “appropriate, responsible, and empowered technology use" by staff and students (Ribble & Park, 2020, p. 25). As mentioned, students are arriving at school with some proficiency in using technology, which can lead some educators to assume that these early learners are already digital citizens (Bacak et al., 2022). While many of today's students are digital natives, educators need to understand that this does not equate to students understanding what it means to be a good digital citizen. As a result, digital safety concerns such as cyberbullying are on the rise (Martin et al., 2021).

Implications

The adoption of a one-to-one model of each student having access to technology devices has led to an enormous push for teachers to be proficient in integrating technology into the curriculum. This study can be used to understand the needs of teachers as they work toward finding effective and efficient ways to transition from traditional methods of teaching to technology-infused methods. Suppose teachers can have the guidance and supports necessary to implement technology into their teaching practices. In that case, it can be expected that teachers will begin to move toward transcendent uses of technology. A potential outcome of this study is to help teachers enact positive social change every day in their classrooms by tapping into the desire of 21st century learners to interact with technology while learning. This can produce students who are engaged and ready to enter college or the workforce with the necessary skills to be successful.

Providing students with the necessary 21st century skills they will need to be successful in college and the workforce is at the forefront of most school districts' visions and missions. With the future of the world moving forward with technology, it is no wonder schools are identifying these skills as highly necessary and desirable. Integrating technology into the classroom provides students the opportunity to develop digital fluency, which will lead to students who are competent in using and adapting to new technologies (Fleming et al., 2021).

A possible avenue for moving forward is to develop job guides for teachers based on the information gained by the research. An additional direction is to develop and deliver training courses geared toward meeting teacher needs based on the findings of the research.

Summary

The T3 framework for innovation guides teachers as they make the transition from traditional teaching models where no technology is used to the ability to incorporate technology into the curriculum instruction seamlessly. In Section 1, I have examined the local problem, the rationale for the study, definitions of terms, the significance of the study, the research questions, a review of the literature relating to the conceptual framework and the broader problem, and implications for the project. In Section 2, I will provide the methodology, including the design and approach, participants, methods for collecting data, data analysis, and limitations of the study.

Section 2: The Methodology

Introduction

In this study, a qualitative design was used to explore the guidance and supports that teachers deem necessary to integrate technology into the mathematics curriculum. I selected a qualitative approach due to the purpose of the study being to explore technology integration within the curriculum rather than working towards confirming a hypothesis (Saldaña, 2011). I used interviews in this basic qualitative study to understand what guidance and supports teachers feel are necessary to incorporate technology into the mathematics curriculum. I collected data through interviews to answer my three research questions:

- RQ1: In what ways are teachers in the study district currently incorporating technology into their mathematics curriculum?
- RQ2: What guidance is needed to ensure teachers are prepared to use technology within the mathematics curriculum?
- RQ3: What supports are needed to ensure teachers can utilize technology to support the mathematics curriculum?

The purpose of this study was to examine what guidance and supports are necessary for second through sixth-grade mathematics teachers to integrate technology into the mathematics curriculum effectively. This information is helpful in addressing the local problem that elementary teachers are not implementing technology into the mathematics curriculum as intended by the district's curriculum documents for technology learning. In the following sections, I describe the qualitative study, describe the data that was collected, and how the data I collected helped answer the research questions.

Qualitative Research Design and Approach

The qualitative research method lends itself to exploratory research that sets out to determine an understanding of the patterns and themes related to the study area. According to Saldaña (2011), qualitative research is descriptive and often used to explore complex social phenomena. This study used interviews to explore what teachers need to be able to integrate technology into the mathematics curriculum successfully.

According to Saldaña (2011), a qualitative method is selected for research when the researcher is attempting to build an understanding of human experiences. This method allows the researcher to build interpretations from natural observations. Qualitative methods are often used in conjunction with participant observations and interviews in a natural setting and allow the researcher to use both inductive and deductive reasoning to analyze data to establish potential patterns or themes (Saldaña, 2011). After a thorough review of qualitative methods, I selected a basic approach to allow for the study of a problem in the field and the interpretation of teacher experiences with integrating technology into the mathematics curriculum in the study district. I considered the following qualitative methods and ultimately rejected them: case study, narrative inquiry, phenomenology, ethnography, and grounded theory (see Table 1). Although each of these study methods has great merit when used, I decided each would be inappropriate for this study.

Table 1

Alternative Qualitative Methods Considered and Reasons for Rejection

Qualitative method	Method's purpose	Reason for rejection
Case study	A case study is a deep focus on a single aspect of a study for analysis. This might be a single person, group, event, etc. (Saldaña, 2011).	While this study is focusing on a specific location the study is not limited to only a single location and could be transferred to additional locations.
Narrative inquiry	Narrative Inquiry looks at transforming data from participants into a narrative format that presents an artistic approach to the data (Saldaña, 2011).	This study will include some narrative aspects to report the data but is not focused on presenting all data in a narrative approach.
Phenomenology	Phenomenology looks at nature and the meanings of things with an emphasis on the lived experiences of humans (Saldaña, 2011).	This study will ask teacher participants about their experiences with integrating technology into the mathematics curriculum but will not be focused on comprehending or describing those experiences.
Ethnography	Ethnography views the social life of a group to develop a view of a group's culture from the members of the group's perspective (Saldaña, 2011).	This study looks at individual teachers' needs for integrating technology into the mathematics curriculum and does not look at teacher culture.
Grounded theory	Grounded theory requires thoroughly analyzing data to discover human processes in an attempt to develop a core that then becomes the foundation for a theory about the observed processes (Saldaña, 2011).	While the data in this qualitative study will be thoroughly analyzed, it is not intended to develop a theory.

The qualitative data collection instrument used in this study is a semistructured interview. Semistructured interviews were conducted to gather personal experiences from the participants in an effort to understand the phenomenon fully. All efforts were made to conduct participant interviews in person. However, navigating the COVID-19 pandemic required flexibility. As necessary, interviews were conducted by phone. Interviews were audio recorded and transcribed.

Participants

Criteria for Selecting Participants

I planned to have a purposive sample of approximately 10 to 12 participants. Keeping a small purposive sample of roughly 10 to 12 participants was encouraged by Patton (2015), as a smaller sample can provide the researcher with a deeper understanding and connection with each of the participants in the qualitative study. Therefore, it provides the most valuable data for the research.

For this study, I recruited participants from 15 different elementary schools and included mathematics teachers from a variety of areas, including general education, special education, title services, and extended curriculum services. Additionally, my participant pool included varying levels of teaching experience, ranging from novice to veteran teachers. Participants were required to meet the following criteria: currently teaching second through sixth grade mathematics in the study district. I solicited participants on a voluntary basis only. To recruit participants, I emailed potential participants an invitation to participate. Once I received a response from a potential participant, I sent them a Google Forms survey to gather information, including grade level taught, current location of teaching, what type of teaching position they are in, and number of years total of teaching. The district provided email addresses for potential participants via the online staff directories.

The invitation to participate included information about the purpose of the study, the criteria participants must meet to be included, and the procedures the participants could expect to experience while they are study participants. To ensure my participants are a varied representation of teaching experience and grade levels, I followed up with each potential participant to gather this information by asking what grade level they have most recently taught mathematics in and how long they have been teaching mathematics. This follow-up was made via email after a participant expressed interest in taking part in the study. I used this information to narrow the participant pool and ensured a wide variety of participants were included.

Procedures for Gaining Access to Participants

The study district greatly understood the value of educational research and has adopted a straightforward process for approving educational research requests. The study district required the study proposal with all inventories and questions to be submitted for review. Additionally, the study district required an explanation of how the results would be shared with the district. Once I provided all the documentation, the study was approved by the curriculum department of the study district. It was then sent to the study district superintendent, where the study received final approval.

After approval was granted by the study district and from Walden University’s institutional review board (IRB), I reached out to current second through sixth-grade teachers via staff directories of the study district elementary schools. I initially reached out to 75 teachers who would potentially meet the study criteria. In the initial email to potential participants, I included information regarding the study, criteria for selection, and an informed consent form. The informed consent included information on any possible risks and benefits as well as participants' rights and protections. In response to my invitation to participate, I sent each teacher who expressed interest in the study a link to a Google form that asked each potential participant for their name, school, grade level(s), number of years teaching, and if they are a general education teacher, special education teacher, or title teacher. I initially received interest from 16 teachers. After sending the Google form out to those 16, I received back 15. After looking over the responses provided, I narrowed the participants down to 12. Once the participants were selected, I contacted them to schedule their interviews. At the start of each interview, informed consent was received. When working on planning this research study, I had planned to adjust my study to include teachers in kindergarten and first grade and potentially also the middle school grades, which are seventh and eighth grade in the study district. By including these teachers in my participant pool, I would increase my pool from approximately 200 individuals to around 300 potential participants. Fortunately, I was able to recruit the participants I needed without adjusting the study.

Establishing a Researcher–Participant Relationship

I am currently employed in the study district as a third-grade general education teacher. I currently have 7 years of experience in teaching mathematics in the study range of second through sixth grade. In my current teaching position for the study district, I have had professional contact with many teachers who fall within the study criteria, and this has helped with relationship establishment and building. In the study district, I am not currently serving in a supervisory role to any potential participants. When I recruited a participant who was unknown to me, I reached out via email to ensure that a relationship was built prior to the scheduled interview. Additionally, I ensured that I was available to participants to answer any questions that they might have throughout the entire process. The main reason for developing and maintaining relationships with the participants was to help participants feel comfortable when the time came for the interview. Keeping the participants comfortable allowed a level of trust that allowed for open dialogue throughout the process (Karagiozis, 2018).

Protection of Participant Rights

Building the level of trust needed to ensure positive relationships with the participants began with informing participants of the rights and protections afforded to them as voluntary participants. I assured participants of their rights, including strict confidentiality and protection from harm. These protections are of the utmost importance for me as a researcher. The initial step in protecting participants' rights began with obtaining informed consent. The informed consent form provided participants with extensive information about the study, including the objective, the roles of the participant and the researcher, and how the results from the study are shared and used. I also informed participants of the voluntary nature of their role as a participant and their ability to opt out of further participation in the study at any time. Additionally, I informed participants on how data were collected and stored. All of this information was discussed again with the participants at the beginning of the interview. Following this strict sequence of events helped ensure that no ethical issues would arise (DiCicco-Bloom & Crabtree, 2006).

To maintain the confidentiality and privacy of the participants, I identified each participant by a number, and no names were used. I used no identifying information for participants in the study. In addition, I did not release any school names in the study, and I did not identify the study district. Masking the names and locations protected all participants from potential harm (Patton, 2015). The recorded interviews were secured on my laptop computer in a password-protected file to prevent unauthorized access. Additionally, I secured all digital data on my computer in a password-protected file, and I secured all handwritten files in a locked safe at my home. I will hold all data for the required 5 years and then destroy all data.

Data Collection and Analysis

Interview Protocol

This qualitative research study explored the supports and guidance that teachers need to be successful in integrating technology into the math curriculum. The qualitative method of this study allowed me to interpret the data and gain a deep understanding of the data for the study (Saldaña, 2011). Data collection was paramount to the success of the study. Once I received approval from Walden University’s IRB and the superintendent of the study district, data collection began. I collected data from the participant interviews on their experience in using technology in the classroom and their perceived supports and guidance needed for effectively integrating technology into the mathematics curriculum. Interviews were the primary data source and provided the bulk of data for the study. The semistructured interviews were open-ended to allow for natural conversations, which led to detailed and in-depth discussions (Rubin & Rubin, 2012).

I developed the interview protocol with consideration of the conceptual framework, the problem statement, and the research questions. The first consideration was finding the current level of knowledge and comfort of the participant regarding integrating technology into the mathematics curriculum. Once the base level was known, we moved on to the conceptual framework. The T3 framework for innovation discusses three stages for using technology in the classroom. The three stages are translational technology use, transformational technology use, and transcendent technology use (Magana, 2017). It was important to understand where on the stages list the participants were currently in using technology within their mathematics teaching. Next, I asked participants about the supports and guidance that the study district could provide to teachers to be more successful in integrating technology into the mathematics curriculum. Finally, I allowed the participants to add any additional information they might want to share and ask if they had any questions or would like any clarification on any parts of the study. The interview consisted of eight questions (see Appendix B). Each interview question was guided by the study research questions (see Table 2).

Table 2

Alignment of Research to Interview Questions

Purpose of the interview question	Interview questions	Research question alignment
Determine the participant's current knowledge and comfort level for using technology in their mathematics instruction.	• Describe your knowledge and use of technology in your mathematics instruction in your classroom. • Describe your strengths in using technology in your mathematics instruction. • Describe your weaknesses in using technology in your mathematics instruction.	RQ1
Determine the level at which the participant is currently using technology in their mathematics instruction, with specific questions about the T3 Framework for Innovation.	• Describe times in your mathematics instruction when you use technology at the translational level or in a way that could be accomplished with paper and pencil. • Describe times in your mathematics instruction when you use technology at the transformational level or in a way that students use technology for production or contribution. • Describe times in your mathematics instruction when you use technology at the transcendent level or where students use technology for inquiry design.	RQ1
Determining what supports and guidance the participant feels would be helpful in integrating technology into their mathematics.	• What guidance from the district do you feel is needed to help you with integrating technology into your mathematics instruction? • What supports from the district do you feel is needed to help you with integrating technology in your mathematics instruction?	RQ2 and RQ3

I followed up with each participant after their interview was complete to ask for any final information they might want to share. Each interview lasted between 30 to 45 minutes and was audio recorded. The recordings were uploaded and stored on my computer and were password protected for security.

Sufficiency of Data Collection

All data collected were from the semistructured interviews. These interviews were completed in person or via phone call, and all were completed in a one-on-one setting. I reviewed the data for sufficiency to ensure a thorough understanding of the supports and guidance second through sixth-grade teachers feel they need to be able to successfully integrate technology into the mathematics curriculum, which was the purpose of this study. The interview questions addressed the 3 research questions. Additionally, during the interviews, probing questions were utilized as necessary to achieve data saturation. According to Patton (2015), saturation is achieved when no new information can be gained. Further, saturation is achieved when analysis begins to extend beyond the bounds of the study (Patton, 2015).

System for Keeping Track of the Data

All interviews were audio recorded, and I created transcripts in an electronic Word document. The audio recorder contains all original recordings, and I secured all recordings in a locked safe at my home. All audio recordings were also saved securely on my laptop in a password protected file. All transcripts, digital notes, researcher memos, and research logs were saved digitally and securely on my laptop in a password protected file. I secured all handwritten notes, logs, and journals in a locked safe at my home.

The Role of the Researcher

My time as a teacher in the study district has provided me with hands-on experience with the integration of technology into the classroom. I have been in the classroom as new technology has been purchased by the district and brought into the classroom. Additionally, my experience as a teacher during the COVID-19 pandemic highlighted the importance of being technology capable in teaching as we were forced to transition to a remote learning model rapidly.

As more technology entered the classroom, it became apparent that many elementary teachers were struggling with integrating technology into the mathematics curriculum across the district. With the study district's drive to integrate technology, this study will be beneficial in their plan, outlined in the district's technology plan, of integrating technology into the classroom. Finally, building and maintaining relationships with the participants and study district administrators was a priority in my role as the researcher.

Evidence of Quality

As I collected the data for this qualitative study through the interviews, I reviewed the data for emerging codes as I developed transcripts. Additionally, I read the transcripts many times to obtain a broad view of the data. During this time, I took notes with the insights gained from the interviews; I also wrote memos after each interview and began the first cycle of coding using in vivo coding. Using in vivo coding allowed me to review the data for recurring topics and subtopics using the language from the participant interviews (Saldaña, 2011). To begin the first cycle of coding, I transcribed the interviews using the speech to text feature in Microsoft Word. Once I created the transcript in Word, I saved the transcript under the participant number in a password protected file on my laptop. Listening to the audio recordings and creating the transcripts was completed within two days of completing the interview. Once the interview was transcribed, the first cycle of coding began. I reviewed the recordings, transcripts, and memos repeatedly and used in vivo coding to develop a thorough understanding of the participant's thoughts. Microsoft Excel was used to organize the codes via color coding and categorizing them as they emerged. Once I completed all interviews and finished the first cycle of coding, I moved on to the second cycle of coding. During these subsequent coding cycles, Saldaña (2011) recommends that it should become more cultivated. During the second cycle of coding, I used pattern coding. Utilizing pattern coding allowed the grouping of similar codes into themes (Saldaña, 2011). As themes emerged, they were noted and organized in the Excel Spreadsheet with the coordinating codes.

To properly address the research questions of this study, I ensured the trustworthiness by having the interview protocol approved by the doctoral committee and Walden University's IRB. Additionally, to further establish credibility, I used peer debriefing and member checking. Peer debriefing consists of consulting with a peer who is not involved with the study to engage in ongoing discussions that will help with clarifying conclusions and reduce researcher bias (Janesick, 2007). I worked with my former mentor, who is a retired elementary teacher, to complete peer debriefing for my study. We meet weekly during my interview process to review data from my interviews. This process allowed me to get a new perspective and ensure that my personal biases were not affecting my data analysis. Member checking allows for checking both for accuracy and validity by allowing participants to review the transcript of the interview and providing feedback to ensure my interpretation of the data is correct (Yazan, 2015). After each interview, I converted each audio recording into a typed manuscript. These were then sent to the participant in a follow-up email. In that email, in addition to the manuscript, the participant was asked if there were any additional information they would like to add. Three days after sending the manuscript, if I had not heard back from the participant, I sent an additional follow-up asking if the participant had any questions or had any additional information to add, or if they wanted me to remove any information from the manuscript.

Discrepant Cases

In qualitative research using semistructured interviews, it is expected that differing views might come to light. These discrepant cases should not immediately be viewed as a negative aspect of the research. Though I did not encounter discrepant cases, it would be important to ensure that I did not dismiss this data if I had. Instead, if a discrepant case had arisen during the process of this study, I would have investigated further to see if the differing viewpoint could be explained. If I had encountered a discrepant case in the research, I would have investigated fully during the interview with additional probing questions and follow up with the participant. Additionally, I used member checking to have the participants review their transcripts for accuracy and validity.

Data Analysis Results

Once IRB approval was received (approval number 09-08-23-104330), I began recruiting participants. This study included 12 teachers who are currently teaching mathematics in second through sixth grade in the study district. Of the participants, 11 were female and one was male. The participant's time in the district ranged between two months and 20 years. There were two second-grade teachers, two third-grade teachers, two fourth-grade teachers, two fifth-grade teachers, two sixth-grade teachers, one extended curriculum services teacher, and one resource teacher. Data analysis for this study began immediately following each interview. As the study is qualitative in nature, it was important to have time to review the audio recordings of each interview immediately following the interview. This approach allowed for immersion in the data as it was collected. Additionally, I continued to review the audio and transcripts to ensure a thorough understanding of the participants' data and to ensure accuracy in the data and my interpretation of the data to maintain credibility in the study.

To maintain consistency in the study, I adopted a systematic approach to data collection. Once approved to proceed by Walden's IRB and the local study site, I recruited participants and scheduled the interviews with participants. I held the interviews between September 11, 2023 and September 25, 2023. Each interview lasted between 15-40 minutes. Each interview followed the interview protocol (See Appendix B), which included eight questions. I used the same questions for every interview and gave each question in the same order each time. I emailed the interview questions to the participant the day before the scheduled interview. Once the interview began, I obtained consent, and audio recording began. Throughout the interview, I made notes as participants answered the questions. After each interview, I produced a transcript within two days of completing the interview. I followed up and provided each participant with a copy of their transcript within three days after completing the interview.

I used the office transcribe feature in Microsoft Word to transcribe the interviews. Once the office transcribe feature was complete, I checked the transcript for accuracy by listening to the audio and adjusting the transcript as necessary to ensure the transcription was a verbatim representation of the interview. After completing each transcript, I wrote a memo that functioned as a reflective journal. After the interview was complete, I began the first cycle of coding, in vivo coding. In this coding cycle, I manually documented some possible codes from the interviews in the participants' own words by using the highlight feature and bold text on my copy of the transcript and in the memos in Microsoft Word. Then, I transferred those codes and snippets associated with the code from each interview into a new Word document that functioned as a code book. In this code book, I added information about how often the code emerged and from which participant(s).

Further, in the first coding cycle, each participant was assigned a number. As a code emerged from the interview, I added it to the codebook and copied the text excerpt under the code. As other interviews were analyzed, if that same code emerged, the text excerpt was copied and added to the codebook under the corresponding code and identified by the participants' assigned number. I documented the number of times each code appeared.

After completing all the interviews, I completed the first cycle of coding and then began the second cycle of coding, pattern coding. For pattern coding, I reviewed the codes I had found in the interviews and grouped them into categories and themes as they emerged. I then moved around the codes and coordinated interview snippets to have the codes grouped in the Word document under the themes placed as headings. Throughout the coding cycles, the emerging codes naturally begin to group into themes.

When I completed the coding process, ten themes had emerged. Each of these themes was grouped around one of the three research questions. Five themes emerged from participants' responses to Research Question 1. Theme 1 was tools and devices used to integrate technology into the classroom. Theme 2 was perceived strengths that increase teachers' use of technology. Theme 3 perceived weaknesses that decrease technology use by teachers. Theme 4 was websites used for math in the classroom. Theme 5 was the technology used in subjects other than mathematics. Two themes emerged from participants' responses to Research Question 2. Theme 6 was guidance needed in technology resources. Theme 7 was guidance needed in technology training. Three themes emerged from participants' responses to Research Question 3. Theme 8 was supports needed with technology devices and programs. Theme 9 was that people needed to support teachers with technology integration. Theme 10 was supports needed from the district administration.

These themes are explained in depth in the following sections. During this review, I found no discrepant or conflicting codes. Table 3 shows the emergent themes and the related codes of each theme in the data, as well as alignment to the research questions.

Table 3

Emergent Themes, Related Codes, and Research Question Alignment

RQ alignment	Code	Emergent theme
RQ1	• Robots • Document cameras • Promethean • Promethean tools • Chromebooks • Paper/pencil • Lockboxes • Graphing machines • Curriculum • Exit tickets • Informative assessments • Projector • Calculator • Manipulatives	1. Tools and devices used to integrate technology into the classroom
RQ1	• Collaborative work • A drive to learn • Higher education degree • Brings new opportunities to students • Pre- and post-assessments • Teach to specific standards • More meaningful learning opportunities • Tangible • Technology stations • Able to filter • Standards-based • Differentiation • Engagement • Analyzing data • Willingness to use technology • Student teaching during the COVID-19 pandemic • Extensive technology use during COVID-19	2. Perceived strengths that increase technology use by teachers
RQ1	• Class management • Patience • Troubleshooting • Inconsistencies • Frustration • Overwhelming • Too many resources • Being unaware of technology options • Curriculum restrictions • Training offered by district does not support technology integration • Being set in their ways • No technology diversity in the district • Lack of knowledge of using technology • Failure to prepare students • Technology doing the teaching, summer training gap • Time constraints • Sharing technology	3. Perceived weaknesses that decrease technology use by teachers
RQ1	• Google Sheets • Google Classroom • Generation Genius • IXL • Desmos • Google Forms	4. Websites used for math in the classroom

RQ alignment	Code	Emergent theme
	• Seesaw • Happy Numbers • PowerPoint/Google Slides • Padlet • Code.org • Prodigy • Xtra Math • YouTube • YouCubed • Onkey • Khan Academy • Google Doc • Kahoot • Sum Dog • Coin Box	
RQ1	• Social studies • Science • Language arts	5. Technology used in subjects other than mathematics
RQ2	• Availability list • Centralized/resource sharing • More awareness • Technology diversity modeled • Implementation guides • Modeled lessons in the classroom • Screen recordings • Flow charts	6. Guidance needed in technology resources
RQ2	• Small group training • Meaningful training options • Grade-level training opportunities • Training on available technology • Training in the T3 framework for innovation • Training in current technology devices/programs • Additional pds geared toward technology • Hands-on training • Troubleshooting • More collaborative options • Training that are accessible • Consistency in training	7. Guidance needed in technology training
RQ3	• More technology choices • Technology diversity • Materials geared toward technology • Robotics • Additional program licenses • Properly maintained technology • Tools to implement technology • Curriculum with a digital component • Consistency in programs	8. Supports needed with technology devices and programs
RQ3	• In-building support person • More technology coaches available • Math specialists • Technology mentors for new teachers • Specific math coaches with a technology focus • Additional support person	9. People needed to support teachers with technology integration
RQ3	• Less curriculum pressures • Consistency • Continued support • Technology focus • Overall support	10. Supports needed from the district administration

Research Question Findings

This study evaluated what guidance and supports teachers need to be able to effectively and efficiently integrate technology into their mathematics curriculum. I developed the three research questions to find the guidance and supports teachers require. I thoughtfully developed the interview questions to find the answers to the research questions. While reviewing the interview audio and transcript files, I developed themes that naturally grouped around the research questions.

Research Question 1: Technology Integration

Research Question 1, in what ways are teachers in the study district currently incorporating technology into their mathematics curriculum, was developed to determine the participant's current knowledge and comfort level for using technology in their mathematics instruction. Additionally, I developed Research Question 1 to determine the level at which the participant currently uses technology in their mathematics instruction, gaining specific information for the T3 framework for innovation. The interview questions related to Research Question 1 included:

- Describe your knowledge and use of technology in your mathematics instruction in your classroom.
- Describe your strengths in using technology in your mathematics instruction.
- Describe your weaknesses in using technology in your mathematics instruction.

- Describe times in your mathematics instruction when you use technology at the translational level or in a way that could be accomplished with paper and pencil.
- Describe times in your mathematics instruction when you use technology at the transformational level or in a way that students use technology for production or contribution.
- Describe times in your mathematics instruction when you use technology at the transcendent level or where students use technology for inquiry design.

While analyzing the data generated by the interviews, the following themes emerged related to Research Question 1: Tools and devices used to integrate technology into the classroom, perceived strengths that increase technology use by teachers, perceived weaknesses that decrease technology use by teachers, websites used for mathematics in the classroom, and technology used in subjects other than mathematics.

The key findings for RQ1 showed that participants are using technology in their classrooms, though not often in their mathematics instruction time. Participants in the study indicated they are using many different types of technology devices, primarily Chromebooks, the Promethean Smartboard, and document cameras. While participants noted using technology in the classroom, the use of technology was generally to augment the teacher rather than allow for student-centered learning opportunities. When considering the T3 framework for innovation, the participants are primarily using technology in their classroom at the translational level or in ways that could be completed without the technology.

Theme 1: Tools and Devices Used to Integrate Technology into the Classroom

The first theme from the research that aligns with Research Question 1 is the tools and devices participants use to integrate technology into the classroom. As technology continues to change and grow, the list of available tools and devices for use in the classroom continues to grow and change rapidly. The study district has acknowledged this rapid change and the benefits of using technology in the classroom and has moved toward being a one-to-one district, meaning that each student in the district has access to a district-provided device.

The study district is currently using Chromebooks to fill this model. Additionally, the district has provided most classrooms with a Promethean Smartboard and a document camera. Almost every participant mentioned using some combination of these devices in their classroom daily. However, each participant's level of knowledge and skill in using these devices was quite varied. For example, Participant 12 mentioned being able to use "different tools off the Prometheans such as protractors and grids" when appropriate in their mathematics instructions. On the other side of the spectrum, Participant 1 mentioned that while using the Promethean for a "whiteboard," they are "not too familiar with it" for use in the classroom overall. When asked about receiving training, Participant 1 mentioned receiving only minimal training when the study district first implemented the Prometheans. Likewise, six participants mentioned feeling they did not receive extensive training on implementing the Promethean into the classroom. Participant 2 stated that the training received was approximately 30 minutes long and was not as beneficial as they had hoped. Participant 8 stated that most of what they have learned with the Promethean has been picked up through trial and error and their research.

Chromebooks have become more common in the study district over the past decade as the devices have been purchased and placed into classrooms. At the beginning of this process, Chromebooks were provided by the study district to one grade level at a time, and teachers received several half days of training throughout the year on ways to utilize these devices in the classroom. During this early time with the Chromebooks, grade levels shared a class set. As the study district purchased more devices, it reached its desired one-to-one model. During the research, all participants except one, Participant 3, reported they had their own class set of Chromebooks available. One participant is still sharing with their grade-level teaching partners at the time of the interview.

While all participants mentioned using the Promethean Smartboards and/or Chromebooks frequently during the interviews, a few other devices were also mentioned. One of these was document cameras. Participants 1 and 8 both mentioned the document cameras were primarily used to work with the whole group with students from the textbook or a worksheet. This allows the teacher to project a copy of the page from the textbook or worksheet to work together with students, as teachers could write directly on the displayed page or have students come up to write answers displayed via the document camera. The other mentioned device was robotics. Participant 4 mentioned having robots available. These are not provided directly through the district as they were “PTA purchased” and have allowed for technology integration, especially with coding, which the “kids loved!” Many other participants wished they had devices such as robotics available to use in the classroom with students for hands-on, inquiry-based learning opportunities. The tools teachers have at their disposal are an important aspect of how teachers can incorporate technology into their mathematics instruction.

Theme 2: Perceived Strengths That Increase Technology Use by Teachers

During the interviews, I noted that all participants tended to stay focused on the negatives and weaknesses of technology integration. With additional prompting, it was discovered during the research that there were also strengths that participants highlighted. Strengths identified include analyzing data, filtering through sites and programs, differentiation, and a drive to learn more about using technology in the classroom. These strengths allow teachers to use technology within their classrooms confidently.

Analyzing data is a job that teachers complete daily in the classroom. Using data from observing students, data from student work, standardized testing, and classroom-based formative and summative assessments provide data to teachers that can shape each day's academic instruction. Participant 9 reported a strength of "analyzing data that are provided through the IXL program [district provided online learning program] and integrating that within my current lesson planning for mathematics instruction and looking at where students are struggling." This highlights how technology can aid a teacher in analyzing student data.

Having a classroom full of individual students poses a challenge to teachers daily. This leaves teachers with the monumental task of meeting each student where they are in their learning. Differentiation is the key to overcoming this challenge. Four participants noted using technology to aid them in differentiating their classrooms. Participant 5 mentioned using technology during "small group instruction" and being able to "break my kids up into high, medium, and low growth [groups], and I use technology as one of my stations so they can practice the math standard that we are working on." Participant 7 briefly mentioned using technology for "differentiation purposes," though not specifically for mathematics instruction.

Additionally, Participant 11 added that using technology as a "differentiation tool and allowing it to meet each of those individual needs and using it to help fill in the gaps the low kids have and then still push and challenge the upper children." Using technology in pre- and post-assessing students was identified by Participant 5 as a differentiation aid. Participant 5 noted using "different websites for different math skills and using it for pre-assessing and post-assessing" students to find the holes and gaps in their knowledge. Teachers felt that the ability to individualize students' education experience ensures that each student receives the greatest benefit.

Several research participants recognized the benefits of using technology in the classroom. Knowing that benefit, some participants have seen the strengths of using technology in the classroom and pursued higher education degrees geared toward technology-based education. Participant 1 noted pursuing a master's degree in learning and technology. While getting this degree, Participant 1 mentioned understanding that mathematics is a "major subject that we all know we could be doing more" to create engaging student lessons. Additionally, Participant 8 is a relatively new teacher and completed their student teaching experience during the COVID-19 pandemic. This led to most of this participant's early teaching experience being saturated with technology, as it was during the remote learning model that most school districts adopted, allowing for a deeper appreciation of the benefits of infusing teaching with technology.

Theme 3: Perceived Weaknesses That Decrease Technology Use by Teachers

Another commonality was that all participants expressed perceived weaknesses in using technology within their classrooms, especially in their mathematics instruction, which led to decreased use of technology by the participants. While several participants saw this area as a weakness, Participant 10 repeatedly mentioned feeling restricted in using technology in their mathematics instruction due to the adopted curriculum. Additionally, Participant 10 mentioned feeling like they cannot integrate technology into the mathematics curriculum without feeling they are "being questioned" by the administration. Participant 10 further mentioned only being "encouraged to use the worksheets and the remembering pages" from the student workbook provided with the curriculum. Additionally, Participant 10 mentioned a recent attempt to find additional supports to bring into their mathematics teaching for technology integration. It stated the "Google search was overwhelming." After looking at only a few options, they gave up, scraped the whole idea, and returned to the "tried and true strategy of using paper and pencil." Suppose the district provided a mathematics curriculum with engaging digital components that provided students with meaningful hands-on learning opportunities. In that case, teachers might feel less overwhelmed and could incorporate technology more effortlessly in their mathematics instruction.

Participants 3, 5, 7, and 10 in the study mentioned feeling overwhelmed by the sheer number of options available regarding websites and programs. In those mountains of options, some are better than others, and teachers are left to sift through to find the options that will benefit the classroom. Participant 3 mentioned knowing “there are a lot of resources out there” but not having training on how to implement those resources best. Likewise, Participant 5 also mentioned knowing that there is an abundance of resources available, but the problem lies in not knowing how to use those resources. Similarly, Participant 10 noted a desire to use additional technology resources but is simply “not aware of a ton of other options” outside of the district recommendation of IXL. Some teachers have developed filtering skills to sort through the sea of options to find those best suited to meet student needs. Participant 7 identified honing those skills to allow them to “know what is good and what is not good.” This ability to filter allows the participant to “differentiate and to find it quickly.” Additionally, Participant 7 mentioned that the ability to filter through and find good resources is “really helpful to know if it is [the resource] actually hitting the standard I am hoping it to or not.”

Another weakness area I found was tied to time constraints. Participant 9 mentioned, “Time is hard to come by in terms of being able to go outside the box or figure out how things work outside the box and not recreating the wheel.” Additionally, Participant 9 mentioned the time to develop additional learning opportunities for students focusing on technology integration within the mathematics curriculum. Still, the sheer amount of curriculum to cover during the school year leaves them constantly “feeling behind” concerning the district-provided implementation guides. Likewise, Participant 10 mentioned that having “so many plates that are spinning” and “the pressure that we are under to make sure we are covering all of these things” makes it difficult to allot time to focus on technology integration within the mathematics curriculum. In addition to participants 9 and 10, these sentiments were echoed by participants 1, 2, 3, and 5.

Having a lack of general knowledge in the use of technology was also identified as a weakness by study participants. Participant 3 recognized that "lots of resources are out there," but unfortunately, they "do not know how to use" many of those options. Participant 4 added that they sometimes feel uncomfortable using technology in the classroom simply because their "knowledge in technology is not huge." Participant 9 identified a weakness as a "lack of knowledge for above and beyond what I am currently doing." Additionally, Participant 9 added, "not knowing what programs are out here or how to integrate technology into my lesson plans" outside the district-provided programs. Likewise, Participant 10 mentioned that because they do not currently use much technology in their math instruction, it is "not something that I turn to." Additionally, Participant 10 continued feeling "not sure of a whole lot of other options for the use of technology" when working around the mathematics curriculum.

Finally, a weakness found while analyzing the data was in the area of troubleshooting. Participant 1 mentioned they had "never been told or taught what to do if [technology problems] happen." Likewise, Participant 2 mentioned losing patience when "technology does not always work when you need it to, and that can be frustrating." Participant 4 also mentioned "getting frustrated even if it is thinking with the technology not working and being able to troubleshoot," which leads to moving away from using the technology. Participant 11 also found they tend to get "flustered, and then it kind of just turns into ok, we're moving on from using technology for right now." The inability to troubleshoot technology problems in the classroom is a limiting factor in how teachers use technology in their mathematics instruction.

Theme 4: Websites Used for Mathematics in the Classroom

The websites and programs available for student use are staggering and often cause participants to feel overwhelmed by what is available. The study district has worked to alleviate some of the teachers' worries by providing a list of approved programs. This extensive list includes over 250 approved programs and websites across 12 pages to look through. The study district uses the IXL Program, and nearly every participant mentioned incorporating this program into their classroom regularly. The district also uses TypingPal to develop typing skills at the elementary level, and four participants mentioned using this according to the district recommendations provided to teachers. Google Classroom and Seesaw were both also mentioned by participants as district-provided and recommended programs to use. Finally, all participants mentioned other websites and programs they have located on their own, such as Desmos, Kahoot, YouCubed, Prodigy, and Khan Academy. Some of the mentioned websites are on the approved list, while many are not on the district's approved list.

Technology would not be as beneficial without programs that support students and teachers. Participants 1, 2, 4, 6, 7, 8, 9, 10, and 12 acknowledged using IXL, an interactive online learning platform that provides students with individualized content that can be teacher-selected. IXL is a district-provided online learning program and is expected to be utilized. The opinions of using IXL were generally positive, and participants favored the program. Participant 1 mentioned that the study district provides the license for the IXL program, and though it does align with the standards, "it is not connected with our curriculum." Participant 2 mentioned IXL as "district mandated" and said it is used to assign students to practice for their "weak areas." Participant 4 noted appreciating the ability to assign lessons to students, ensuring the IXL content matched the content being covered in class lessons. Likewise, Participant 6 uses IXL to "strengthen a concept that we are learning in class." Participant 7 also favored using IXL specifically for "differentiation purposes" and assigned specific areas to each student needing individualized practice. Participant 8 also mentioned using IXL as an "informative assessment to see where all my students are." Participant 9 also used IXL as an assessment tool, specifically "analyzing data that are provided through the IXL program and integrating that within my current lesson planning for mathematics instruction." Finally, Participant 10 was the only participant to note that using IXL falls within the translational stage of the T3 framework, as students are working digitally on problems that could be completed on paper.

Aside from the district-provided program of IXL, the study participants also mentioned many additional programs they have found and used in their classrooms for mathematics instruction. These range from well-known online learning websites such as YouTube, Kahoot, and Khan Academy to lesser-known ones such as Coin Box and Sum Dog. Eight participants mentioned using these websites and programs as engagement items and for differentiation. Participant 2 mentioned using YouTube to show math songs such as "Number Rock … to help them remember the steps they needed to do." Likewise, Participant 2 noted using "YouTube videos when they are learning different concepts or different ways to solve math problems." Participants 3 and 7 were big supporters of using online manipulatives to supplement the physical manipulatives in their classrooms.

Theme 5: Technology Used in Subjects Other Than Mathematics

Early in gathering data, it became evident that all of the study participants used technology in their classrooms regularly, just not often in mathematics. Participant 1 mentioned using technology within the three T3 framework for innovation tiers in other areas, such as science and language arts, but "not in the concept or subject of math." Similarly, Participant 2 also mentioned using technology frequently in science and social studies, even mentioning "everything else but not as much with math." Participant 5 also mentioned using technology in other subject areas in their classroom but not in mathematics. Participant 6 followed the same pattern: "In sixth grade, we used so much technology through our whole curriculum that math is probably one area where they actually use pencil [and] paper." These findings were not completely unexpected as the mathematics curriculum adopted by the study district relies heavily on the traditional teaching model, with students answering mathematics questions on paper from a textbook or pages copied out of a student workbook.

Research Question 2: Guidance Needed

Research Question 2, what guidance is needed to ensure teachers are prepared to use technology within the mathematics curriculum, was developed to determine what guidance the participant feels specifically would be helpful in integrating technology into their mathematics instruction. The interview question related to this research question is:

- What guidance from the district do you feel is needed to help you with integrating technology into your mathematics instruction?

While analyzing data generated by the interviews, the following themes stood out when considering this research question: guidance needed in technology resources and guidance needed in technology training.

The key finding for RQ2 showed that participants are requesting guidance in both technology resources and technology training. Most participants were unaware of the T3 framework for innovation, but they did identify using technology at the translational level. During the interview, participants noted a desire to use technology at the transformational and transcendent levels. However, they were not sure where to start. They requested guidance to help support teachers as they work on integrating technology into their mathematics instruction at the transformational and transcendent levels.

Theme 6: Guidance Needed in Technology Resources

All participants were aware of the abundance of available resources. The sheer number of resources was overwhelming to some participants and seen as a positive to others. Regardless of whether participants saw the unending list of technology resources as positive or negative, Participants 2, 4, and 7 all voiced concerns over the lack of guidance provided by the district to teachers to guide them in finding and using these technology resources.

Participants 2 and 4 noted the benefits of having a list provided to teachers that explained all technology resources that were available to teachers. The participant made this request because, during the interview, the participant became aware of additional resources available by the district. Participant 4 specifically stated, “It would be nice to have a list of all the things they provide,” and was frustrated about missing out on opportunities because they did not have access to such a list. Along the same lines, Participant 7 noted that the district does not seem to have a department focused on supporting teachers with technology integration other than “us [teachers] communicating with each other, and I think there is got to be another centralized way to do that.” Having a centralized list that is explicitly provided to all teachers by the study district could set teachers on a path of technology integration within their mathematics curriculum.

Additionally, participants requested to have some supports with implementing resources. All participants, except Participant 8, mentioned receiving training in some resources, but when back in their classrooms, they struggled with “in the trenches” implementation. They often forget steps or get frustrated when things do not work as smoothly as they did during the training. To help teachers, the study participants provided several recommendations, including implementation guides (Participant 2), flow charts (Participant 4), screen recordings (Participant 5), and modeled lessons (Participant 2) in the classroom. Once the study district provides guidance to help teachers overcome the challenges they face in the classroom, technology integration is more likely to occur.

Theme 7: Guidance Needed in Technology Training

The study participants mentioned not feeling prepared to use technology in their mathematics teaching. For some, this was traced back to their teacher preparation programs that did not adequately prepare teachers for using technology in the classroom. In addition to a lack of preparation from teacher preparation programs, all participants, except Participant 8, mentioned not having adequate training opportunities provided by the study district. Specifically, training opportunities were geared toward helping them incorporate technology into the classroom, especially the mathematics curriculum. Participant 11 requested “training about other resources that we could use in other ways that we could match it to our curriculum and an engaging way to meet our standards.”

The study district requires teachers to complete 18 hours of professional development each year. To help with this, the study district provides a selection of pupil instruction-related (PIR) training days. The district mandates six of the required 18 hours, and teachers select the additional 12 hours based on their needs from the selection provided. Most interviewees mentioned that the PIRs that are being provided are sometimes geared toward mathematics instruction. The PIRs rarely address technology integration into mathematics instruction. Participant 7 mentioned having the district provide “quick and accessible PDs for teachers” that specifically provide teachers with hands-on experiences using technology in mathematics instruction.

Further, Participant 6 added that the training must be “current with current technology” to benefit teachers wanting to integrate technology into the mathematics curriculum. Participant 5 also wanted to see training geared toward using technology “for early elementary” and in a “small group setting” to be meaningful. Finally, Participant 4 mentioned the gap in the district’s current PIR model, which can make implementing things learned during the training difficult. For reference, a majority of the PIRs are offered during the summer break time from June through August each year, meaning information gained in these PIRs might not be used for weeks or even months, and the training sometimes loses its effectiveness. In addition to providing technology integration-geared PIRs, it was apparent from the interviews that teachers would also benefit from having training in troubleshooting technology problems as they arise in the classroom. Participant 2 mentioned that when technology problems arise, she has “no patience” to try to solve them and always opts to transition to a traditional model when technology stops working.

Finally, the training provided generally occurs during the summer months, which leaves a time gap between receiving the training and implementing it in the classroom. The district provides a robust selection of training options for district teachers. The district teachers must complete 18 hours of professional development training each year outside of the contracted school year. While the options are varied, technology generally is not a major focus as a topic area for these training courses. Participant 5 mentioned being excited about the training received during the summer months but struggling with implementation during the school year because of the time lapse between when the training occurred and when it could be implemented.

Research Question 3: Supports Needed

Research Question 3, what supports are needed to ensure teachers can utilize technology to support the mathematics curriculum, was developed to determine what supports from the district, specifically what do the participants feel would be helpful in integrating technology into their mathematics instruction. The interview question related to this research question is:

- What supports from the district do you feel is needed to help you with integrating technology into your mathematics instruction?

While analyzing data generated by the interviews, the following themes stood out when considering this research question: supports needed with technology devices and programs, people needed to support teachers with technology integration, and supports needed from the district administration.

Key findings for RQ3 showed that participants are requesting additional supports with the technology devices and programs provided, additional support people in the district to assist with technology integration and supports from the district administration. Many participants noted feeling pressured to follow the adopted mathematics curriculum. This pressure seemed to stem primarily from the administration level and the feeling that teachers could not move away from the curriculum. The adopted mathematics curriculum follows a traditional model of teaching with students answering mathematics problems from a textbook. This has led to the reluctance of teachers to work on technology integration in mathematics curriculum at the transformational or transcendent levels of the T3 framework for innovation.

Theme 8: Supports Needed with Technology Devices and Programs

Along with the guidance deemed necessary, the study participants also highlighted several areas where support from the district is necessary for successful technology integration. One of the areas noted by participants was being supported with technology devices and programs. One common area among participants was the desire for additional technology diversity. In fact, Participants 1, 6, 8, 9, and 11 all specifically mentioned the need for more technology choices to be made available in the study district. Participant 9 mentioned, “I just have a Promethean and Chromebook, and there is a lot that can be done on the internet, but also, I feel like there are other tools.” Most participants also mentioned only having the Promethean Smartboard and Chromebooks as the available devices. While the study district provides IXL as an online learning program for students, there were no other programs that were specifically provided for mathematics instruction by the study district.

In addition to having a wider variety of technology devices and programs, it is also important to the participants that the district works to maintain the technology that is provided. Three participants did mention knowing that there is a technology department that is available to help troubleshoot and maintain technology, the wait time on help ticket responses can be lengthy, resulting in times when technology devices are not available for use in the classroom until they are repaired or replaced as needed. Additionally, teachers need to be given the tools necessary to implement technology integration in the classroom. Participant 7 noted that teachers are sometimes given recommendations on implementing technology into the classroom, but unfortunately, teachers are not always given “the tools to implement” the technology into their classroom.

Finally, Participants 1, 3, 6, 7, 8, 9, and 11 noted that the current mathematics curriculum in use by the study district, Math Expressions, follows the traditional model of teaching. Participant 1 noted that Math Expressions provides the basic materials needed. Those basic materials are a teacher’s manual and a class set of mathematics textbooks. Participants 6 and 7 both agreed that with the current curriculum, students work from the student textbook, answering questions from the textbook on paper or working on worksheets that are taken from the textbook or the student activity workbook. Participant 3 requested “a curriculum that has a digital component.” Participants 8, 9, and 11 all expressed a desire for a new curriculum to be adopted that would provide teachers with a built-in technology component. A mathematics curriculum that includes a digital component could be a bridge that helps teachers move from the traditional model to a technology-infused learning model.

Theme 9: People Needed to Support Teachers With Technology Integration

Analyzing the data gained from the participants showed that teachers in the study district are looking for additional supports from the district to feel that they can effectively and efficiently integrate technology into their mathematics instruction. The supports requested from the participants was centered around having mentors, technology teachers, job guides, and coaches available to support teachers in a variety of ways. Participant 4 suggested making sure that new teachers are teamed up with a mentor who is well-versed in technology use, including the district-provided programs teachers must use, such as Power School, for grading purposes. Participant 4 also suggested having a tech teacher in each elementary building that teachers can reach out to for support in implementing technology into their classrooms. Multiple participants also requested a job guide or flow chart for teachers to use as needed. These documents would be helpful in learning new technology applications, refresh training previously given, and even troubleshooting. Finally, five participants also voiced the need to have more technology-based coaches that are more readily available. There is currently only one instructional technology coach at the elementary level, and this single person is responsible for all 15 elementary schools in the district. Additionally, Participant 2 specifically requested additional technology coaches that "would come in and model exactly the expectation and not only the expectations but the diverse ways that you can bring technology into math." Likewise, Participant 10 requested a technology-based coach to model or co-teach and support using technology within the district-provided mathematics curriculum.

Theme 10: Supports Needed From the District Administration

The final category noted by Participants is the idea that teachers need supports from the study district administration in moving toward technology integration into their mathematics instruction. Participants 1, 4, 9, 10, and 12 all acknowledged the feeling that there is a lack of support for technology integration at the administrative level. Specifically, looking at the pressures to be "page-turners" of the current curriculum and not having time allowed for extension activities that could include technology integration, a lack of consistency and continued supports for technology integration, and a lack of technology-based focus by the administration.

Feeling confined by the mathematics curriculum left Participant 9 feeling that there was no time left over to work on technology integration. This time several other participants echoed constraint as a reason for why they do not feel able to work on technology integration within their mathematics instruction. Participants 1 and 10 both mentioned a desire to have more consistency in the support provided by the district administration for using technology. Likewise, Participant 12 requested continued support as the district administration often "gets excited about a new tool, device, or program, but then that excitement fizzles out rapidly." Finally, Participant 1 highlighted the need to see the district administration shift to more of a technology-based mindset. With continued, consistent support that promotes technology infusion from the highest level, teachers might have the supports they need to branch out and attempt additional technology integration in their mathematics teaching.

Limitations

Qualitative research requires interpretation of the descriptive data that is collected. Interpretations of data can be widely varied based on individual backgrounds and perspectives. Saldaña (2021) noted the lenses that cover a researcher's eyes and the angles at which the researcher views the data. When interpreting qualitative data, knowing these lenses and angles is important. If a researcher cannot adjust and view the data subjectively, the research findings might not be accurate, and any resulting projects might not be beneficial.

The data collected for this study was limited to a single school district in the northwestern United States. The study was further limited to only second through sixth-grade teachers who are currently teaching mathematics. I collected all data for this study through semistructured interviews conducted either in person or via a phone conversation. Interviewees used personal experiences and opinions to self-report their information as they interpreted the interview questions supplied.

This study was also limited to only 10-12 participants from the study district. This is a small percentage of the teachers in the study district. Additionally, only second through sixth-grade teachers were included, which leaves out the experiences of the kindergarten and first-grade teachers and all of the study district's secondary teachers. Finally, as a current teacher in the study district, I have worked with many teachers who qualified as participants in this study. Having a previous relationship could affect participants' responses to the interview questions.

Proposed Project

This study's findings have shown that several areas could be addressed in solving the problem. Many of these areas would require extensive funding from the study district, which may not be feasible for the district now. A low-burden, high-impact option is a training program for teachers in the study district to integrate technology into their mathematics instruction effectively and efficiently. This training program must be interactive and delivered during the school year so teachers can use the information immediately. The best time to provide this training would be during the end of each quarter when teachers have a half day of training with no student contact. The training will be three hours long and should be provided in grade-level bands. This training would be in-person, with devices available for teachers to use during the interactive training. Finally, following each training session, follow-up information and support should be provided to teachers.

Summary

In Section 2, I have introduced the methodology design and approach as basic qualitative. I have presented the research questions that guided the data collection. I provided the criteria for selecting participants and the procedures for gaining participants.

I established the researcher-participant relationships and detailed the protection of participant rights. I discussed the interview protocol and sufficiency of data collection, as well as a system for keeping track of the data. I covered the role of the researcher and provided evidence of quality, including the potential for discrepant cases. Finally, I reviewed the data analysis results and presented a project proposal. In Section 3, the project study developed due to the findings of the study are discussed. Additionally, Section 3 will address the rationale, literature review, project description, project evaluation plan, and project implications.

Section 3: The Project

Introduction

For this doctoral project study, I have opted for an in-person training program (see Appendix A), which will be completed in three sessions throughout the school year. The format is meant to address the lack of guidance and supports teachers in the study district are currently dealing with integrating technology into their mathematics instruction. Training will be provided at the end of the first three quarters of the school year when teachers have a day of no student contact for training and preparation. Each session will be one day in length and will be delivered in grade-level bands. Each training session will be followed up with emails for additional support as needed for each teacher. The three training sessions will cover the following topics: (a) Fundamentals: Getting Connected to Technology, (b) Basics: Learning Styles and Technology, and (c) Advanced: Troubleshooting and Beyond.

This in-person training program will provide teachers with the opportunity to experience technology integration into mathematics instruction by providing sample lessons, a demonstration of technology integration into a mathematics lesson, and hands-on experience working with technology in their mathematics instruction in an instructor-guided environment. Each training session will allow for teacher collaboration and exploration time to experience technology options that are currently available within the study district.

Rationale

The problem addressed through this study was that elementary mathematics teachers are being provided with technology to use in conjunction with their mathematics curriculum; however, they are not receiving any guidance or supports on how to incorporate the technology into the educational setting best. Data from this study showed that second through sixth-grade teachers are not receiving the training necessary to be able to effectively and efficiently integrate technology into their mathematics instruction. Looking at the coded data, it became clear that the study participants were requesting additional training and supports from the study district. Therefore, a training program, such as an in-person training opportunity provided throughout the school year, might meet teacher needs to be able to integrate technology into their mathematics instruction. The training course will consist of 3 days of in-person training with follow-up support to teachers as needed throughout the school year. This training should provide teachers with the necessary skills to be able to integrate technology into the mathematics curriculum. Finally, the training program should provide teachers with the supports they need in a timely manner for integrating technology into the mathematics curriculum.

Review of the Literature

A further review of the literature was completed to explore the most current research on technology integration into the mathematics curriculum. The literature review focuses on the following themes: teacher professional development, teacher mentoring, instructional coaches, technology coaches, and teacher preparation programs. I searched Education Source, Academic Search Complete, ScienceDirect, SAGE Journals, Taylor and Francis Online, and Google Scholar for recent, peer-reviewed research papers. I used the following search phrases: *professional development for teachers, teacher mentoring, instructional coaches and elementary school,* and *preservice teachers and ed-tech*.

Teacher Professional Development

Extensive research has been devoted to the area of teacher professional development. Boz (2023) found that a teacher's education is not a single point of time that is completed once they graduate from a teacher preparation program. Education and training must continue and should be developed and implemented with careful thought to be the most effective (Boz, 2023). Research has shown that the improvement of education is closely tied to teachers' professional development. Montero-Mesa et al. (2023) added that professional development is not just for new and novice teachers but important for all teachers, no matter what stage of their career they are in. Teaching is a lifelong endeavor, and therefore, teachers need to be continually learning. Continual learning allows for improvement in a teacher's ability in all aspects of classroom work.

Looking into professional development should also include a look at the perspectives of teachers. After all, a teacher will only get as much as they want out of any professional development that they attend. Hooper et al. (2023) found that teachers are often displeased with professional development opportunities due to those opportunities being irrelevant to them. Hooper et al. also discussed how professional development offerings need to be tailored for a specific group of teachers. These specifics might be grade levels, topics, or even geographical in nature. A school district could benefit from surveying teachers to find out how to develop a training program that best meets their individual teacher's needs.

Meeting individual teacher needs will go a long way in creating professional development options that make lasting impacts in education. It is also important to consider the role of technology in professional development. Pantic and Cain (2022) found that as the world emerges from the COVID-19 pandemic, teachers are more receptive to integrating technology into their teaching after being forced to be so dependent on technology during the pandemic. Further, for professional development to be effective, it should provide active learning experiences and avoid cognitive overload (Pantic & Cain, 2022). In a longitudinal qualitative study, Smith et al. (2020) found that effective professional development required similar characteristics such as content-focused, active learning, coherence with other learning activities, collective participation, and duration. Providing effective professional development helps teachers stay abreast of the new best practices and changes in the world of education.

Since changes are a part of education, it is important that professional development courses include a myriad of options for teachers to choose from. This allows teachers to pick the topics they feel they need additional supports or topics that meet their individual needs. These topics often include specific academic and instructional supports, social-emotional learning, and classroom management. It is important also to consider offering a wide range of technology-based options for teachers (Fütterer et al., 2023). Alemdag et al. (2020) found that a professional development program based on technology integration required additional thought and preparation to be successful.

Alemdag et al. (2020) found that a needs assessment was a valuable tool in developing a professional development program from which teachers would receive the most benefit. Additionally, teachers in the study requested hands-on activities, for example, lesson plans with technology integration be provided for teachers and a chance for teachers to collaboratively create additional lesson plans with technology integration.

Teacher Mentoring

As teachers enter the classroom either as new teachers or experienced teachers moving to a new area, they should be set up for success on day one. One way to ensure a successful transition into a new classroom is to have a mentoring program available. Mosely et al. (2023) noted that teacher stress has led to high turnover in recent years, especially for new teachers. Providing a mentor to teachers can help reduce the stress that sometimes drives new teachers away from the profession (Mosley et al., 2023). Likewise, Rogers et al. (2021) noted that having mentors in place provides collaboration and builds a sense of community, which in turn can increase teacher retention rates. Additionally, Cooper et al. (2020) stated that mentoring programs provide many benefits, including building upon professional development by facilitating social relationships among teachers.

Mentorship for teachers does not have to begin with their first teaching placement. Craig et al. (2023) recognized that mentoring needed to begin while preservice teachers were still in their teacher preparation program. Offering mentoring services when future teachers are beginning their field experiences brings a new level of support that can assist these students as they transition into their teaching careers. In a study developed by Andrew et al. (2019), a program of doctoral students mentoring undergraduates was studied. Through this study, Andrew et al. found that implementing this model of peer mentoring allowed preservice teachers to gain positive perspectives on the expectations of the academic lifestyle necessary to be successful in their college education.

Mentors should not be haphazardly assigned just for the sake of implementing a mentoring program. Top et al. (2021) found that providing teachers with one-on-one mentoring support where mentors are deliberately matched to teachers based on teacher needs and desires allowed for more prosperous relationships between teachers and mentors and more benefits to both the teachers and mentors. This is especially true when considering making mentoring pairs when considering technology integration. Teachers must be provided with mentors who are receptive to technology integration to ensure that teachers are getting the supports they need, especially when looking at implementing hardware/software programs and technical support (Top et al., 2021).

Instructional Coaches

The idea of having coaches for academic purposes in elementary schools is not a new concept. Sacitz and Ippolito (2023) acknowledged that coaches in schools have been around in some capacity since the Title 1 program began in the 1960s. The rise of integrating coaches into elementary schools has varied over the years, with shifts being made between having these coaches work primarily with students in targeted instructional areas and focusing on working with teachers in a support role (Sacitz & Ippolito, 2023).

According to Shelton et al. (2023), an instructional coach functions as a form of professional development meant to support teachers as they navigate the task of using knowledge gained to develop learning activities in their classroom. According to Horn et al. (2021), a gap exists between training and practice. This means that teachers are not always able to fully utilize the training they receive outside of the classroom in the classroom. Instructional coaches can help bridge this gap and support teachers in implementing the training received (Horn et al., 2021). The idea of using an instructional coach in this capacity allows for much more individualized supports for teachers compared to providing a training course where numerous teachers are attending. Instructional coaches can assist teachers in many areas of the classroom, including classroom management, developing teaching strategies, adapting lesson plans, observing and collecting data, and supporting English language learner students (Shelton et al., 2023).

The role of instructional coaches has been fluid and continues to shift depending on a school district's specific needs. As noted by Hashim (2020), there have been many extensive changes to the education system, ranging from the adoption of the Common Core State Standards to technology integration, the COVID-19 pandemic, and the fallout from teacher attrition and burnout. These changes have led to some challenges for many districts. Some districts have looked to instructional coaches to help overcome the challenges that education is facing with these changes.

Instructional coaches are an essential part of making a professional learning community (PLC) successful. Elfarargy et al. (2022) surveyed 67 teachers in Texas. They found that instructional coaches not only help teachers enhance their teaching capabilities but also bring benefits to PLCs by building a safe environment for teachers by upholding rules and norms at PLC meetings and promoting trust and respect among teachers. To achieve these benefits, instructional coaches need to meet teacher needs. Reddy et al. (2018) found the top five positive coaching characteristics to be reliable, skilled, confident, goal-oriented, and responsible, while the top five negative coaching characteristics are uncertain, forgetful, unpredictable, disinterested, and negative. When considering individuals for these important roles in a school district, it is important to look into these specific characteristics.

Teacher Preparation Programs

Moving forward, technology use in the educational setting will continue to become mainstream. Current teachers are showing the desire to access more technology-based professional development opportunities. However, new teachers entering the career need to be prepared to integrate technology effectively and efficiently, starting in their first year of teaching (Zaragoza et al., 2023). In order for that to happen, new teachers need the proper training and experience while completing their teacher preparation program.

Research has shown that many new teachers struggle with educational technology use when they leave their teacher preparation program (Maraisa, 2023). Even as new teachers enter the field of teaching with more personal technology experience than ever before, there is often a disconnect when considering how to implement technology into the classroom for educational purposes (Maraisa, 2023). This occurs because technology use on a personal level is often used for entertainment rather than for academic purposes. Maraisa (2023) found that when this gap exists for preservice teachers, then technology use in the classroom was done simply to check the box of having incorporated technology, and often the technology had no real purpose in the lesson. For this reason, preservice teachers need to have the training required to be able to evaluate and implement technology in the classroom while they are working with their teacher preparation program educators (Alelaimat et al., 2020).

One of the problems leading to preservice teachers having a lack of self-efficacy in technology integration into the classroom is the lack of focus on technology integration in many teacher preparation programs (Baroudi et al., 2022). The model that most colleges follow is to implement a single course that is focused on technology integration and then suggest that instructors of other content courses in the teacher preparation program include technology integration within their courses (Foulger et al., 2019). Hicks and Bose (2019) found this model to be insufficient in preparing preservice teachers for technology integration. They recommended a teacher preparation program that provides future teachers with a technology-rich experience by promoting technology use throughout the program and not just as a stand-alone course embedded into the first year of the program.

Preparing teachers to use technology in the classroom has been an ongoing struggle. Still, it has become especially important as the world transitioned to full remote learning at the beginning of the COVID-19 pandemic. Learning models were turned upside down when the world suddenly found itself confined by lockdowns. These lockdowns forced teachers to adapt to a remote teaching style. Even as the world emerges from the COVID-19 pandemic, remote and online teaching models are not going away. Hall (2019) found that after schools moved back to face-to-face teaching models, many schools continued to incorporate some online and blended teaching elements. Since schools are opting to maintain these teaching models, teacher preparation programs should ensure that future teachers are prepared to meet these expectations by providing technology integration experiences throughout the teacher preparation program.

Project Description

The in-person training program consists of three days of training spread throughout the school year. The training will be provided at the end of the first three quarters of the school year when teachers have a day of no student contact for training and preparation. Each session of training will be one day in length and will be delivered in grade-level bands. Additionally, each session will include follow-up to each teacher for any additional support as needed with technology integration within the mathematics curriculum. The training program will be presented to the study district's Curriculum Program Coordinator once completed and approved by Walden University. This training program includes a plan for three days of training. The three topics are as follows: (a) Fundamentals: Getting Connected to Technology, (b) Basics: Learning Styles and Technology, and (c) Advanced: Troubleshooting and Beyond.

This training program will include job guides and flow charts to assist teachers as they take the information gained from the training into their classrooms. The three topics were decided upon based on my study findings and the data from the literature review.

Additionally, participant input from the interview data was included as the topics were developed. In the course of the interviews, participants indicated they needed additional training opportunities during the school year and requested supports in the form of job guides and flow charts.

Necessary Resources

Many resources are necessary to develop and implement the in-person training program presented in this study. These resources include the research conducted by this project study to guide the project and the data collected from the literature reviews completed for this study. This project was developed based on the participant interviews conducted during this study to address the guidance and supports teachers feel are necessary to integrate technology into their mathematics instruction. The information gained from the literature reviews supports the development of the project and ensures the project was developed thoughtfully for maximum success.

Additionally, for the three-day training program to occur, there will be a requirement for personnel hours to be provided by district personnel. The in-person training for teachers will require 126 personnel hours from seven personnel members, as well as additional hours for preparation and to follow-up with teachers as necessary. These hours will need to be provided by the study district's curriculum program coordinator, the technology integration coach, instructional coaches, and the teacher on special assignments. Technology devices will be required for hands-on use for each training session; these include Chromebooks and Promethean Smartboards, as well as various applications and programs. Finally, some consumable products will be required, such as paper, pens/pencils, etc.

Possible Barriers and Solutions

The major potential barrier to the implementation of this in-person training program will be the refusal of the study district to implement the training program. This challenge could be overcome by providing the study district with a thorough understanding of the training program with information and data gathered from the participant interviews and the literature reviews. Additionally, meeting with the study superintendent and the school board to present the benefits of the in-person training program could alleviate concerns and increase the probability of the study district adopting the proposed training program.

Implementation Proposal

Upon approval of the project study by Walden University, I will contact the curriculum program coordinator and the executive directors of student achievement to schedule a meeting to discuss the proposed in-person training program. Additionally, the technology integration coach for the study district will be contacted to discuss any possible barriers to the implementation of the technology for the training program. Finally, the Information Technology department will be contacted to ensure that technology devices are available for the training program. See Table 4 for the projected timeline for project implementation.

Table 4

Projected Timeline for Project Implementation

Timeline	Tasks
May 2024	Meet with district leadership to discuss the implementation of the training program.
July 2024	Meet with the district curriculum program coordinator, technology integration coach, instructional coaches, and the teacher on special assignment to discuss the layout of the training program.
October 2024	Meet again with the district curriculum program coordinator, technology integration coach, instructional coaches, and the teacher on special assignment to plan and coordinate the first day of training.
November 1, 2024	Conduct the first in-person training session with teachers.
November 4-8, 2024	Follow up with teachers after the first training session.
November 11-21, 2024	Provide additional follow-up with teachers as needed. Meet with the district curriculum program coordinator, technology integration coach, instructional coaches, and the teacher on special assignment to debrief the first training session.
January 2025	Meet with the district curriculum program coordinator, technology integration coach, instructional coaches, and the teacher on special assignment to plan the second day of training.
January 24, 2025	Conduct the second in-person training session.
January 27-31, 2025	Follow up with teachers after the second training session.
February 3-14, 2025	Provide additional follow-up with teachers as needed. Meet with the district curriculum program coordinator, technology integration coach, instructional coaches, and the teacher on special assignment to debrief the second training session.
March 2025	Meet with the district curriculum program coordinator, technology integration coach, instructional coaches, and the teacher on special assignment to plan the third day of training.
March 28, 2025	Conduct the third in-person training session.
March 31-April 4, 2025	Follow up with teachers after the third training session.
April 7-17, 2025	Provide additional follow-up with teachers as needed. Meet with the district curriculum program coordinator, technology integration coach, instructional coaches, and the teacher on special assignment to debrief the third training session.
May 2025	Meet with the district curriculum program coordinator, technology integration coach, instructional coaches, and the teacher on special assignment to debrief the training program and potentially develop additional training opportunities.

Roles and Responsibilities of Researcher and Others Involved

The role of the researcher was to develop the in-person training program to take place over the 2024-2025 school year. Additionally, the researcher will present the training program to the curriculum program coordinator and the executive directors of student achievement. After approval of the training program, the researcher will coordinate with the training implementation team which consists of the researcher, the curriculum program coordinator, the technology integration coach, the instructional coaches, and the teacher on special assignment. Finally, the researcher will work with the training implementation team throughout the duration of the training program.

Project Evaluation Plan

To ensure the project is providing beneficial guidance and supports for teachers, the project will be evaluated through both formative and summative evaluations. During the implementation of the training project, teachers attending the training will be asked to provide feedback through an anonymous survey after each training session. This survey will provide a formative assessment, and the information gained will help guide future training sessions. Additionally, teachers will complete a pre training survey to gauge the levels of technology use and comfort level prior to training. After the training sessions are completed, teachers will complete a post training survey that will allow the implementation team to determine the effectiveness of the training program and can provide information to move forward with additional training as needed. Comparing the data from the pre- and post-training surveys will function as a summative assessment.

Project Implications

All projects can have implications, and this project study is no exception. Being a project study working with only one specific school district, this project has local implications. The findings of this study could uncover a need for additional training, guidance, and supports for teachers for successful technology integration. Additionally, the project could lead to the determination that the district needs to invest in additional technology devices and/or hardware or software programs. If the training program developed in this study is implemented, the training and follow-up support that teachers receive could lead to positive changes in classroom practices as teachers begin to implement technology in the classroom with more confidence and regularity. Additionally, when teachers successfully implement technology, student engagement and achievement could improve.

Section 4: Reflections and Conclusions

For this qualitative project study, I was looking at what guidance and supports teachers in the study district need to be able to effectively and efficiently integrate technology into their mathematics curriculum. To determine how best to help teachers in the study district with technology integration, I conducted semistructured interviews with open-ended questions to assess their current comfort level and use of technology in their classrooms. I also asked questions regarding the T3 framework for innovation to determine at what levels teachers in the study district are currently using technology in their classrooms. Finally, I asked what guidance and supports teachers needed to be more successful in integrating technology into their mathematics instruction. To address the problems discovered during this study, I developed a training program that consists of three, 1-day training sessions that would be delivered at the end of each academic quarter in November, January, and March during the 2024–2025 school year. In Section 4, I present my reflections and conclusions, including project strengths and limitations; recommendations for alternative approaches; scholarship; scholarship, project development and evaluation, and leadership and change; reflection on the importance of the work; and implications, applications, and directions for future research.

Project Strengths and Limitations

The 3-day, in-person training project presented in Section 3 has the potential to improve knowledge in technology integration within the mathematics curriculum as well as knowledge and understanding of the T3 framework for innovation for teachers in the study district. Using the T3 framework for innovation allows teachers to provide learning opportunities that are more impactful and provide deeper levels of technology use by students (Magana, 2017). The goal of the 3-day training program is to provide the guidance and supports teachers need to be able to use the T3 framework for innovation with technology integration into the mathematics curriculum. Each day of the training offers opportunities for teachers to experience grade-level specific mathematics lessons at each level of the T3 framework for innovation (translational, transformational, and transcendent).

Another strength of this training project is that it will allow teachers the opportunity to collaborate and network among their grade-level colleagues. Additionally, during each 1-day training session at the end of the academic quarters, teachers will have the opportunity to collaborate on additional lesson plans for integration technology at the three levels of the T3 framework for innovation. Each day of the training in November, January, and March, teachers will have the opportunity to participate in an open forum where they will have the opportunity to exchange and discuss ideas with their same grade-level teachers. Teachers will also have the opportunity to discuss what they notice working and what is not working in their classroom. On the second day of training at the end of Quarter 2 in January, teachers will have a session to brainstorm and share possible lesson plans.

Finally, having in-person, hands-on training scheduled during the school year is a strength, as teachers will have the opportunity to interact with the technology with guidance from the training instructors and IT department personnel. During data collection, it became clear that teachers wanted the opportunity to collaborate to share ideas and network amongst themselves. For this reason, teachers will be given extensive time during the 3-day training to work together and share ideas and potential lesson plans.

While there are numerous strengths identified in the project presented, there can also be limitations with the 3-day training program proposed. First, the program must be approved and then adopted by the study district. Although I will complete all preliminary steps with fidelity, there is no guarantee that the training program will be adopted and implemented by the study district.

Further, while I will work with the training implementation team, I will not be available to work with every grade-level group of training. That responsibility will fall to district personnel. Therefore, I will not be able to ensure that all training sessions are completed with fidelity. Additionally, the follow-up support being offered to teachers will also have to be completed by the training support team. It will rely on their dedication to the training program to provide supports to teachers as needed.

Finally, while a 3-day training program has been developed, it will be important to follow through with additional training and supports for teachers after the 2024–2025 school year. Technology continues to change, and there are always changes in teaching personnel each school year. With the continual changes to technology and the changes in teachers, the district must continue to provide the guidance and supports that teachers will continue to need to be able to integrate technology into their mathematics instruction.

Recommendations for Alternative Approaches

As an alternative to the 3-day training program presented, there are some other options for the school district to help teachers with technology integration. One alternative approach would be to have frequent meetings with staff at monthly staff meetings. These training courses would be more informal and shorter in duration but would also provide teachers with additional guidance and support with technology integration. Additionally, this method would reinforce to teachers that technology integration is supported by district administration. A monthly meeting model compared to a quarterly training day would allow teachers more to have repeated exposure and opportunities for collaboration.

Another alternative approach would be to develop a mentor program that deliberately partners up teachers with a mentor who has strong technology integration skills. The partnering would need to be based on the needs of the mentee teachers and those needs considered when proposing a mentor. A potential option for ensuring purposeful pairing would be to have both teachers and mentors complete surveys and use the information when making those pairs. Having a mentor program would provide teachers in the study district with guidance and support with technology integration. Building professional relationships between mentors and mentees can help ensure teachers have a safe and supportive environment to reach out for the guidance and supports they need.

Scholarship, Project Development and Evaluation, and Leadership and Change

I have worked in the study district as an elementary teacher for 7 years at the time of this study. My undergraduate work focused on elementary education, and my master's degree focused on science, technology, engineering, arts, and mathematics. I have continued my lifelong learning by taking additional courses at a local community college before pursuing my terminal degree in educational technology. These professional experiences in both college and as a teacher have allowed me to gain many beneficial skills and a thorough understanding of the research process. The coursework I have taken up to this point and the support of professors and my project committee have laid a foundation for completing the research process. This guidance has supported me in identifying a topic area that needs to be addressed, researching scholarly articles, developing a research plan, collecting and analyzing data, and building a plan based on the findings that emerged through the research process. While a daunting challenge, the research process has been extremely satisfying to complete and has changed the lens through which I view the world around me.

This project study has provided incredible growth opportunities for me as a scholar and as an educator. When considering selecting a topic for my project study, I completed extensive self-reflection on my teaching experiences in my classroom. As I noticed where I felt my weaknesses, I started to reach out to colleagues and fellow teachers and began opening up dialogue with teachers around me about the areas I felt were weaknesses in my teaching. I started to notice that my weaknesses were not specific just to me, and many other teachers around me, in fact, echoed them. This process allowed me to gain confidence in reaching out to those around me to determine areas that need improvement. This also led me to build a drive to dive into the research process, which I was hesitant to undertake previously.

Additionally, I gained skills in collaboration and leadership, which, in turn, increased my skills in being a proponent of social change. One of the common occurrences in education is to identify a problem and then “admire” the problem rather than bring about solutions to solve the problem. Through completing this capstone experience, I gained the skills not only to identify problems but also to research them appropriately and present potential solutions. I gained the skills to recruit and collect data from participants. I have struggled with not wanting to reach out to those in the profession around me, and the process of data collection and analysis has allowed me to be more open not just with teachers but also with administrators. These growth areas have boosted my confidence in leadership and allowed me to see myself as a person who can make positive social changes. These growth areas were not without challenges, however.

One challenge I experienced throughout my doctoral journey was selecting a topic for my project study. In the world of educational technology, there is no lack of potential topics and areas that warrant further study. For this reason, I explored several potential topics and reached out to my department head for support as I worked to find the topic of my project study. As mentioned above, selecting the topic for my project study came down to self-reflection and visiting other teachers around me, which led me to the topic.

Knowing that others around me were also struggling to integrate mathematics into their teaching built a passion in me to help other teachers.

Another challenge I experienced with this project study was maintaining alignment throughout the entire project. Once I selected the topic, it was important to maintain alignment at every step of the project. From developing the problem statement, purpose statement, and research questions, to selecting the framework and conducting the literature review, it was difficult at times to keep the scope of the study narrow and maintain alignment. Conferencing with my doctoral committee, my department head, and former professors helped guide me in maintaining alignment. It came down to analyzing each step of the process to ensure that the study stayed aligned throughout the entire process. Though I experienced some challenges involved in the process, the overall experience was positive.

Reflection on the Importance of the Work

While developing this training program and visiting with teachers around me, I am confident that this training program will benefit teachers in the study district. It has been well documented throughout this study that integrating technology into the classroom, especially at the elementary level, has many challenges, and the study district is no exception. The purpose of this study was to identify the guidance and supports that teachers in the study district need to be able to integrate technology into their mathematics curriculum. Teachers in the study district, at the elementary level, could benefit from additional training to improve their confidence levels in integrating technology into their mathematics instruction. The training program developed in this project will provide the training that teachers need to be able to integrate technology into the mathematics curriculum more consistently.

Additionally, it is important to understand that since the COVID-19 pandemic, the role of technology in education has grown and will continue to grow moving forward. Despite the end of the pandemic beginning to occur, many school districts are maintaining some virtual elements that were originally adopted during remote learning. As technology continues to have a mainstream place in the world of education, it will be important to ensure that educators are prepared to use technology effectively and efficiently.

Implications, Applications, and Directions for Future Research

Analyzing the data from the study made it clear that further guidance and supports were necessary for the teachers in the study district in regard to integrating technology into their classrooms. This project works to solve that problem by providing teachers with a 3-day training program that allows for in-person, hands-on learning in best practices for integrating technology into the mathematics curriculum and is followed by additional supports for teachers as needed (see Appendix A). The results of the study showed that teachers were requesting additional training opportunities that are geared toward technology integration. This training program is meant to be taught in small groups of grade-level colleagues. It must include hands-on learning opportunities and a troubleshooting technology problems workshop to be successful, as these were all requested by the study participants.

The key findings for this study showed that participants are using technology in their classrooms, though not often in their mathematics instruction time. Additionally, participants are requesting guidance in both technology resources and technology training. Finally, participants are requesting additional supports with the technology devices and programs provided, additional support people in the district to assist with technology integration and supports from the district administration.

The outcome of the 3-day training program is focused on providing teachers with the guidance and supports they need to be able to integrate technology into the district-adopted mathematics curriculum, specifically with technology integration taking place at all three tiers of the T3 framework for innovation. Future research could focus on academic areas other than mathematics for technology integration. Teachers might struggle to transfer skills gained in the training to other academic areas. They might benefit from training that is specifically geared toward other academic areas such as language arts, science, reading, or history. This could lead to additional training programs needing to be developed.

Future research could also focus on the follow-up to the year-long training program. The training implementation team could continue to follow up with teachers in the following school years but continue to offer advice and modeled lessons to support teachers in technology integration in the classroom. This ongoing support could be molded into a mentoring program to allow teachers to continue to receive support as needed.

Conclusion

In this qualitative study, I set out to explore what guidance and supports teachers need to be successful in integrating technology into the mathematics curriculum. The problem at the local study site was examined to provide a possible solution and assist teachers as they navigate an increasingly technological world. The results of the study showed that teachers perceived that they needed additional guidance and supports from the study district to be able to integrate technology into their mathematics instruction. The teachers wanted more guidance in the form of hands-on training courses offered during the school year. Additionally, teachers requested supports in the form of additional trained personnel to assist with modeled lessons. They also requested tangible items such as troubleshooting guides and flow charts to assist them as they utilize technology in the classroom.

The training course presented works as a starting point for offering teachers what they perceive is necessary to integrate technology into the district's adopted mathematics curriculum successfully. The training program presented will provide teachers with the opportunity to grow their "tool belt" with strategies for integrating technology into the classroom. It could provide confidence for teachers in technology integration. However, the training cannot be a one-time event. Follow-up will be required to ensure teachers continue receiving the guidance and supports that is necessary for them to continue being successful with technology integration into their instructional time.

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Appendix A: The Project

Training Course Expectations and Outcomes

Title: Technology Integration into Mathematics Instruction

Description: Preparing students for their role in the future will require preparing students to use technology. During this training program, teachers will work toward building confidence in incorporating technology into their mathematics instruction. Topics for the training program include a). Fundamentals: Getting Connected to Technology, b). Basics: Learning Styles and Technology, and c). Advanced: Troubleshooting and Beyond. Teachers will work in a collaborative setting with grade-level colleagues to develop mathematics lesson plans with technology integration.

Training Layout: Three in-person training sessions

Dates: November 1, 2024, January 24, 2025, and March 28, 2025

Learning Outcomes

- Gain skills in connecting technology devices in the classroom.
- Gain skills in integrating technology into their mathematics instruction.
- Discuss various ways to incorporate technology into their mathematics instruction.
- Gain skills in troubleshooting technology devices used in their mathematics instruction.
- Develop teaching strategies to integrate technology at each of the three levels of the T3 framework for innovation (translational, transformational, and transcendent).

Training Outline:

1 November 2024		
Time	**Activity**	**Notes**
8:00-9:00	Welcome, sign-in, important information, introductions, and pre-assessment survey	Ensure all participants sign-in on the sheet, provide schedule, identify restrooms, and introduce all instructors, complete pre assessment handout
9:00-10:00	Icebreaker, present project findings, present goals of training	9:00-9:15 Icebreaker game: Find someone in the room that uses the same math-based website you have used in your classroom and find someone that uses one you have never heard of. 9:15-10:00 Present research findings and training goals
10:00-10:15	Break	
10:15-11:30	Introducing technology devices. The Informational Technology department personnel provides demonstrations and breaks into groups to practice hooking up devices and interacting with devices.	Technology Department Presentation
11:30-12:30	Lunch on your own	
12:30-1:45	Modeled Lesson – T1: Translational	12:30-1:00: Discuss what T1: Translational means in the T3 framework for innovation. https://maganaeducation.com/what-is-the-t3-framework-for-innovation/ 1:00-1:45: Modeled Lesson
1:45-2:00	Break	
2:00-3:00	Open Forum	Break out rooms: Grade level specific discussions following modeled lesson
3:00-3:30	Wrap-up and survey	All back together in main room, training survey handout

24 January 2025		
Time	**Activity**	**Notes**

8:00-9:00	Welcome, sign-in, important information, and introductions	Ensure all participants sign-in on the sheet, provide schedule for the day, identify restrooms, introduce all instructors
9:00-10:00	Icebreaker and discussions about what is working and what is not	9:00-9:30: Icebreaker Game: Find someone in the room that teaches the same grade at a different building and talk about how they are using technology in their classroom (does not have to be math related). 9:30-10:00: Allow for discussions on what ways teachers have been able to integrate technology into their mathematics instruction and what challenges they are facing
10:00-10:15	Break	
10:15-11:30	Modeled Lesson – T2: Transformational	10:15-10:45: Discuss T2: Transformational and the T3 framework for innovation https://maganaeducation.com/what-is-the-t3-framework-for-innovation/ 10:45-11:30: Modeled Lesson
11:30-12:30	Lunch on your own	
12:30-1:45	Brain-storming possible lesson plans, sharing lesson plan ideas	Break out rooms: Grade level brain-storming
1:45-2:00	Break	
2:00-3:00	Open Forum	Break out rooms: Grade level specific discussions
3:00-3:30	Wrap-up and survey	All back together in main room, training survey handout

28 March 2025		
Time	**Activity**	**Notes**
8:00-9:00	Welcome, sign-in, and important information, introductions	Ensure all participants sign-in on the sheet, provide schedule for the

		day, identify restrooms, introduce all instructors
9:00-10:00	Icebreaker and discussions about what is working and what is not	9:00-9:30: Icebreaker Game: Snowball fight 9:30-10:00: Allow for discussions on what ways teachers have been able to integrate technology into their mathematics instruction and what challenges they are facing
10:00-10:15	Break	
10:15-11:30	Modeled Lesson – T3: Transcendent	10:15-10:45: Discuss T3: Transcendent and the T3 framework for innovation. https://maganaeducation.com/what-is-the-t3-framework-for-innovation/ 10:45-11:30: Modeled Lesson
11:30-12:30	Lunch on your own	
12:30-1:45	Troubleshooting Workshop	Technology Department Presentation
1:45-2:00	Break	
2:00-3:00	Open Forum	Break out rooms: Grade level specific discussions
3:00-3:30	Wrap-up and post-training assessment	All back together in main room, training survey handout, and post assessment handout

Facilitator Guide

Day 1:

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
Welcome & Preassessment 8:00-9:00	Sign-in sheet, schedule, identify important info such as where bathrooms are located and the schedule for the day, introduce instructors.	• 8:00-8:15: announce the sign-in sheet location and have everyone in their seats by 8:15 • 8:15-8:45: Important announcements and introductions • 8:45-9:00: Preassessment handout	
Warm-Up 9:00-10:00	Icebreaker After completing the icebreaker present study findings and learning outcomes of the training	• 9:00-9:15: Icebreaker: Find someone in the room who has used a math-based website/app for student use that you have used and find one person in the room who has used one you have never heard of. • 9:15-9:50: Present findings related to each research question (i.e., the reason the	

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
		training was developed). • 9:50-10:00: Provide learning outcomes	
Break 10:00-10:15			
Technology Demonstrations 10:15-11:30	IT Department personnel will provide demonstrations for the following: • Promethean Smartboard • Dell Laptop • Chromebook • Document Camera	• 10:15-10:45: Technology Dept. personnel will demonstrate how to connect and setup each device. • 10:45-11:30: Set up room with stations for each type of device and have groups rotate through stations, practicing hooking up and interacting with devices.	Gain skills in connecting technology devices in the classroom.
Lunch 11:30-12:30			
Modeled Lesson – T1: Translational 12:30-1:45	T1: Translational discussion & Modeled lesson	• 12:30-1:00: Discuss what T1: Translational means in the T3 framework for innovation. • 1:00-1:45: Model the following lesson using	Develop teaching strategies to integrate technology at each of the three levels of the T3 framework for innovation (translational, transformational, and transcendent)

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
		participant teachers as students. 2nd Grade Lesson Provided. Below the lesson are modifications to teach at the 3rd-6th grade levels. Surveys and Graphs • Read 'Tally O'Malley' by Stuart J. Murphy (or play the video read aloud: https://youtu.be/8UL6zQlHkBQ?si=Rix-nTnf1gdUeSkz) and discuss tally marks and collecting data. • Create examples of Tally Charts using the Promethean • Create examples of bar graphs, work on reading the graph asking questions such as: what is this graph about? Which is the most popular option(s)? Least popular? Who might care	

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
		about this information? • Ask about where we get the data for a graph. Introduce the concept of a survey. • Create a two-option survey using Wixie (wixie.com) (such as which book do you like better) and have students make their digital tally marks (Note these can be great bellringer activities) • Make small groups of students and have them create their own survey and collect data to display in a bar graph. Let groups pick their topic (i.e. favorite ice cream flavor, what class pet should we get, etc.). • Have groups create their	

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
		survey and gather data from classmates. • Each individual student will use the data to create a bar graph in Excel and share with their group members • Each group will share their graphs with the rest of the class as presentations on the promethean Grade Level Modifications: 3rd Grade: • Include line plots as well as bar graphs 4th Grade: • Include additional graph options such as pie charts and line charts, line plots, etc. 5th Grade: • Allow surveys to offer more than two choices and require students to use	

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
		additional graph representations 6th Grade: • Allow surveys to offer more than two choices and allow students to collect additional data outside of their classrooms (i.e. other classrooms or staff in the building) and require students to use additional graph representations	
Break 1:45-2:00	Return to breakout rooms after break		
Grade Level Lesson Plan Development 2:00-3:00	Breakout rooms for discussions in grade level groups. Make small groups within each grade level group and have each group develop a lesson plan for a mathematics lesson that uses technology at the translational level.	• 2:00-2:40: Lesson plan worksheet- Break into small groups (2-3 people/group) and have groups fill out the T1: Translational Stage Technology Mathematics Lesson Plan Worksheet. • 2:40-3:00: Allow each group to present their lesson to	Develop teaching strategies to integrate technology at each of the three levels of the T3 framework for innovation (translational, transformational, and transcendent)

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
		the other groups. Make copies of each lesson for all teachers in attendance for them to take back to their classroom	
Wrap-up and survey 3:00-3:30	All back together for wrap up and give training survey handout	• 3:00-3:15: Recap the day. • 3:15-3:30: Have teachers fill out the Training survey handout	

Day 2:

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
Welcome 8:00-9:00	Sign-in sheet, schedule, identify important info such as where bathrooms are located and the schedule for the day, introduce instructors.	• 8:00-8:15: announce the sign-in sheet location and have everyone in their seats by 8:15 • 8:15-8:45: Important announcements and introductions • 8:45-9:00: Have teachers write down one thing they hope to get from today's training on a	

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
		sticky note and place on a designated area.	
Warm-Up 9:00-10:00	• Icebreaker • Review previous training • Discussion time	• 9:00-9:15: Icebreaker: Find someone in the room that teaches the same grade at a different building and talk about how they are using technology in their classroom (does not have to be math related). • 9:15-9:30: Remind teachers of why we are in the training, the learning outcomes, and what was covered in the previous training session • 9:30-10:00: Allow for discussions of what ways they were able to use technology in their math instruction and what challenges they have faced. Have discussions in	

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
		small groups first and then have each group do a share out	
Break 10:00-10:15			
T2: Transformational Modeled Lesson 10:15-11:30	Discuss T2: Transformational and the T3 framework for innovation and provide a modeled lesson	• 10:15-10:45: Discuss T2: Transformational and the T3 framework for innovation. • 10:45-11:30: 2nd Grade Lesson provided. Modifications for grades 3-6 are located below. Seeing Shapes • Introduce different 2-D shapes and show the Shapes song on YouTube (https://youtu.be/pfRuLS-Vnjs) • Discuss shape attributes and read 'The Greedy Triangle' by Marilyn Burns (or play the read aloud video: https://youtu.be/r3DsRKaNFmk?si=_9H_A1Rw12ya5H-k)	Develop teaching strategies to integrate technology at each of the three levels of the T3 framework for innovation (translational, transformational, and transcendent)

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
		• Ask students to look around the classroom to find shapes (i.e. clock is a circle, desk is a square/rectangle, etc.) • Take a walk around the school and have students take pictures of shapes in the environment with an iPod or with a chromebook • Return to the classroom and have students build a PowerPoint presentation of the shapes they found including the picture of the shape and an example of the shape drawn onto the slide. • Have students record their presentation with narration identifying the shape and explaining more about it.	

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
		• Students share their presentations allowing others to watch/listen Grade Level Modifications: 3rd Grade: • Include number of sides, vertices, and angles of 2-D shapes 4th Grade: • Have students classify shapes and show lines of symmetry 5th Grade: • Measure angles of 2-D shapes 6th Grade: • Have students look for 3-D shapes and find area/volume	
Lunch 11:30-12:30			
Grade Level Lesson Plan Development 12:30-1:45	Breakout rooms for discussions in grade level groups. Make small groups within each grade level group and have each group develop a lesson plan for a mathematics lesson that uses technology at the	• 12:30-1:25: Lesson plan worksheet- Break into small groups (2-3 people/group) and have groups fill out the T2: Transformational Stage Technology Mathematics	

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
	transformational level.	Lesson Plan Worksheet. • 1:25-1:45: Allow each group to present their lesson to the other groups. Make copies of each lesson for all teachers in attendance for them to take back to their classroom	
Break 1:45-2:00			
Open Forum 2:00-3:00	Breakout rooms Grade specific open dialogue to address questions and concerns that have come up. Start with small group discussions and then have groups share out.	• 2:00-2:20: What's one piece of advice you can give for using technology in a mathematics lesson? • 2:20-2:40: Any tips or tricks you have picked up? • 2:40-3:00: What technology specific problems or concerns have you encountered?	Discuss various ways to incorporate technology into their mathematics instruction
Wrap-up and survey 3:00-3:30	All back together for wrap up and	• 3:00-3:15: Recap the day.	

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
	give training survey handout	• 3:15-3:30: Have teachers fill out the Training survey handout	

Day 3:

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
Welcome 8:00-9:00	Sign-in sheet, schedule, identify important info such as where bathrooms are located and the schedule for the day, introduce instructors.	• 8:00-8:15: announce the sign-in sheet location and have everyone in their seats by 8:15 • 8:15-8:45: Important announcements and introductions • 8:45-9:00: Have teachers write down one thing they hope to get from today's training on a sticky note and place on a designated area.	
Warm-Up 9:00-10:00	• Icebreaker • Review previous training • Discussion time	• 9:00-9:15: Icebreaker: Snowball. Have each teacher write a math based technology resource on a	

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
		piece of paper and then crumple into a snowball. Allow 1 minute for a 'snowball fight' once 1 min is up each person opens a snowball to find a technology resource. • 9:15-9:30: Remind teachers of previous training session • 9:30-10:00: Allow for discussions of what ways they were able to use technology in their math instruction and what challenges they have faced. Have discussions in small groups first and then have each group do a share out	
Break 10:00-10:15			
T3: Transcendent Articles and Discussion 10:15-11:30	Discuss T3: Transcendent and the T3 framework for innovation and provide a modeled lesson	• 10:15-10:45: Discuss T3: Transcendent and the T3 framework for innovation.	Gain skills in integrating technology into their mathematics instruction

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
		• 10:45-11:30: break into groups. • Group A will read Smashing Milk Cartons (Monson, D., & Besser, D. (2015). Smashing milk cartons. *Science and Children, 52*(9), 38-43. https://pubmed.ncbi.nlm.nih.gov/28403664/) • Group B will read Cardboard City: A whole school integrative engineering experience (Jackson, J., Brenegan, J., Wagner, K., & Berry, M. (2023). Cardboard City: A whole-school integrative engineering experience. *Science & Children*, *60*(7), 78–83. https://doi.org/10.1080/00368148.2023.12315943)	

Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
		• Group C will read Designing Healthy Ice Pops (Bubnick L, Enneking K, Egbers J. Designing Healthy Ice Pops. *Science & Children*. 2016;54(1):70-75. https://www.nsta.org/lesson-plan/designing-healthy-ice-pops)	
Lunch 11:30-12:30			
Troubleshooting Workshop 12:30-1:45	Technology Department will present troubleshooting presentation showing some common problems that arise with the Promethean Smartboards, Chromebooks, and Dell Laptops Additionally, the Technology Department will provide additional tips and tricks for using these devices. After presentation set up stations with 'broken' devices for small groups to	• 12:30-1:15: Technology Dept. personnel will demonstrate how to fix common problems that occur with the devices. • 1:15-1:45: Set up room with stations for each type of device and have groups rotate through stations, practicing hooking up and interacting with devices.	Gain skills in troubleshooting technology devices used in mathematics instruction.

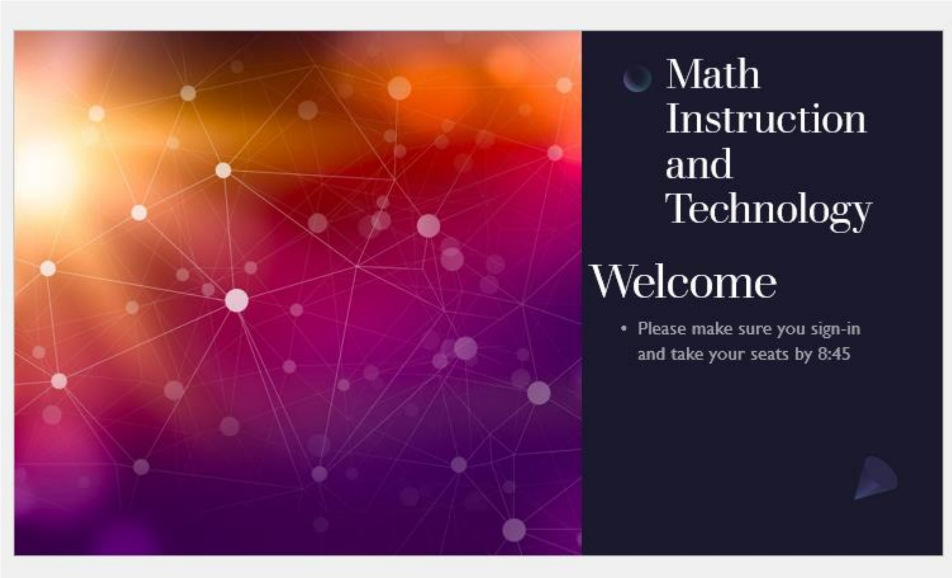
Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
	rotate through to practice fixing.	• Provide Troubleshooting/Tips and Tricks Worksheet	
Break 1:45-2:00			
Grade Level Lesson Plan Development 2:00-3:00	Breakout rooms for discussions in grade level groups. Make small groups within each grade level group and have each group develop a lesson plan for a mathematics lesson that uses technology at the transformational level.	• 2:00-2:40: Lesson plan worksheet- Break into small groups (2-3 people/group) and have groups fill out the T3 Framework for Innovation Technology Mathematics Lesson Plan). Each group can choose the level of the T3 framework for innovation to develop this lesson plan. • 2:40-3:00: Allow each group to present their lesson to the other groups. Make copies of each lesson for all teachers in attendance for them to take back to their classroom	Develop teaching strategies to integrate technology at each of the three levels of the T3 framework for innovation (translational, transformational, and transcendent)

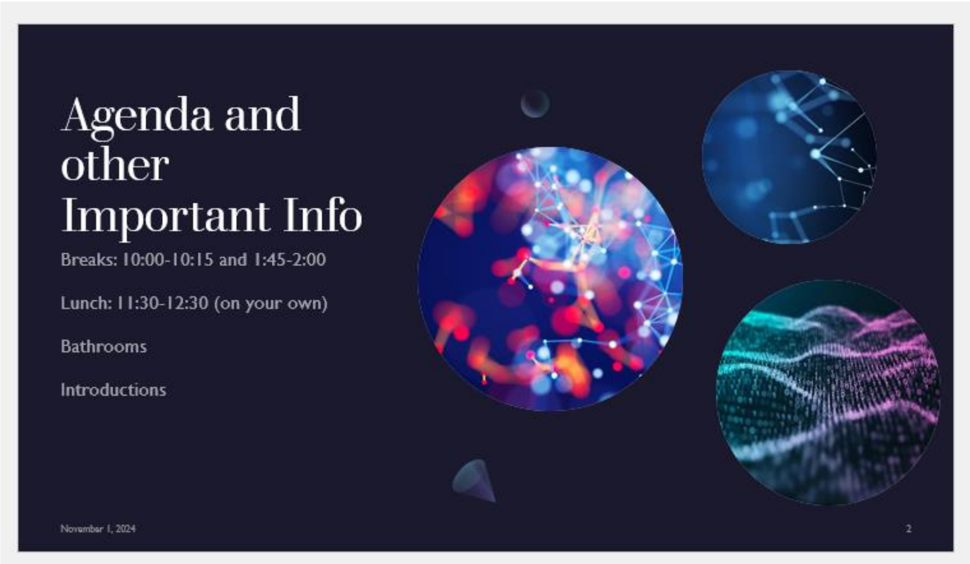
Topics and Time Frame	Reminders	Instructions, Activities, and Materials	Learning Outcome
Wrap-up and survey 3:00-3:30	All back together for wrap up and give training survey handout and post assessment handout	• 3:00-3:15: Recap the day. • 3:15-3:30: Have teachers fill out the Post Assessment Handout	

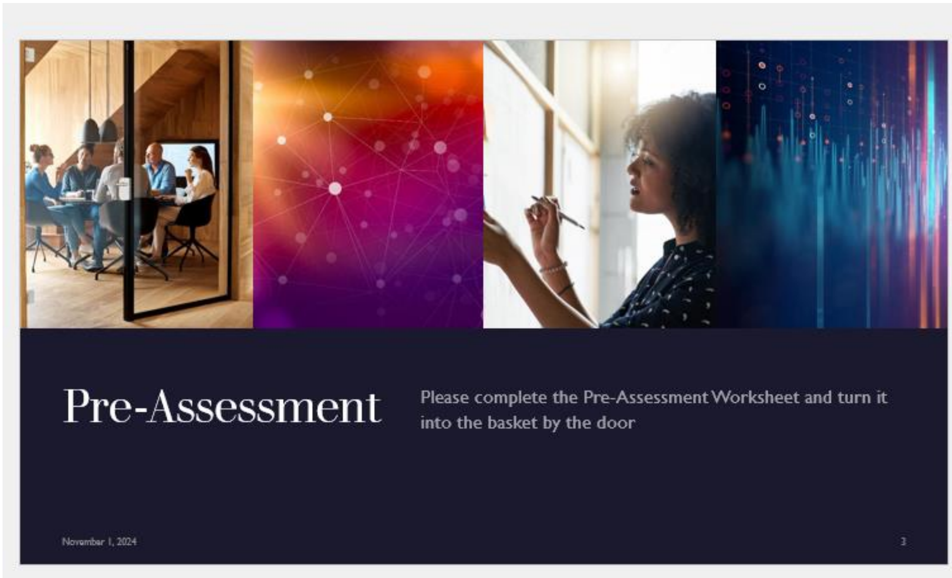
Daily Training Presentations and Handouts

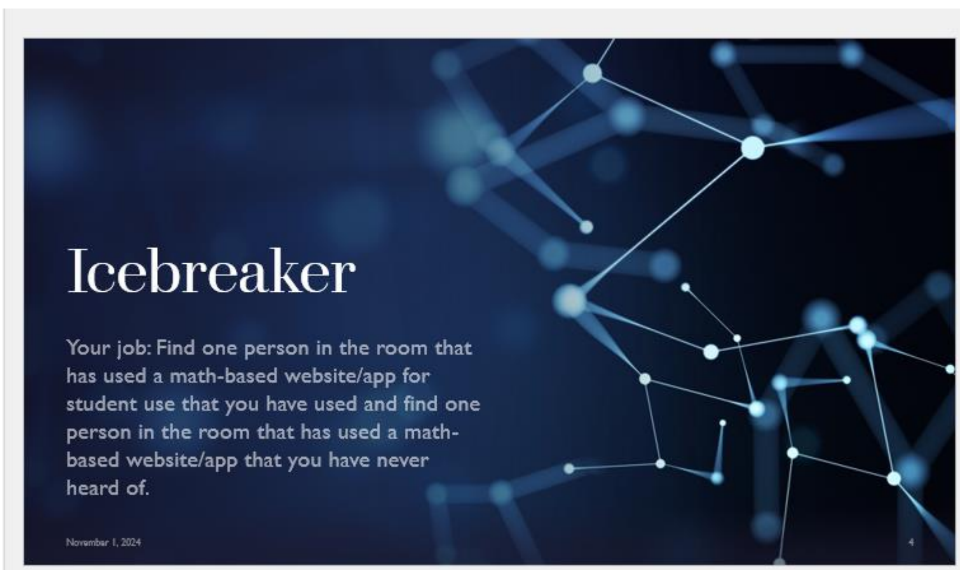
Day 1: Presentation and Handouts

Day 1 Training Presentation:

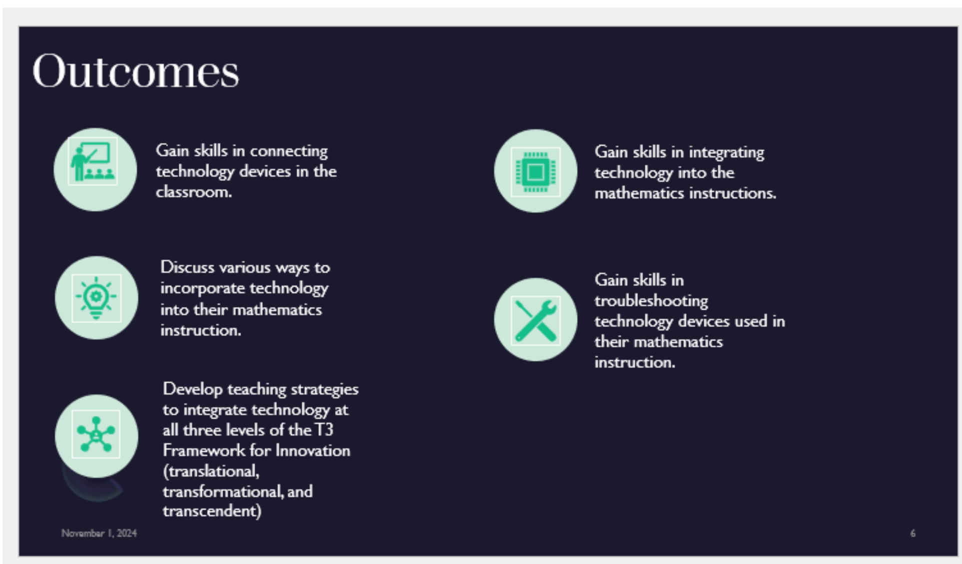


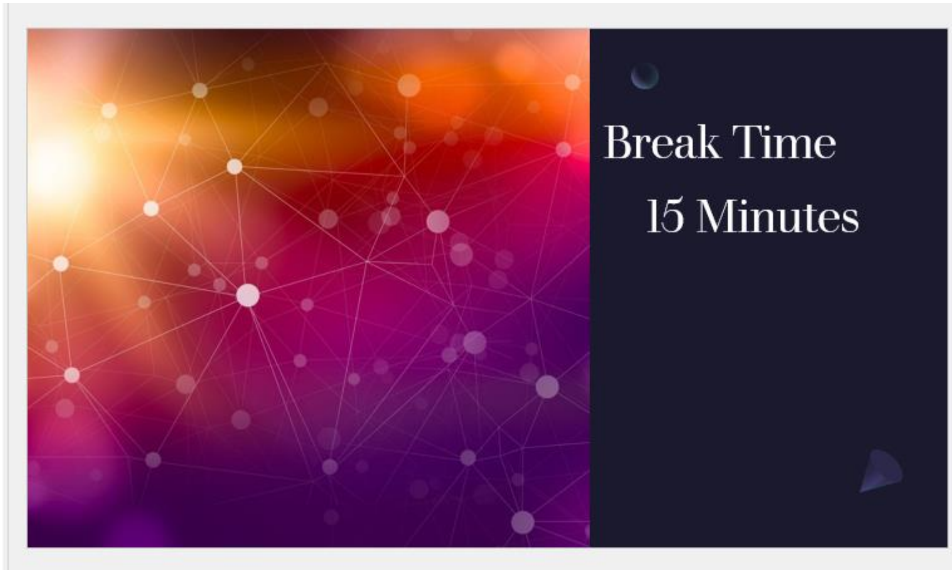


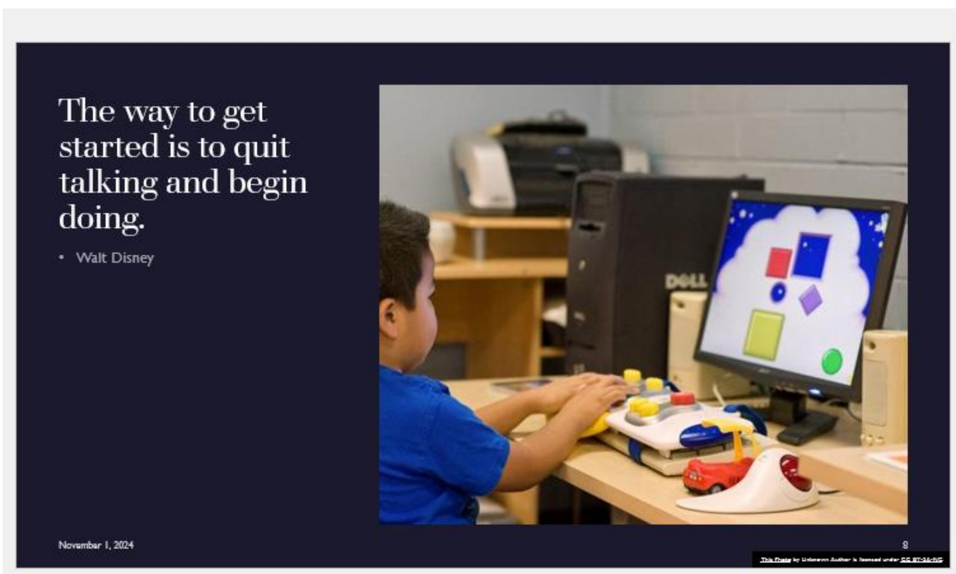

Pre-Assessment
Please complete the Pre-Assessment Worksheet and turn it into the basket by the door
November 1, 2024
3

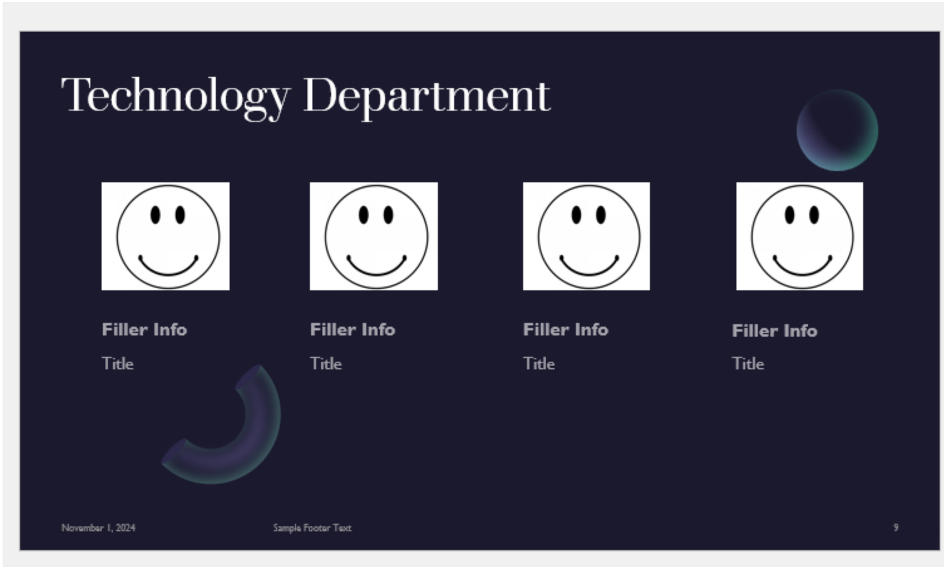

Icebreaker
Your job: Find one person in the room that has used a math-based website/app for student use that you have used and find one person in the room that has used a math-based website/app that you have never heard of.
November 1, 2024
4

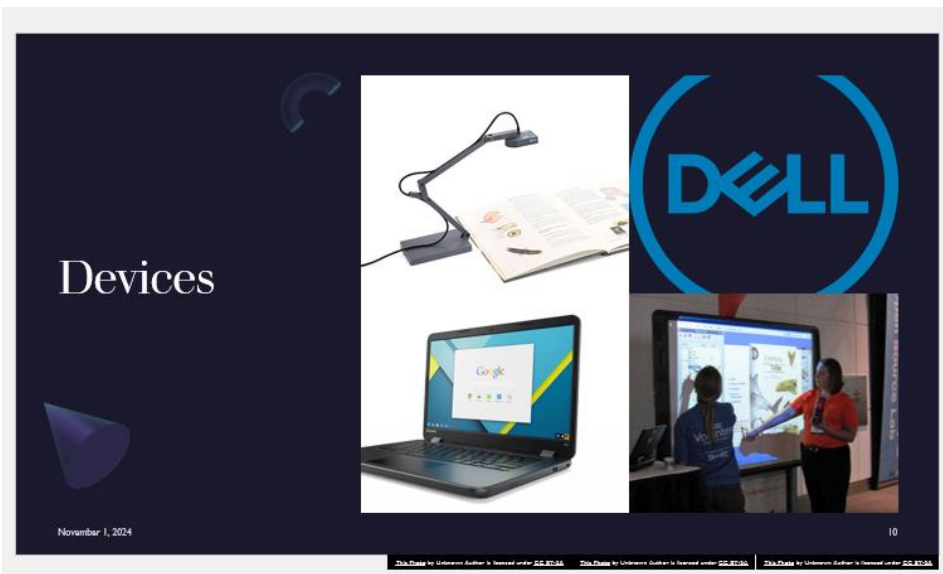

Why are we here?
RQ1: In what ways are teachers in the study district currently incorporating technology into their mathematics curriculum?
Teachers are using technology in their classroom, though not often in their mathematics instruction time.
RQ2: What guidance is needed to ensure teachers are prepared to use technology within the mathematics curriculum?
Teachers are requesting guidance in both technology resources and technology training.
RQ3:What supports are needed to ensure teachers can utilize technology to support the mathematics curriculum?
Teachers are requesting additional support with the technology devices and programs provided, additional support from people in the district to assist with technology integration, and support from the district administration.
November 1, 2024
5

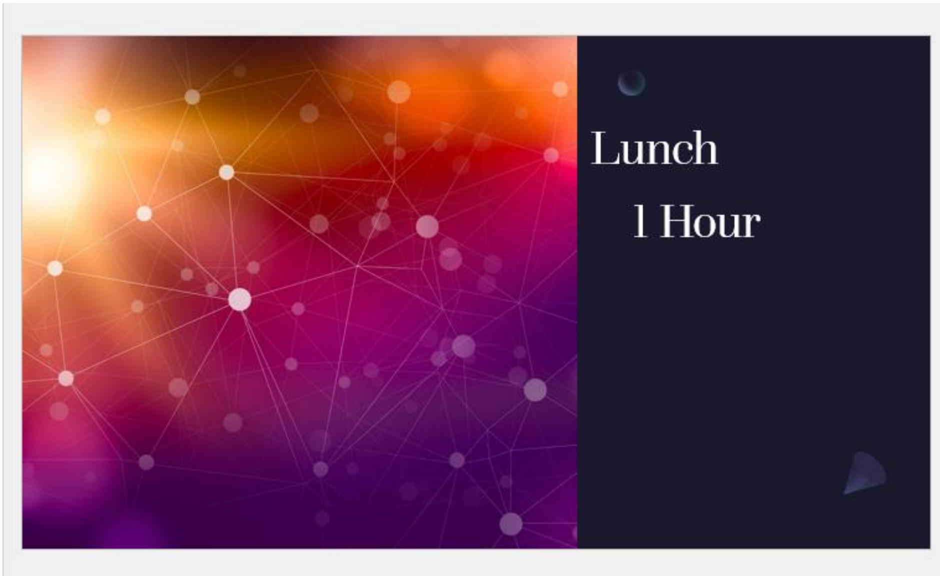

Outcomes
Gain skills in connecting technology devices in the classroom.
Gain skills in integrating technology into the mathematics instructions.
Discuss various ways to incorporate technology into their mathematics instruction.
Gain skills in troubleshooting technology devices used in their mathematics instruction.
Develop teaching strategies to integrate technology at all three levels of the T3 Framework for Innovation (translational, transformational, and transcendent)
November 1, 2024
6

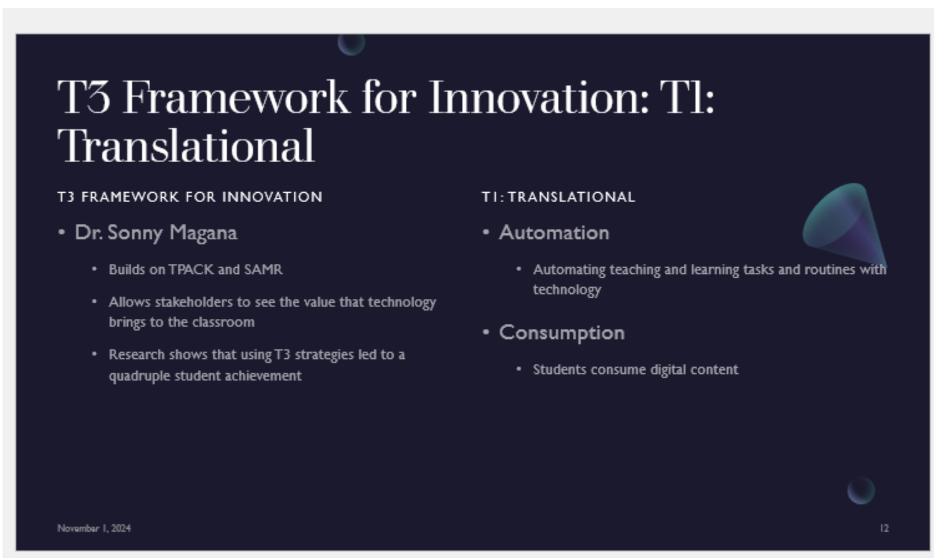

Break Time
15 Minutes

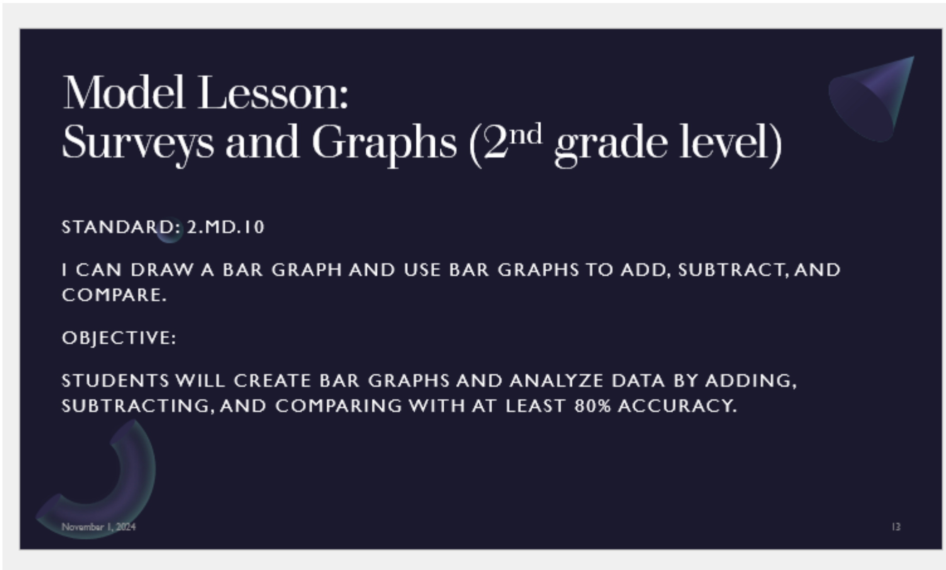

The way to get started is to quit talking and begin doing.
• Walt Disney
November 1, 2024

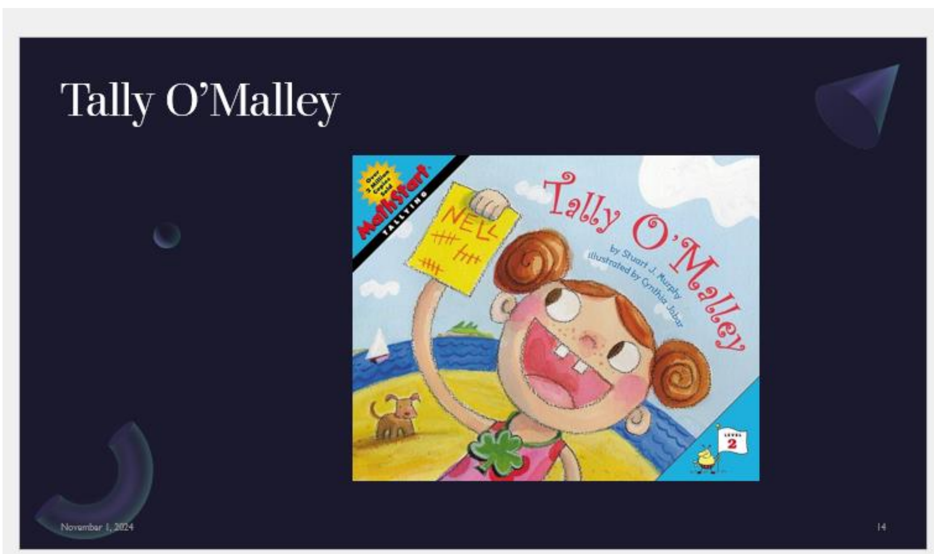

Technology Department
Filler Info
Title
Filler Info
Title
Filler Info
Title
Filler Info
Title
November 1, 2024
Sample Footer Text
9

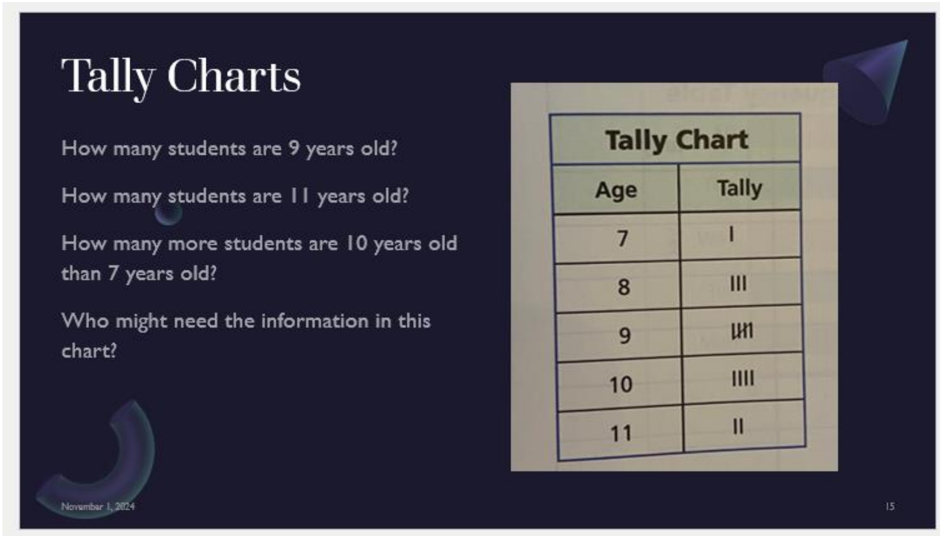

Devices
DELL
November 1, 2024
10

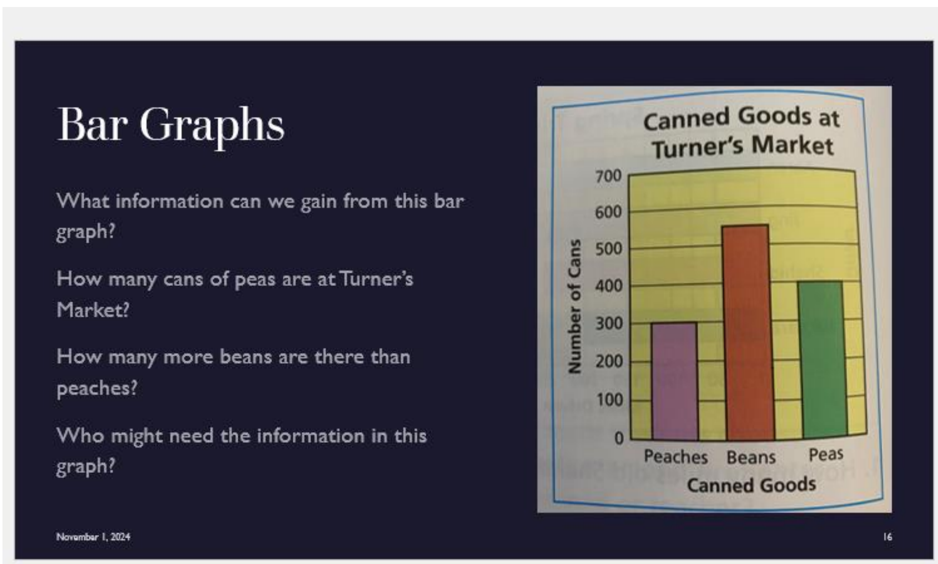

Lunch
1 Hour

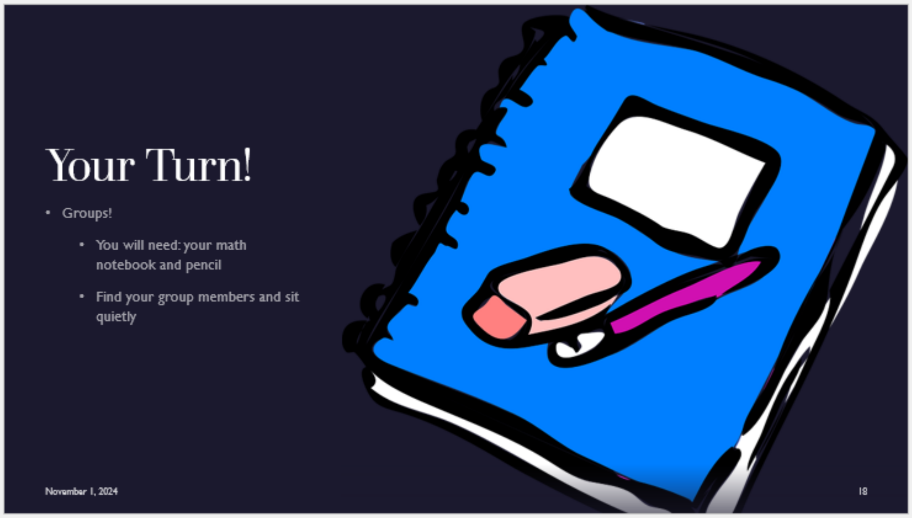

T3 Framework for Innovation: T1: Translational
T3 FRAMEWORK FOR INNOVATION
• Dr. Sonny Magana
• Builds on TPACK and SAMR
• Allows stakeholders to see the value that technology brings to the classroom
• Research shows that using T3 strategies led to a quadruple student achievement
T1: TRANSLATIONAL
• Automation
• Automating teaching and learning tasks and routines with technology
• Consumption
• Students consume digital content
November 1, 2024
12

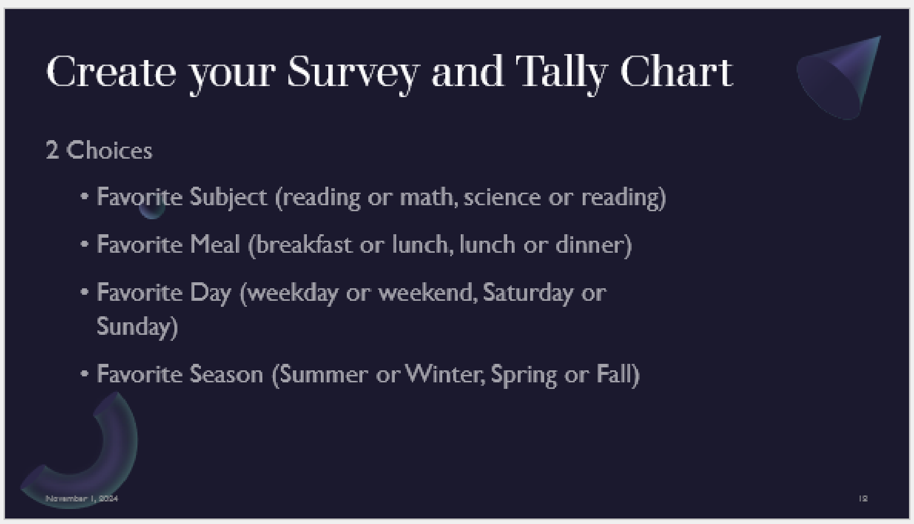

Model Lesson:
Surveys and Graphs (2nd grade level)
STANDARD: 2.MD.10
I CAN DRAW A BAR GRAPH AND USE BAR GRAPHS TO ADD, SUBTRACT, AND COMPARE.
OBJECTIVE:
STUDENTS WILL CREATE BAR GRAPHS AND ANALYZE DATA BY ADDING, SUBTRACTING, AND COMPARING WITH AT LEAST 80% ACCURACY.
November 1, 2024
13

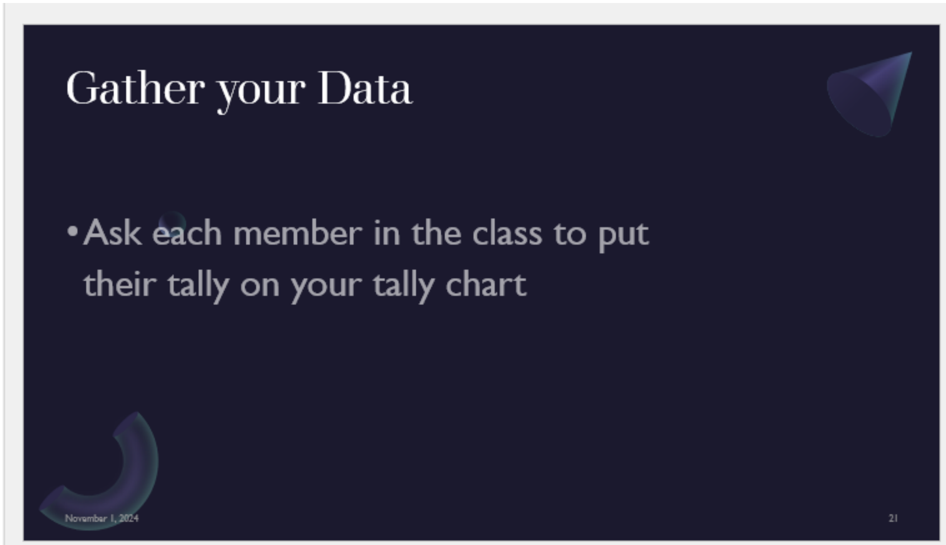

Tally O’Malley
MathStart
Tally O'Malley
by Stuart J. Murphy
illustrated by Cynthia Jabar
NELL
LEVEL 2
November 1, 2024
14

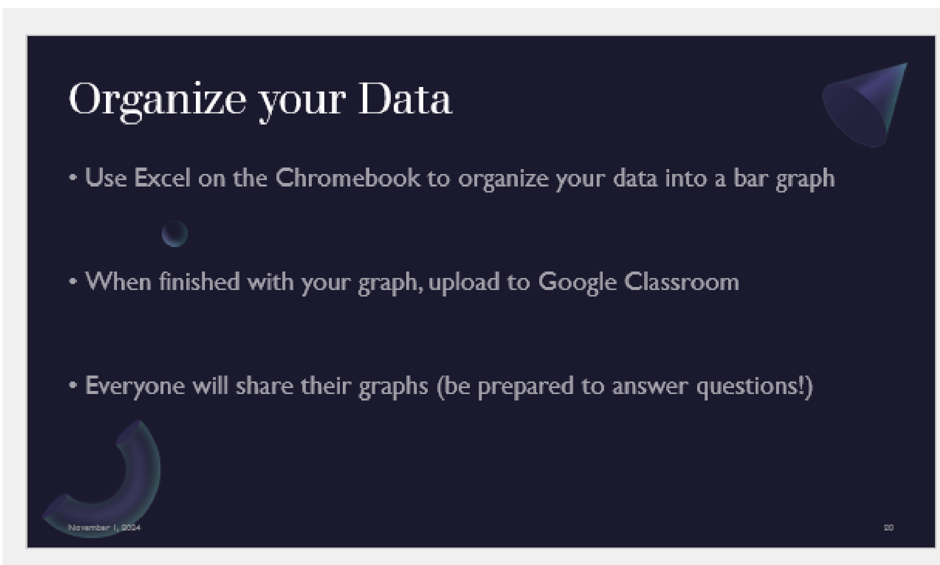

Tally Charts
How many students are 9 years old?
How many students are 11 years old?
How many more students are 10 years old than 7 years old?
Who might need the information in this chart?
Tally Chart
Age
Tally
7
8
9
10
11
November 1, 2024
15

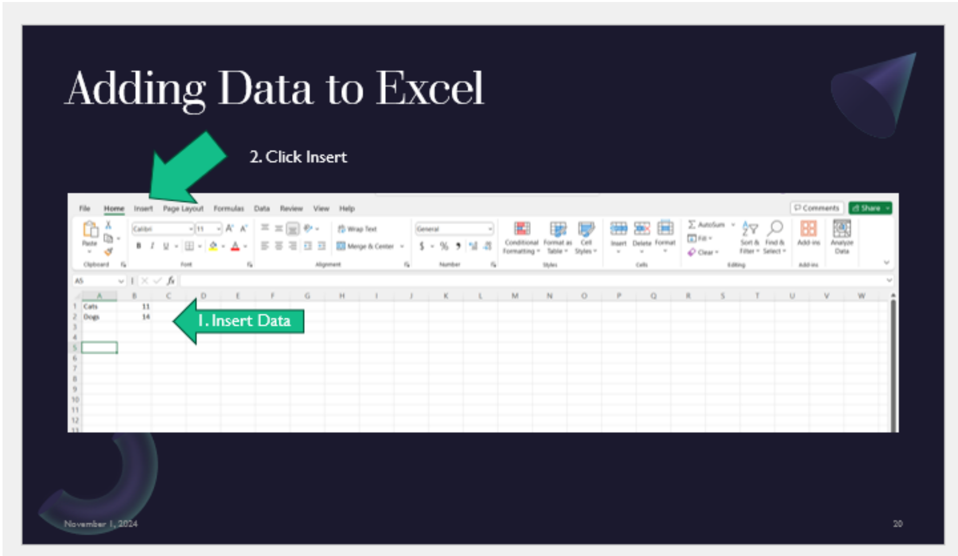

Bar Graphs
What information can we gain from this bar graph?
How many cans of peas are at Turner's Market?
How many more beans are there than peaches?
Who might need the information in this graph?
Canned Goods at Turner's Market
Number of Cans
700
600
500
400
300
200
100
0
Peaches
Beans
Peas
Canned Goods
November 1, 2024
16

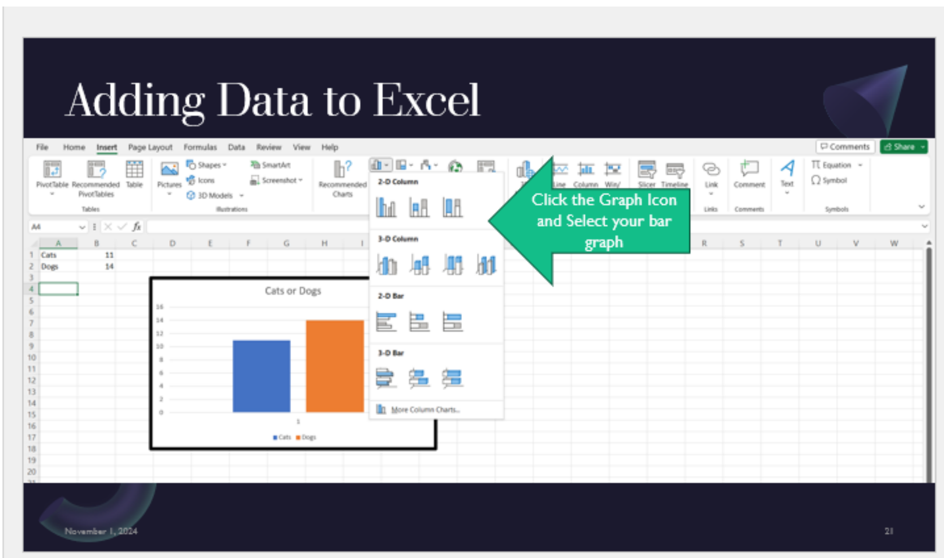

Your Turn!
• Groups!
• You will need: your math notebook and pencil
• Find your group members and sit quietly
November 1, 2024
18

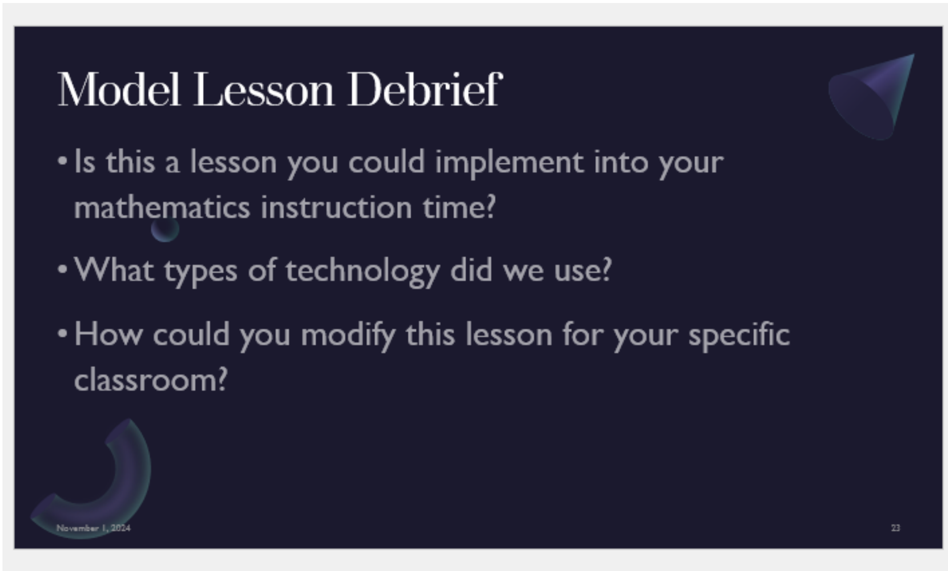

Create your Survey and Tally Chart
2 Choices
• Favorite Subject (reading or math, science or reading)
• Favorite Meal (breakfast or lunch, lunch or dinner)
• Favorite Day (weekday or weekend, Saturday or Sunday)
• Favorite Season (Summer or Winter, Spring or Fall)
November 1, 2024
12

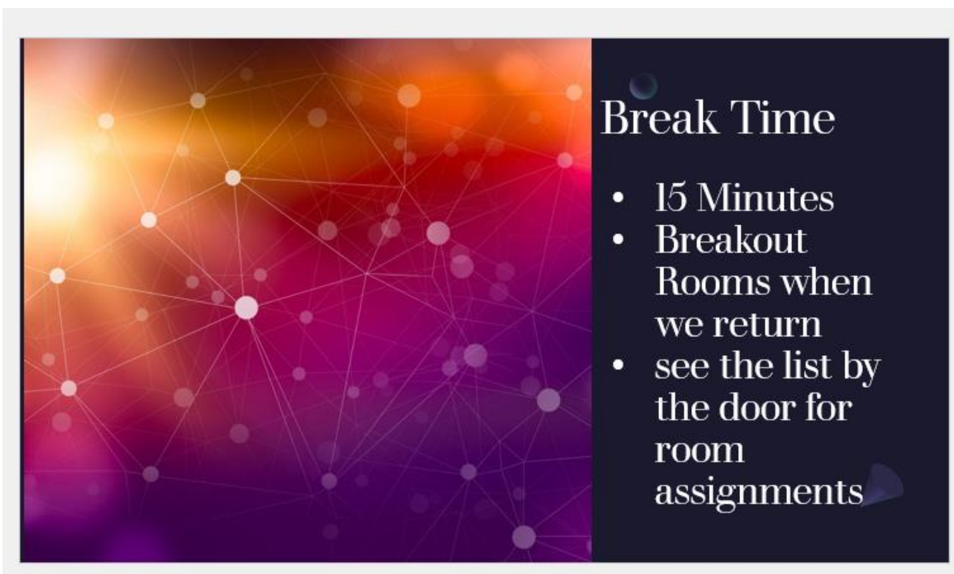

Gather your Data
• Ask each member in the class to put their tally on your tally chart
November 1, 2024
21

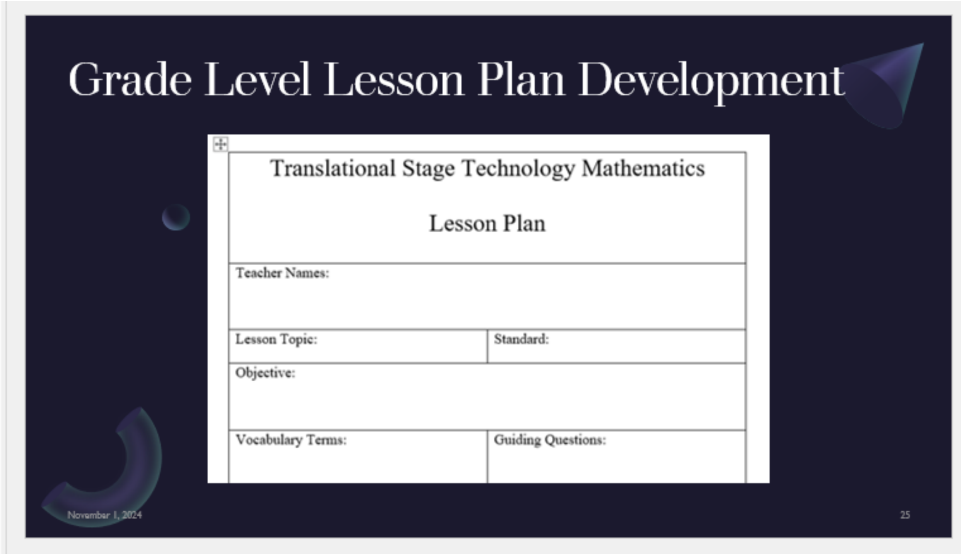

Organize your Data
• Use Excel on the Chromebook to organize your data into a bar graph
• When finished with your graph, upload to Google Classroom
• Everyone will share their graphs (be prepared to answer questions!)
November 1, 2024
20

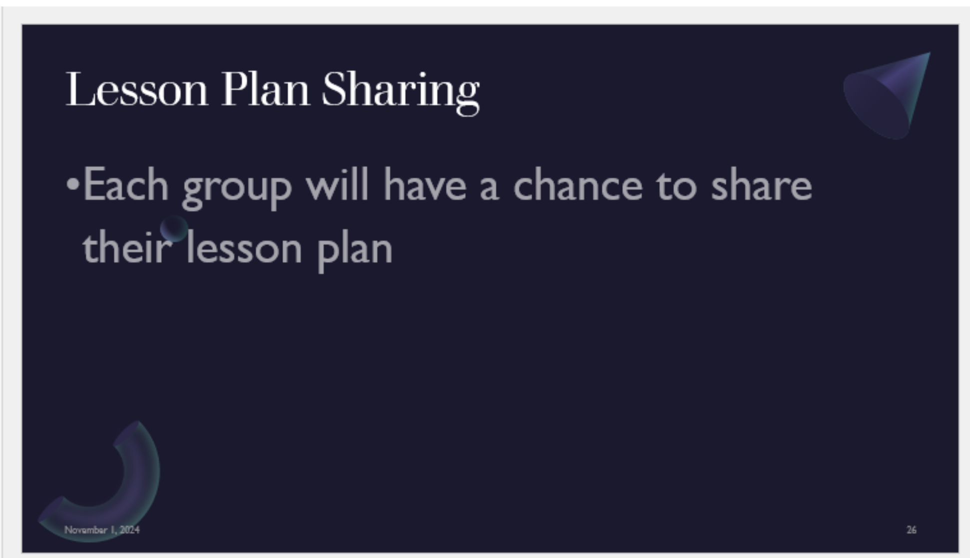

Adding Data to Excel
2. Click Insert
1. Insert Data
November 1, 2024
20

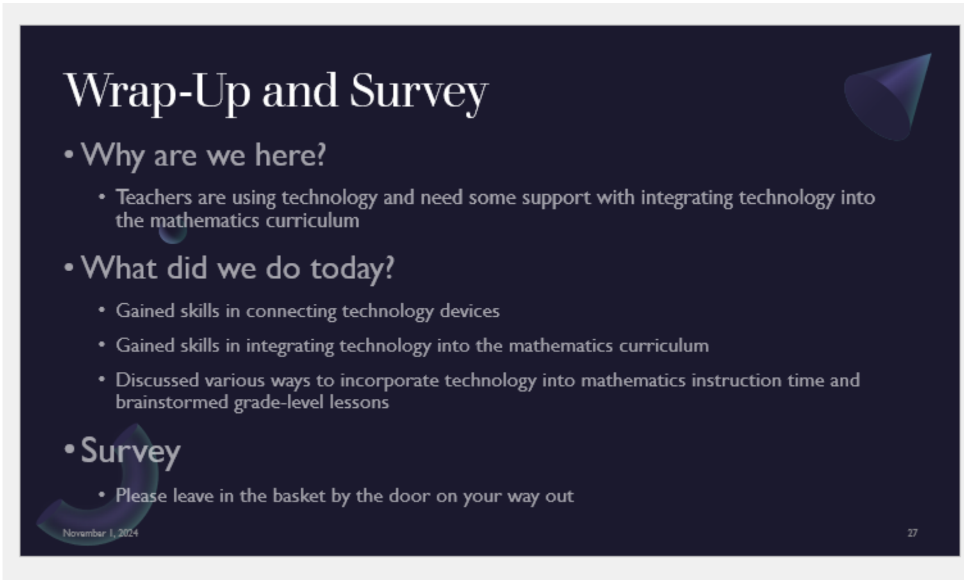

Adding Data to Excel
Click the Graph Icon and Select your bar graph
Cats or Dogs
November 1, 2024
21


Model Lesson Debrief
• Is this a lesson you could implement into your mathematics instruction time?
• What types of technology did we use?
• How could you modify this lesson for your specific classroom?
November 1, 2024
23


Break Time
• 15 Minutes
• Breakout Rooms when we return
• see the list by the door for room assignments


Grade Level Lesson Plan Development
Translational Stage Technology Mathematics
Lesson Plan
Teacher Names:
Lesson Topic:
Standard:
Objective:
Vocabulary Terms:
Guiding Questions:
November 1, 2024
25


Lesson Plan Sharing
•Each group will have a chance to share their lesson plan
November 1, 2024
26


Wrap-Up and Survey
• Why are we here?
• Teachers are using technology and need some support with integrating technology into the mathematics curriculum
• What did we do today?
• Gained skills in connecting technology devices
• Gained skills in integrating technology into the mathematics curriculum
• Discussed various ways to incorporate technology into mathematics instruction time and brainstormed grade-level lessons
• Survey
• Please leave in the basket by the door on your way out
November 1, 2024
27

Day 1 Handouts:

Preassessment Survey (to be completed at the start of Day 1)

Pre-Assessment Survey

1. In what ways are you currently integrating technology into your mathematics instruction?

____

____

____

____

____

____

2. What knowledge do you have of the T3 framework for innovation?

____

____

____

____

____

____

3. On a scale of 1-5, where would you rate your comfort level of using technology in the classroom, with 1 being not comfortable at all and 5 being very comfortable?

   1 2 3 4 5

   Comments:

____

____

____

____

____

Training Survey (to be completed at the end of Day 1)

1. Overall, how would you rate today's training?
    a. Excellent
    b. Very Good
    c. Good
    d. Fair
    e. Poor

    How could the quality of today's training be improved?

    ____

    ____

    ____

    ____

2. How useful was the Tech Department presentation?
    a. Extremely useful
    b. Very useful
    c. Somewhat useful
    d. Not so useful
    e. Not at all useful

    What would make the presentation more useful?

    ____

    ____

    ____

    ____

3. How clearly did your instructor explain the material?
    a. Extremely clearly
    b. Very clearly
    c. Somewhat clearly
    d. Not so clearly
    e. Not at all clearly

What still needs to be explained?

____

____

____

4. How comfortable did you feel voicing your opinions in class?
   a. Extremely comfortable
   b. Very comfortable
   c. Somewhat comfortable
   d. Not so comfortable
   e. Not at all comfortable

Comments?

____

____

____

____

5. Anything else you would like us to know?

____

____

____

____

6. What improvements would you make to the training?

____

____

____

____

Exemplar Translational Stage Lesson Plan for Model Lesson Plan: Day 1

<table>
<tr><td colspan="2"><h1>Translational Stage Technology Mathematics

Lesson Plan</h1></td></tr>
<tr><td colspan="2">Teacher Names: Translational Model Lesson Plan</td></tr>
<tr><td>Lesson Topic: Surveys and Graphs</td><td>Standard: 2.MD.10</td></tr>
<tr><td colspan="2">Objective:
Students will create bar graphs and analyze data by adding, subtracting, and comparing with at least 80% accuracy.</td></tr>
<tr><td>Vocabulary Terms:
Survey
Tally
Tally Chart
Bar Graph
Data tables</td><td>Guiding Questions:
What are tally marks?
What is a tally chart?
How can we create and read a tally chart?
What is a bar graph?
How can we create and read a bar graph?
Why are using these data tables important?</td></tr>
<tr><td>Materials:

Tally O'Malley by Stuart J. Murphy

Math App/Site/Program:
Promethean ActivPanel
Wixie.com
Excel</td><td>Instruction:

• Read 'Tally O'Malley' by Stuart J. Murphy (or play the video read aloud: https://youtu.be/8UL6zQlHkBQ?si=Rix-nTnf1gdUeSkz) and discuss tally marks and collecting data.
• Create examples of Tally Charts using the Promethean
• Create examples of bar graphs, work on reading the graph asking questions such as: what is this graph about? Which is the most popular option(s)? Least popular? Who might care about this information?</td></tr>
</table>

	• Ask about where we get the data for a graph. Introduce the concept of a survey. • Create a two-option survey using Wixie (wixie.com) (such as which book do you like better) and have students make their digital tally marks (Note these can be great bellringer activities) • Make small groups of students and have them create their own survey and collect data to display in a bar graph. Let groups pick their topic (i.e. favorite ice cream flavor, what class pet should we get, etc.). • Have groups create their survey and gather data from classmates. • Each individual student will use the data to create a bar graph in Excel and share with their group members • Each group will share their graphs with the rest of the class as presentations on the promethean
Remediation: Provide manipulatives and allow students to make tally charts with the manipulatives.	Enrichment: Introduce line plots and/or other types of graphs
Additional Notes: Grade Level Modifications: 3rd Grade: • Include line plots as well as bar graphs 4th Grade: • Include additional graph options such as pie charts and line charts, line plots, etc. 5th Grade: • Allow surveys to offer more than two choices and require students to use additional graph representations 6th Grade: • Allow surveys to offer more than two choices and allow students to collect additional data outside of their classrooms (i.e. other classrooms or staff in the building) and require students to use additional graph representations	
Explanation for how this is translational use of technology: Students are completing their bar graphs on Excel; these graphs could also be created on paper without the use of any technology.	

Translational Stage Lesson Plan Template

<table>
<tr><td colspan="2">Translational Stage Technology Mathematics

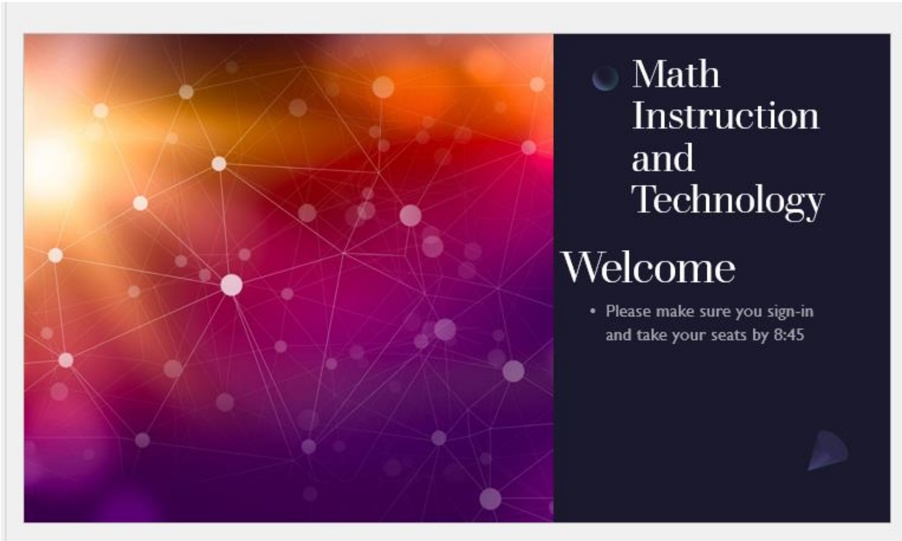
Lesson Plan</td></tr>
<tr><td colspan="2">Teacher Names:</td></tr>
<tr><td>Lesson Topic:</td><td>Standard:</td></tr>
<tr><td colspan="2">Objective:</td></tr>
<tr><td>Vocabulary Terms:</td><td>Guiding Questions:</td></tr>
<tr><td>Materials:

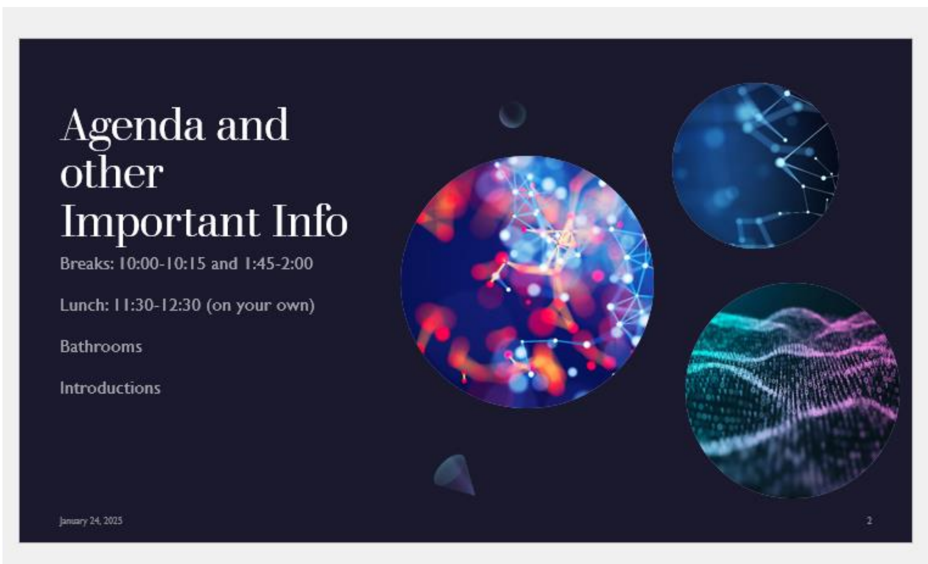
Math App/Site/Program:</td><td>Instruction:</td></tr>
</table>

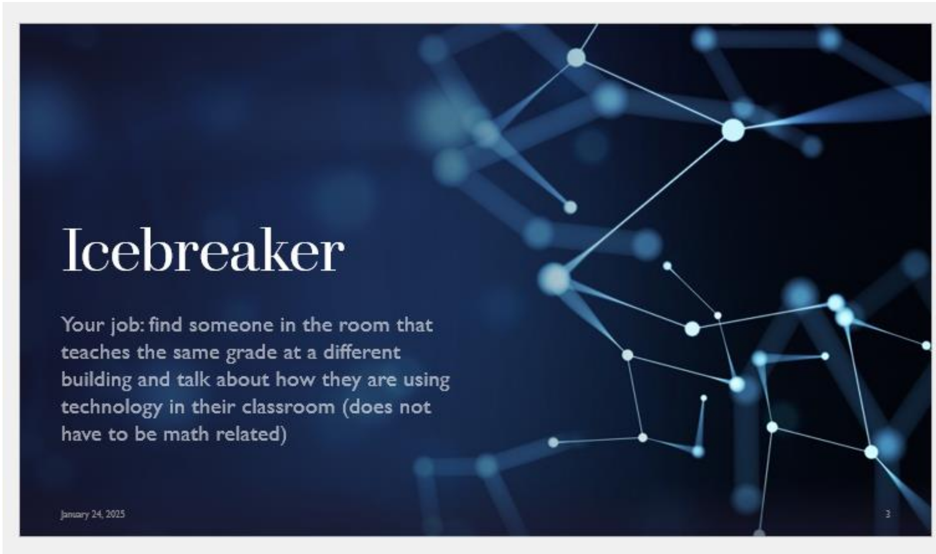
Remediation:	Enrichment:
Additional Notes:	
Explanation for how this is translational use of technology:	

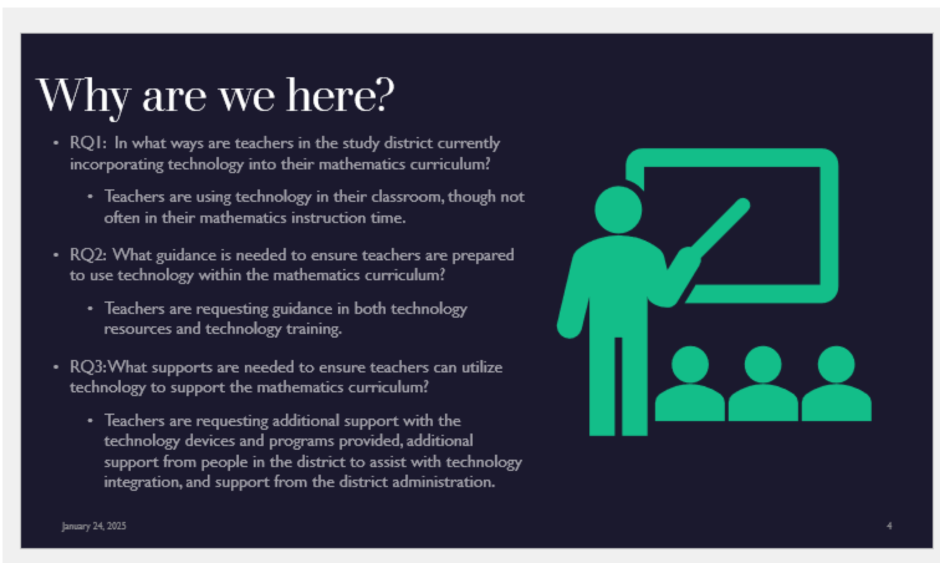
Day 2: Presentation and Handouts

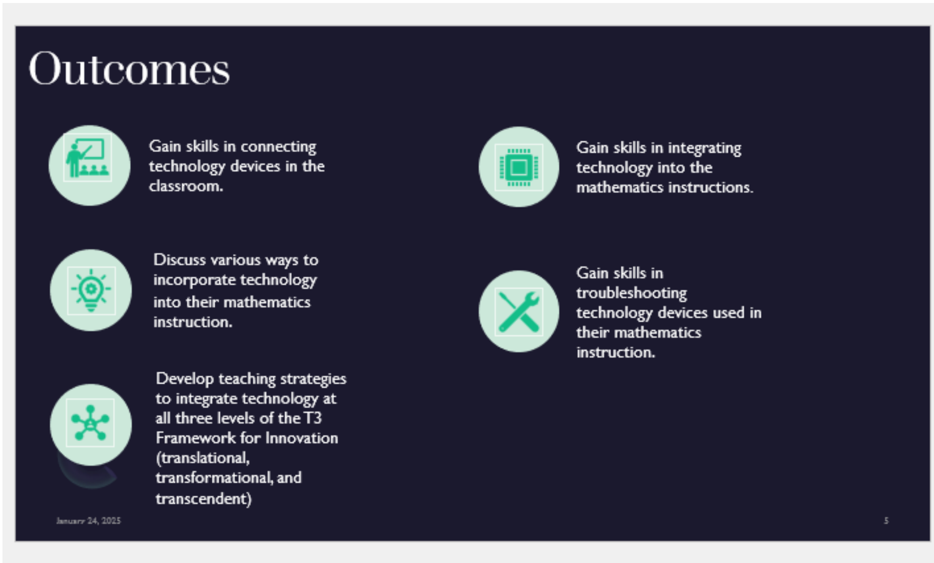
Day 2 Training Presentation

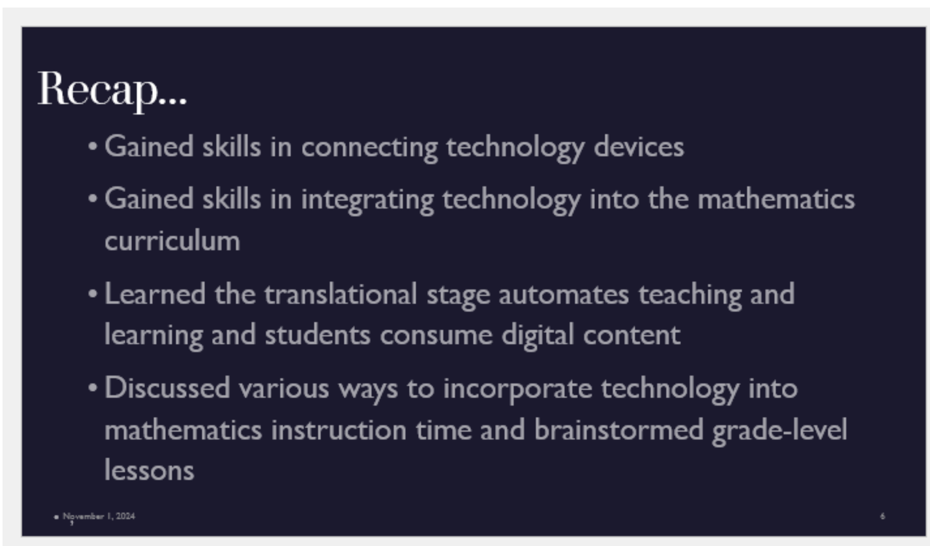


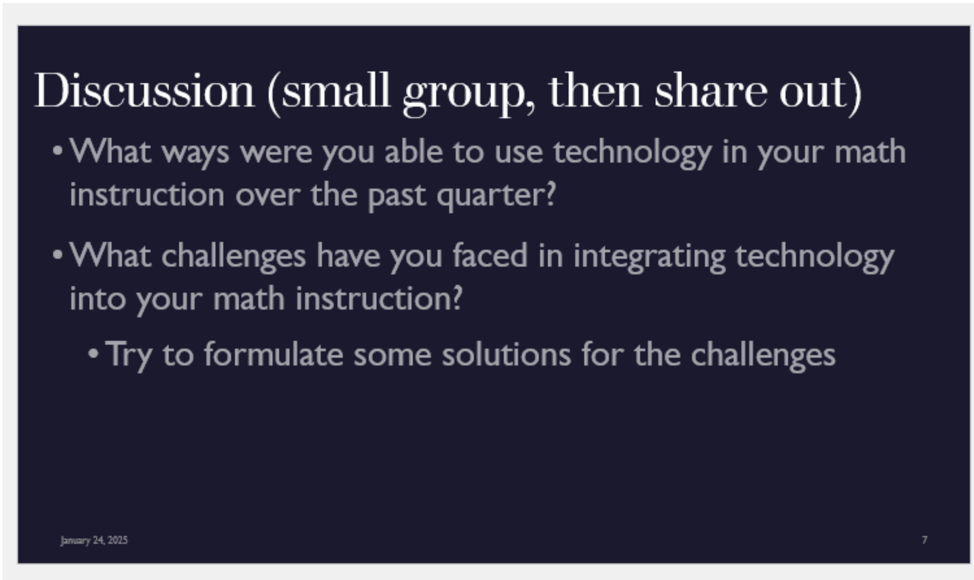



Icebreaker
Your job: find someone in the room that teaches the same grade at a different building and talk about how they are using technology in their classroom (does not have to be math related)
January 24, 2025
3

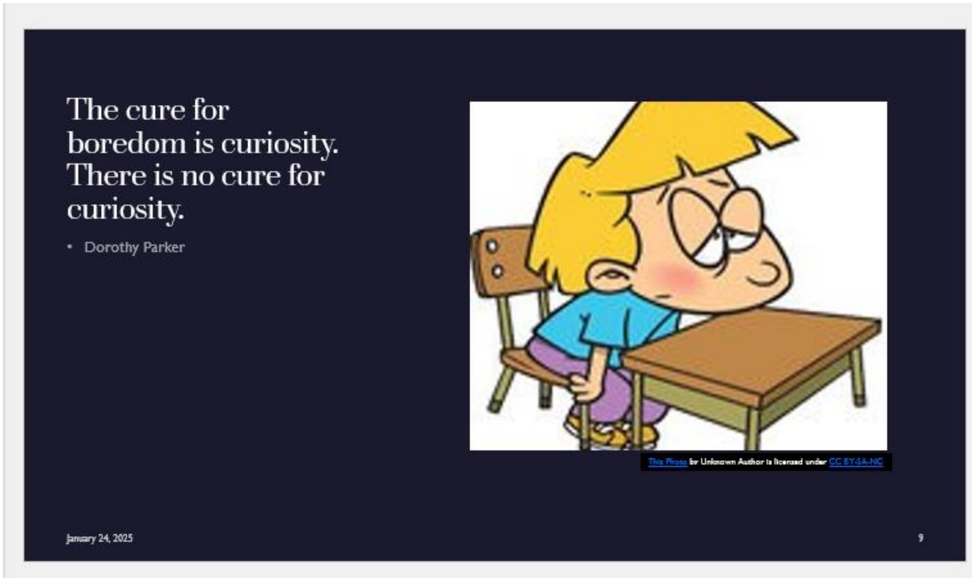

Why are we here?
RQ1: In what ways are teachers in the study district currently incorporating technology into their mathematics curriculum?
Teachers are using technology in their classroom, though not often in their mathematics instruction time.
RQ2: What guidance is needed to ensure teachers are prepared to use technology within the mathematics curriculum?
Teachers are requesting guidance in both technology resources and technology training.
RQ3: What supports are needed to ensure teachers can utilize technology to support the mathematics curriculum?
Teachers are requesting additional support with the technology devices and programs provided, additional support from people in the district to assist with technology integration, and support from the district administration.
January 24, 2025
4

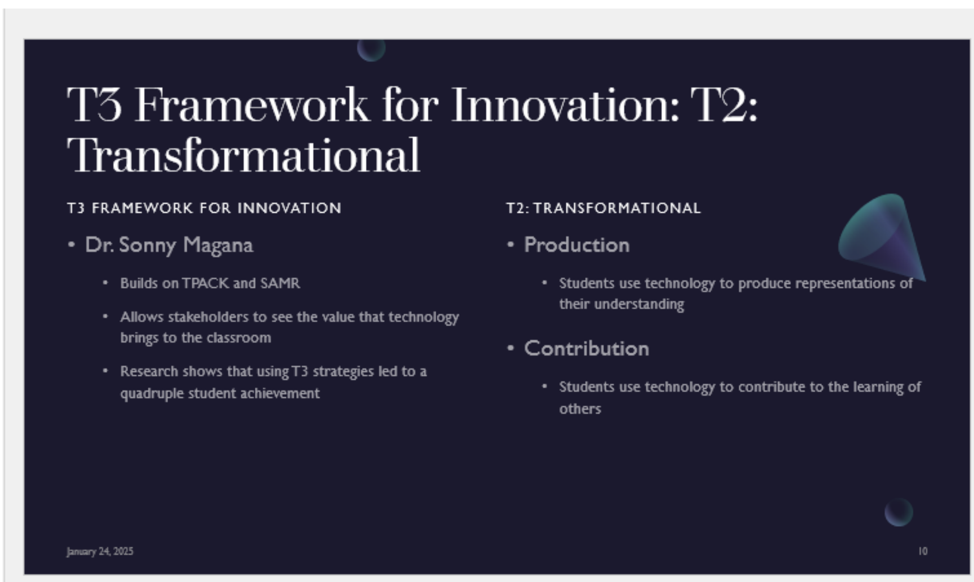

Outcomes
Gain skills in connecting technology devices in the classroom.
Gain skills in integrating technology into the mathematics instructions.
Discuss various ways to incorporate technology into their mathematics instruction.
Gain skills in troubleshooting technology devices used in their mathematics instruction.
Develop teaching strategies to integrate technology at all three levels of the T3 Framework for Innovation (translational, transformational, and transcendent)
January 24, 2025
5

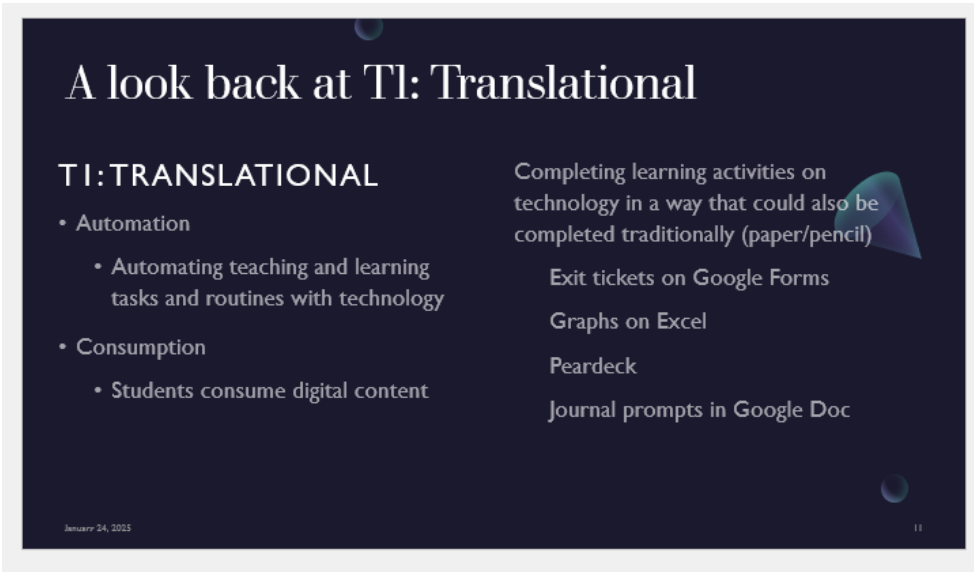

Recap...
• Gained skills in connecting technology devices
• Gained skills in integrating technology into the mathematics curriculum
• Learned the translational stage automates teaching and learning and students consume digital content
• Discussed various ways to incorporate technology into mathematics instruction time and brainstormed grade-level lessons
November 1, 2024
6

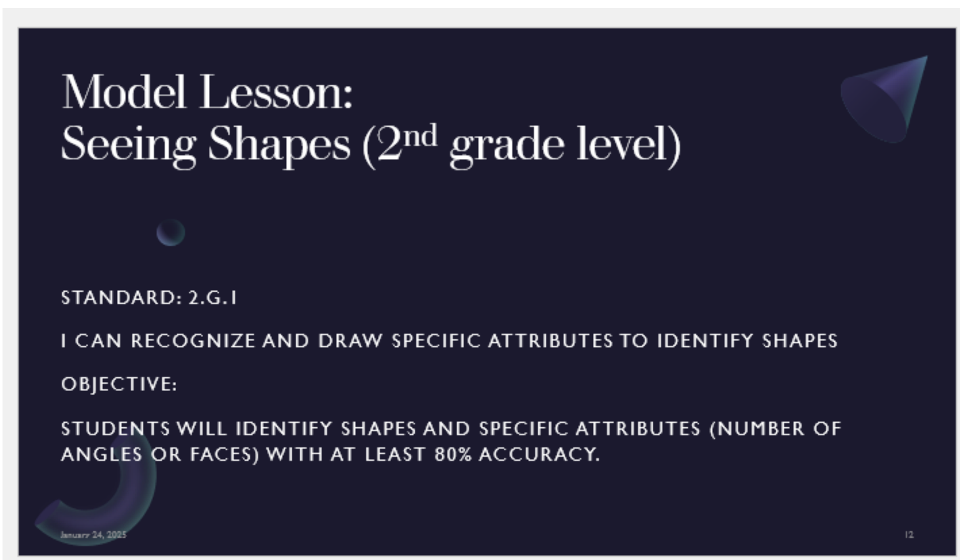

Discussion (small group, then share out)
• What ways were you able to use technology in your math instruction over the past quarter?
• What challenges have you faced in integrating technology into your math instruction?
• Try to formulate some solutions for the challenges
January 24, 2025
7

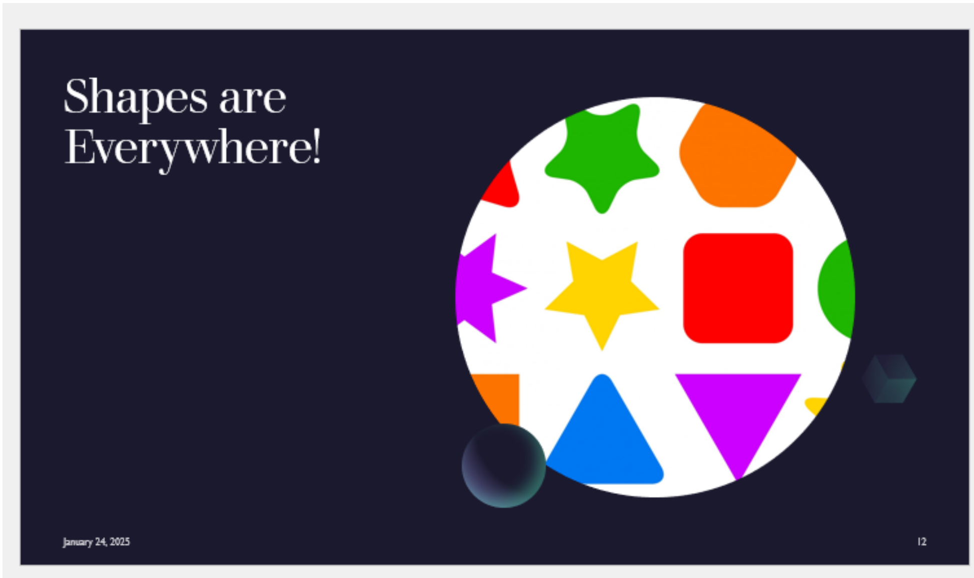

Break Time
15 Minutes

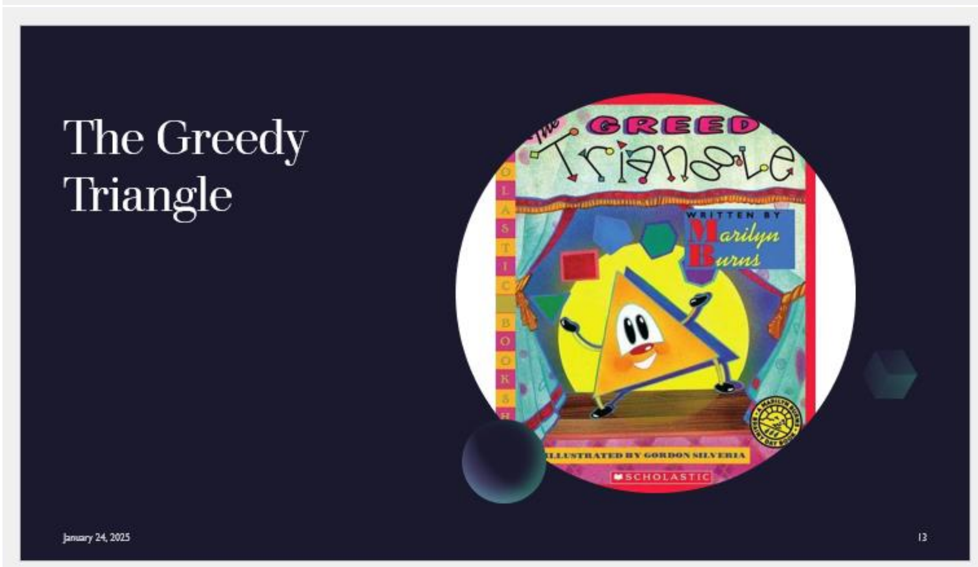

The cure for boredom is curiosity. There is no cure for curiosity.
• Dorothy Parker
This Photo by Unknown Author is licensed under CC BY-SA-NC
January 24, 2025
9

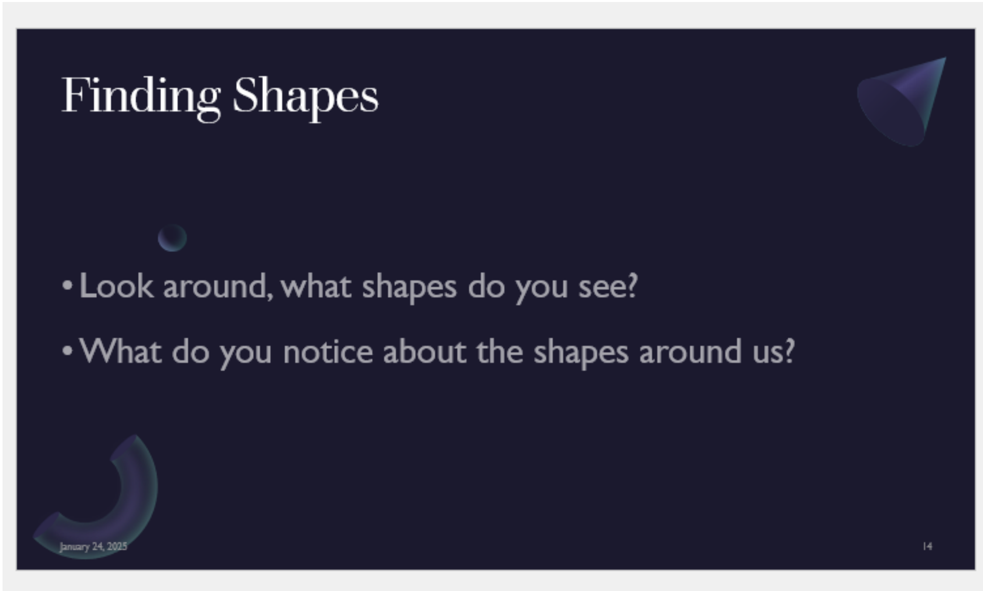

T3 Framework for Innovation: T2: Transformational
T3 FRAMEWORK FOR INNOVATION
• Dr. Sonny Magana
• Builds on TPACK and SAMR
• Allows stakeholders to see the value that technology brings to the classroom
• Research shows that using T3 strategies led to a quadruple student achievement
T2: TRANSFORMATIONAL
• Production
• Students use technology to produce representations of their understanding
• Contribution
• Students use technology to contribute to the learning of others
January 24, 2025
10

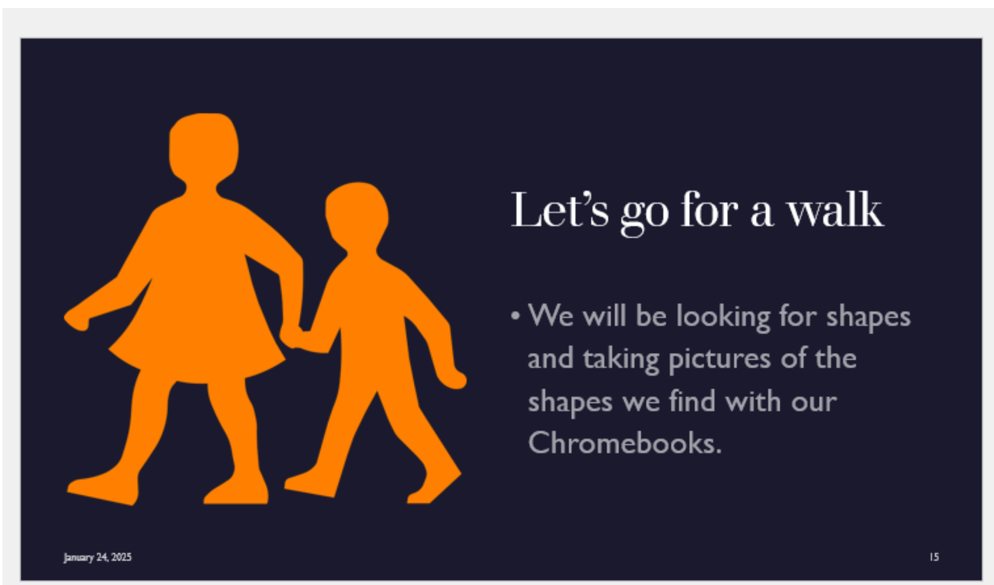

A look back at TI: Translational
T1: TRANSLATIONAL
• Automation
• Automating teaching and learning tasks and routines with technology
• Consumption
• Students consume digital content
Completing learning activities on technology in a way that could also be completed traditionally (paper/pencil)
Exit tickets on Google Forms
Graphs on Excel
Peardeck
Journal prompts in Google Doc
January 24, 2025
11


Model Lesson:
Seeing Shapes (2nd grade level)
STANDARD: 2.G.1
I CAN RECOGNIZE AND DRAW SPECIFIC ATTRIBUTES TO IDENTIFY SHAPES
OBJECTIVE:
STUDENTS WILL IDENTIFY SHAPES AND SPECIFIC ATTRIBUTES (NUMBER OF ANGLES OR FACES) WITH AT LEAST 80% ACCURACY.
January 24, 2025
12

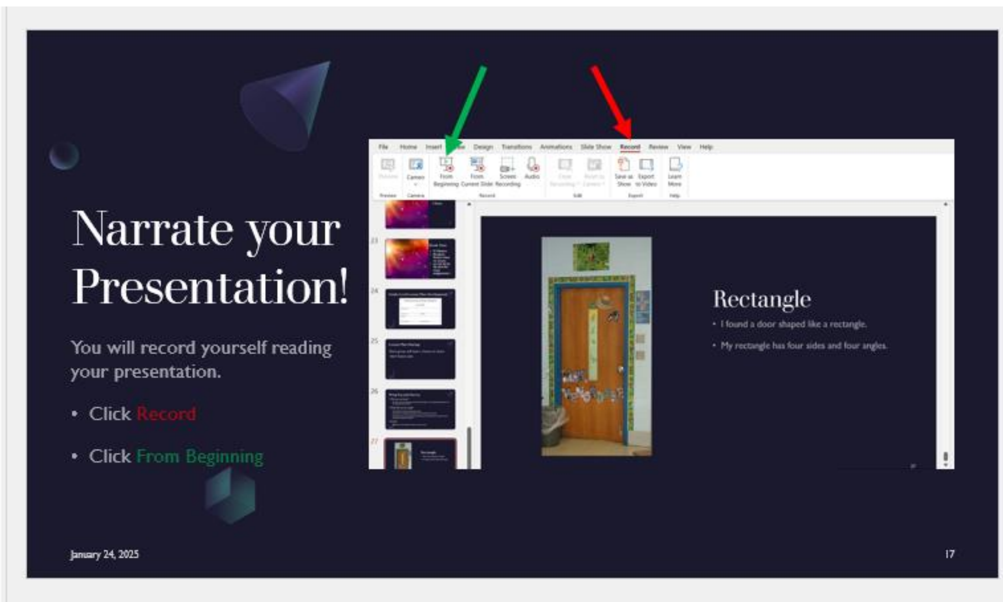

Shapes are Everywhere!
January 24, 2025
12


The Greedy Triangle
The GREEDY Triangle
WRITTEN BY Marilyn Burns
ILLUSTRATED BY GORDON SILVERIA
SCHOLASTIC
January 24, 2025
13

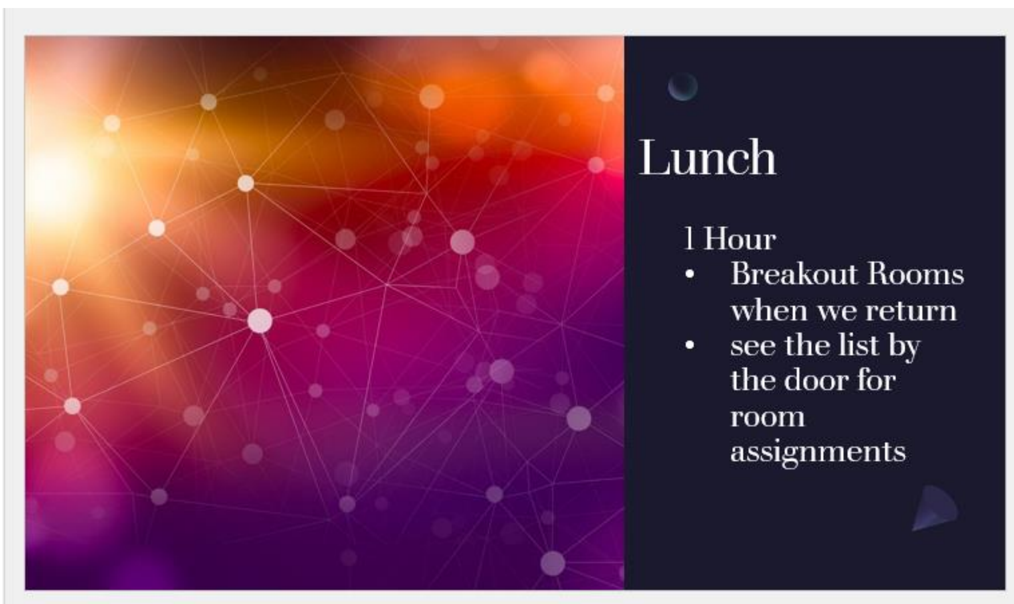

Finding Shapes
• Look around, what shapes do you see?
• What do you notice about the shapes around us?
January 24, 2025
14

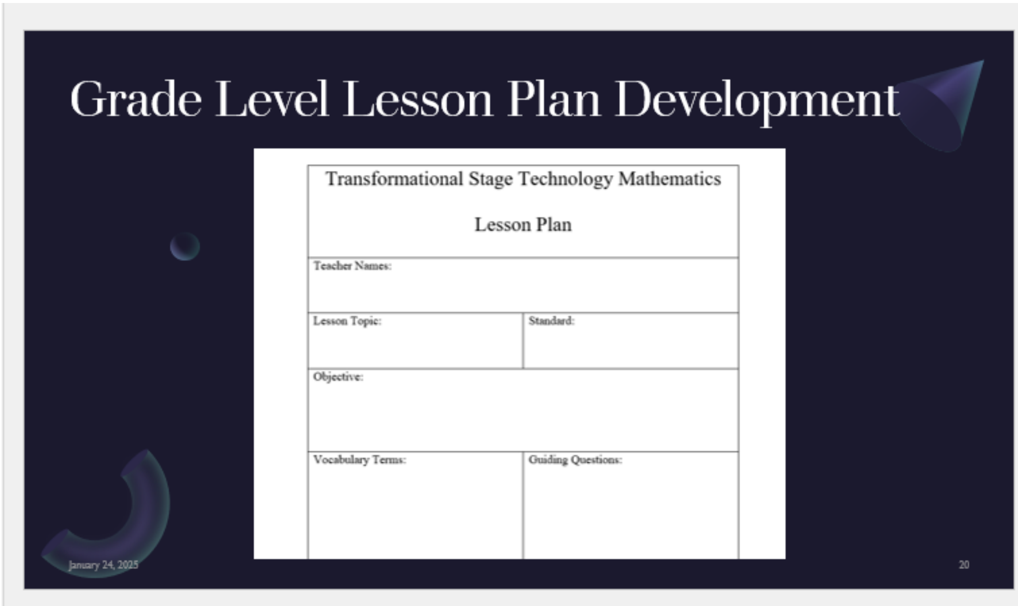

Let's go for a walk
• We will be looking for shapes and taking pictures of the shapes we find with our Chromebooks.
January 24, 2025
15

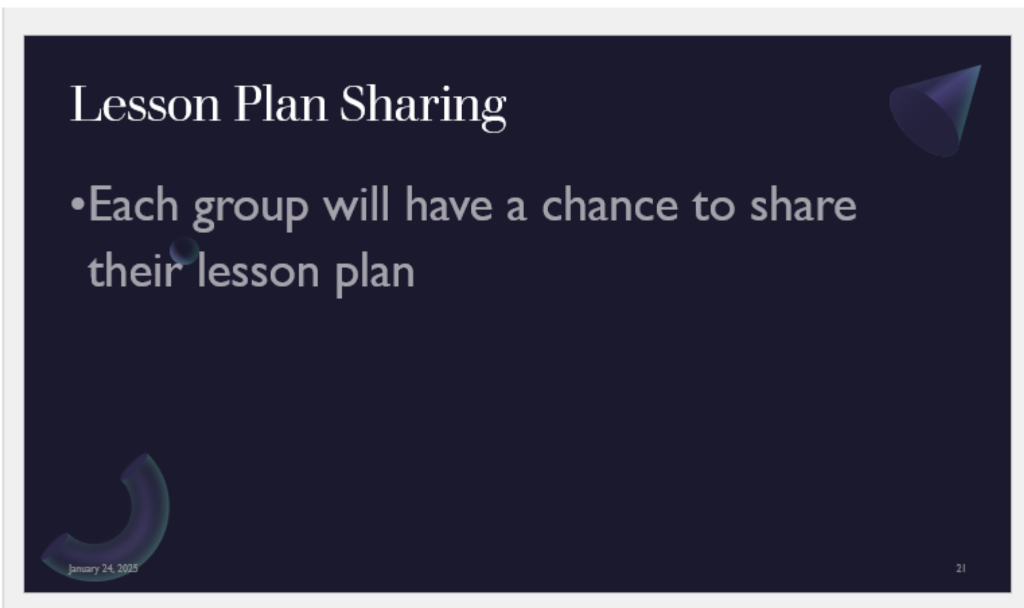

Make your Shapes Presentation
• Use your pictures to create a Power Point presentation to show and describe your shapes.
Rectangle
• I found a door shaped like a rectangle.
• My rectangle has four sides and four angles.
January 24, 2025
16

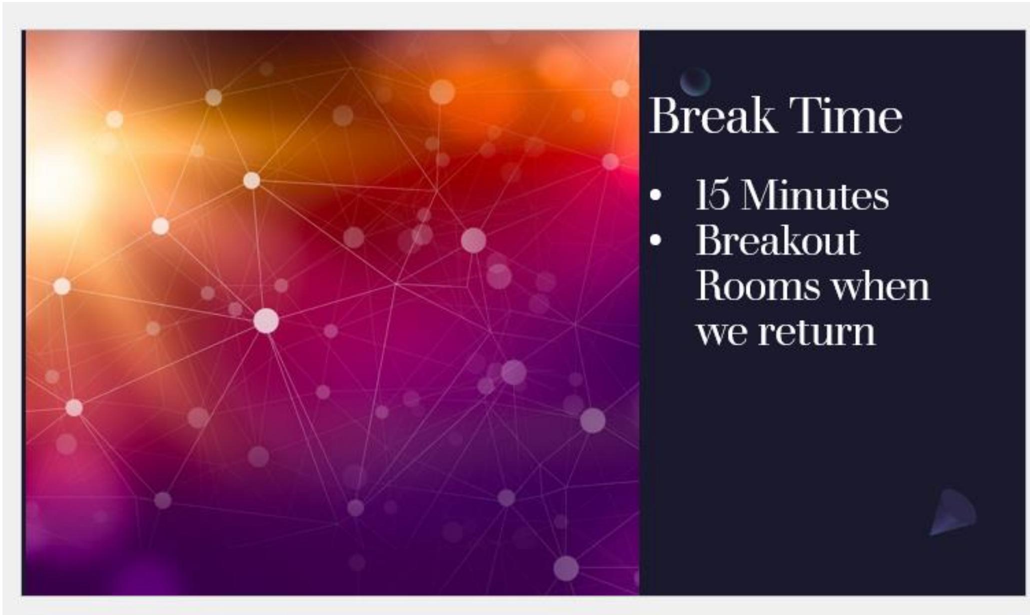

Narrate your Presentation!
You will record yourself reading your presentation.
• Click Record
• Click From Beginning
Rectangle
• I found a door shaped like a rectangle.
• My rectangle has four sides and four angles.
January 24, 2025
17

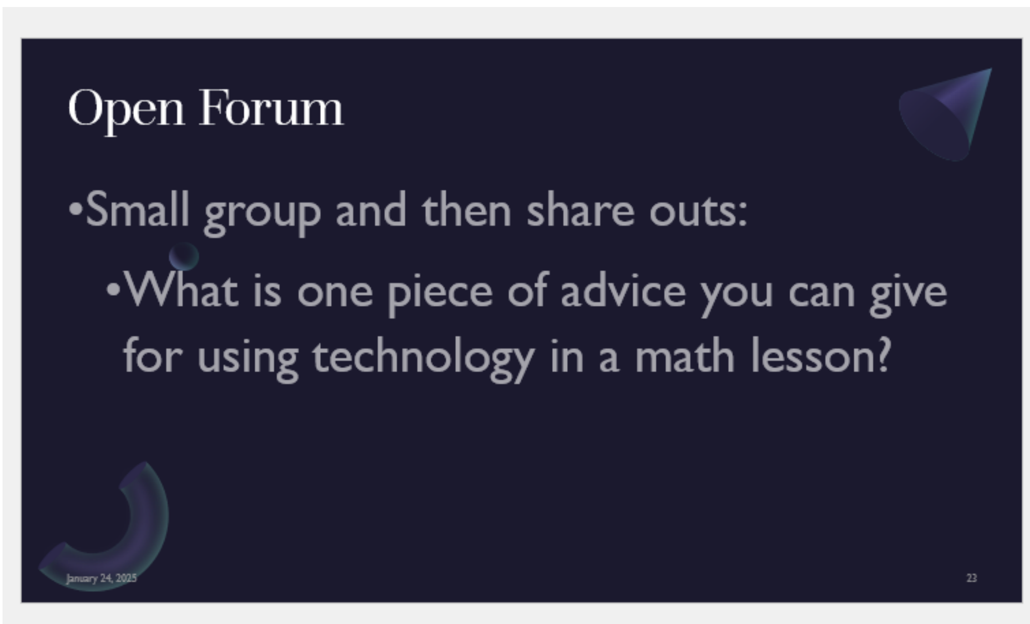

Model Lesson Debrief
• Is this a lesson you could implement into your mathematics instruction time?
• What types of technology did we use?
• How could you modify this lesson for your specific classroom?

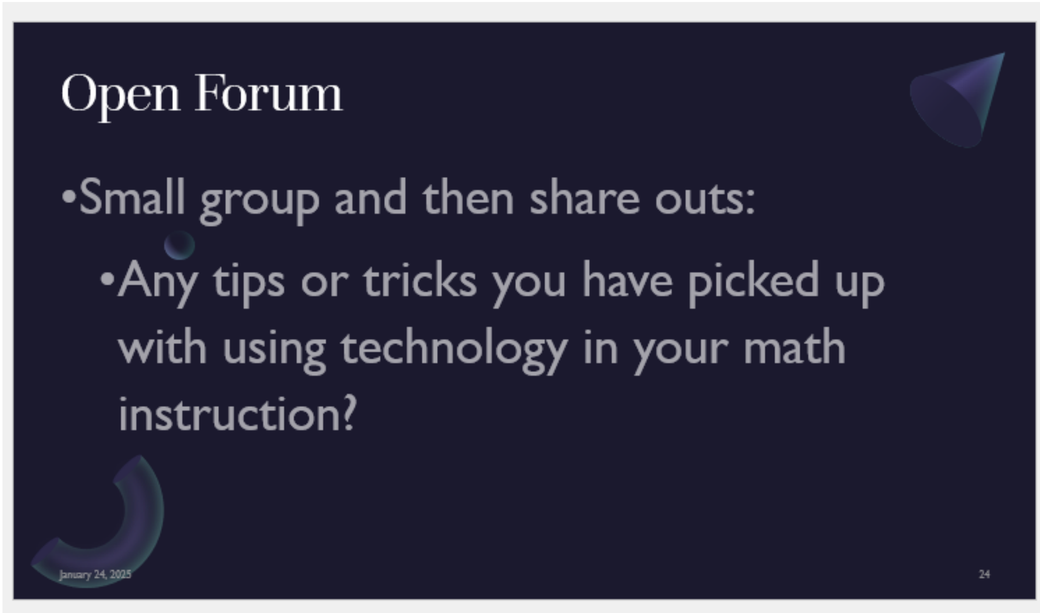

Lunch
1 Hour
• Breakout Rooms when we return
• see the list by the door for room assignments

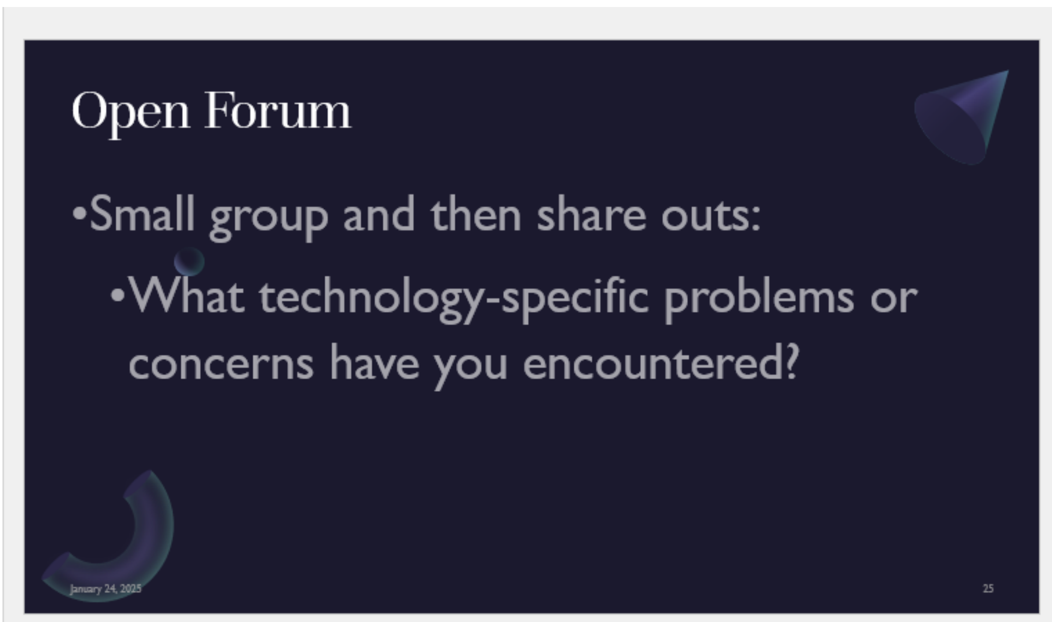

Grade Level Lesson Plan Development
Transformational Stage Technology Mathematics
Lesson Plan
Teacher Names:
Lesson Topic:
Standard:
Objective:
Vocabulary Terms:
Guiding Questions:
January 24, 2025
20

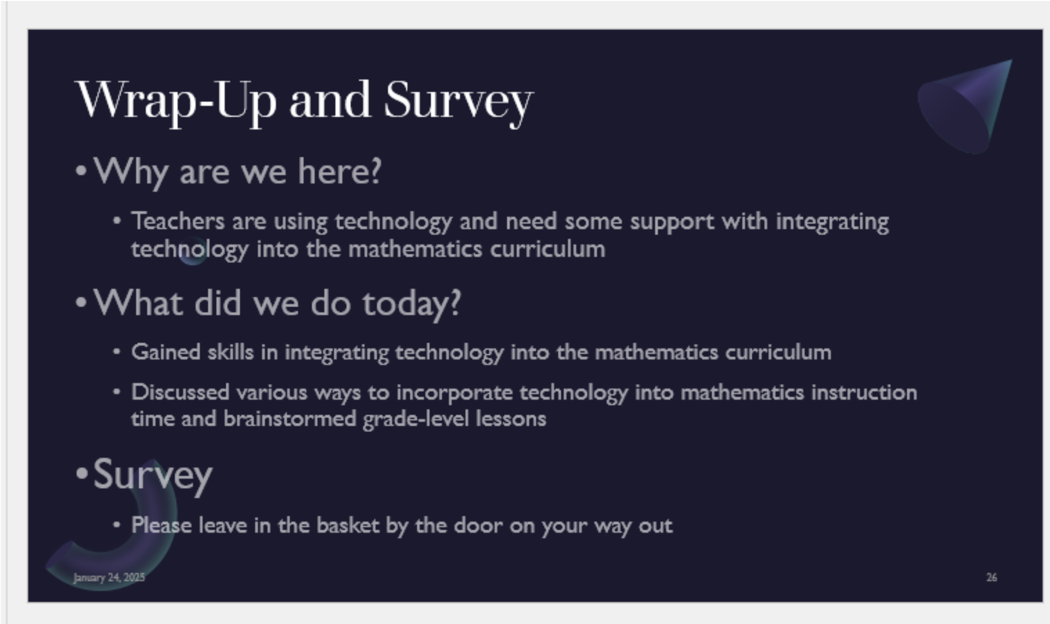

Lesson Plan Sharing
•Each group will have a chance to share their lesson plan
January 24, 2025
21


Break Time
• 15 Minutes
• Breakout Rooms when we return


Open Forum
•Small group and then share outs:
•What is one piece of advice you can give for using technology in a math lesson?
January 24, 2025
23


Open Forum
•Small group and then share outs:
•Any tips or tricks you have picked up with using technology in your math instruction?
January 24, 2025
24


Open Forum
•Small group and then share outs:
•What technology-specific problems or concerns have you encountered?
January 24, 2025
25


Wrap-Up and Survey
• Why are we here?
• Teachers are using technology and need some support with integrating technology into the mathematics curriculum
• What did we do today?
• Gained skills in integrating technology into the mathematics curriculum
• Discussed various ways to incorporate technology into mathematics instruction time and brainstormed grade-level lessons
• Survey
• Please leave in the basket by the door on your way out
January 24, 2025
26

Day 2 Handouts:

Training Survey (to be completed at the end of Day 2)

1. Overall, how would you rate today's training?
    a. Excellent
    b. Very Good
    c. Good
    d. Fair
    e. Poor

    How could the quality of today's training be improved?

    ____
    ____
    ____
    ____

2. How useful were the open forum discussion times?
    a. Extremely useful
    b. Very useful
    c. Somewhat useful
    d. Not so useful
    e. Not at all useful

    What would make the open forum discussion times more useful?

    ____
    ____
    ____
    ____

3. How clearly did your instructor explain the material?
    a. Extremely clearly
    b. Very clearly
    c. Somewhat clearly
    d. Not so clearly

e. Not at all clearly

What still needs to be explained?

____

____

____

4. How comfortable did you feel voicing your opinions in class?
   a. Extremely comfortable
   b. Very comfortable
   c. Somewhat comfortable
   d. Not so comfortable
   e. Not at all comfortable

Comments:

____

____

____

____

5. Anything else you would like us to know?

____

____

____

____

6. What improvements would you make to the training?

____

____

____

____

Exemplar Transformational Stage Lesson Plan: Day 2

Transformational Stage Technology Mathematics Lesson Plan	
Teacher Names: Transformational Model Lesson Plan	
Lesson Topic: Geometry (shapes)	Standard: 2.G.1
Objective: Students will identify shapes and specific attributes (number of angles or faces) with at least 80% accuracy.	
Vocabulary Terms: Attributes Square Circle Triangle Rectangle Pentagon Hexagon Rhombus Oval Semi-circle	Guiding Questions: What shapes do you see around us? What do you notice about squares/circles/triangles, etc. (attributes)?
Materials: The Greedy Triangle by Marilyn Burns Math App/Site/Program: Chromebook/iPod PowerPoint	Instruction: • Introduce different 2-D shapes and show the Shapes song on YouTube (https://youtu.be/pfRuLS-Vnjs) • Discuss shape attributes and read 'The Greedy Triangle' by Marilyn Burns (or play the read aloud video: https://youtu.be/r3DsRKaNFmk?si=_9H_A1Rw12ya5H-k) • Ask students to look around the classroom to find shapes (i.e. clock is a circle, desk is a square/rectangle, etc.) • Take a walk around the school and have students take pictures of shapes in the environment with an iPod or with a chromebook

<table>
<tr><td></td><td>• Return to the classroom and have students build a PowerPoint presentation of the shapes they found including the picture of the shape and an example of the shape drawn onto the slide.
• Have students record their presentation with narration identifying the shape and explaining more about it.
• Students share their presentations allowing others to watch/listen</td></tr>
<tr><td>Remediation:
Limit shapes to squares, circles, triangle, and rectangle</td><td>Enrichment:
Introduce additional shapes, possibly 3D shapes</td></tr>
<tr><td colspan="2">Additional Notes:
Grade Level Modifications:
3rd Grade:
• Include number of sides, vertices, and angles of 2-D shapes
4th Grade:
• Have students classify shapes and show lines of symmetry
5th Grade:
• Measure angles of 2-D shapes
6th Grade:
• Have students look for 3-D shapes and find area/volume</td></tr>
<tr><td colspan="2">Explanation for how this is transformational use of technology:
Students have created a presentation on technology that showcases their understanding of the attributes of shapes. Students are sharing their learning with their peers.</td></tr>
</table>

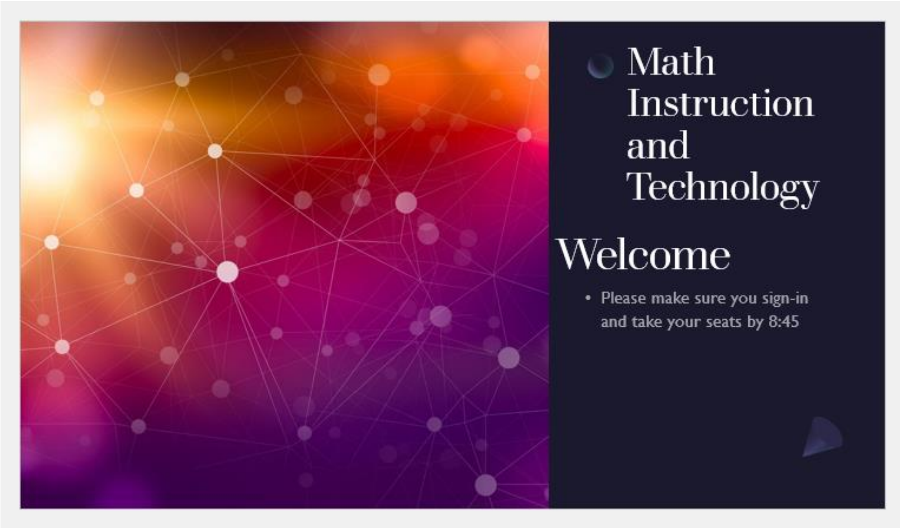
Transformational Stage Lesson Plan Template

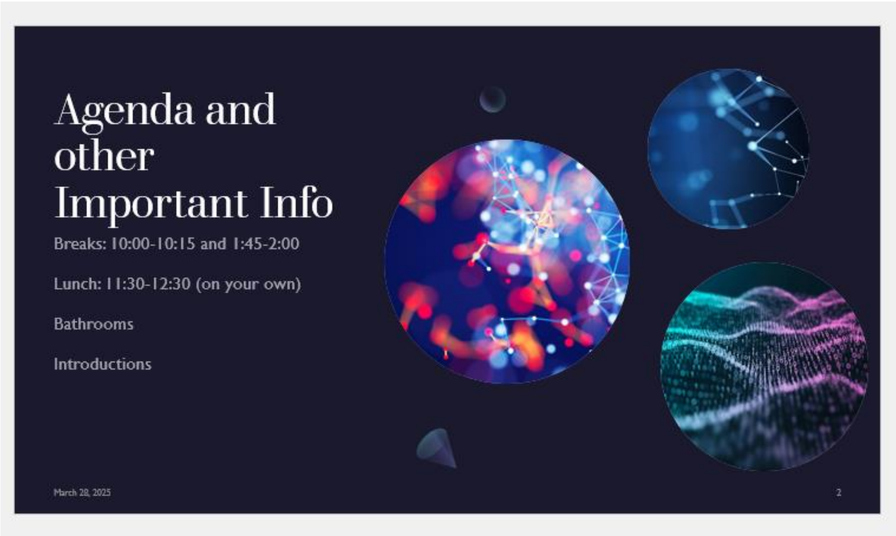
Transformational Stage Technology Mathematics Lesson Plan	
Teacher Names:	
Lesson Topic:	Standard:
Objective:	
Vocabulary Terms:	Guiding Questions:
Materials:	Instruction:

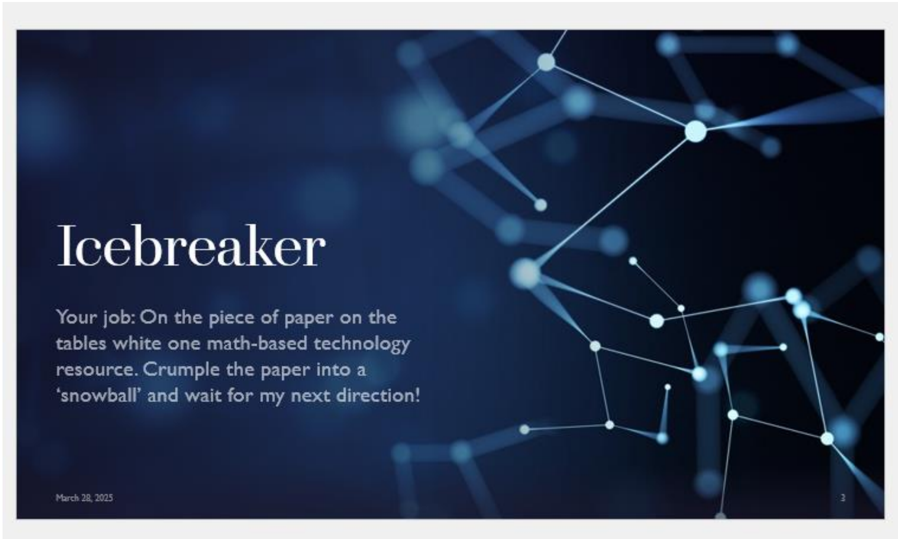
Math App/Site/Program:	
Remediation:	Enrichment:
Additional Notes:	
Explanation for how this is transformational use of technology:	

Day 3: Presentation and Handouts

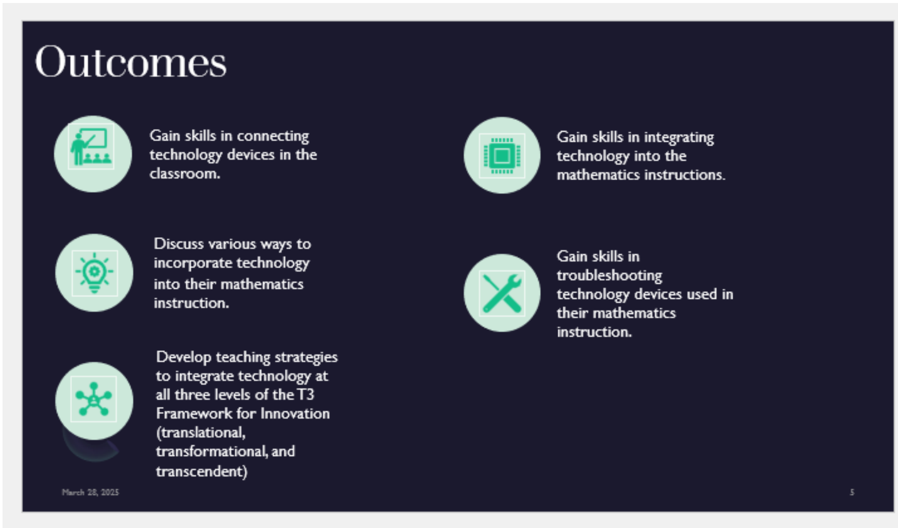
Day 3 Training Presentation:

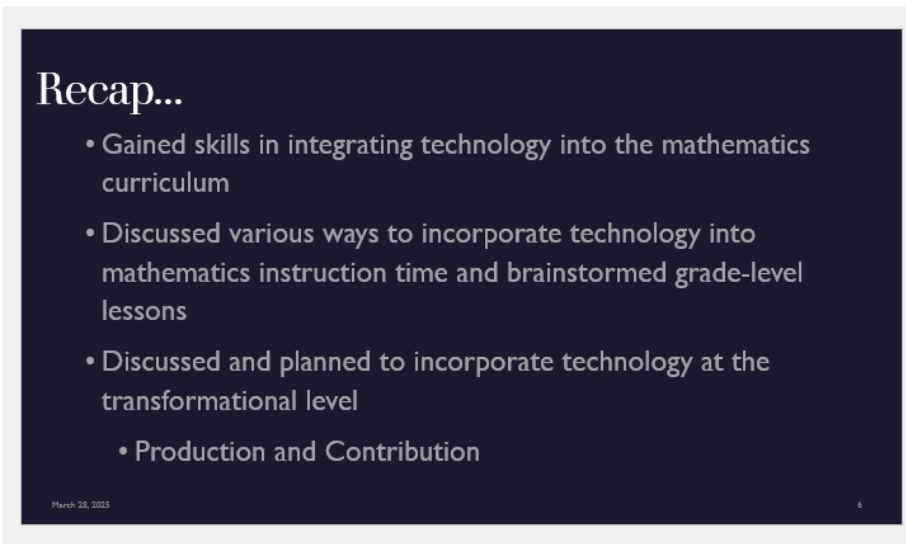


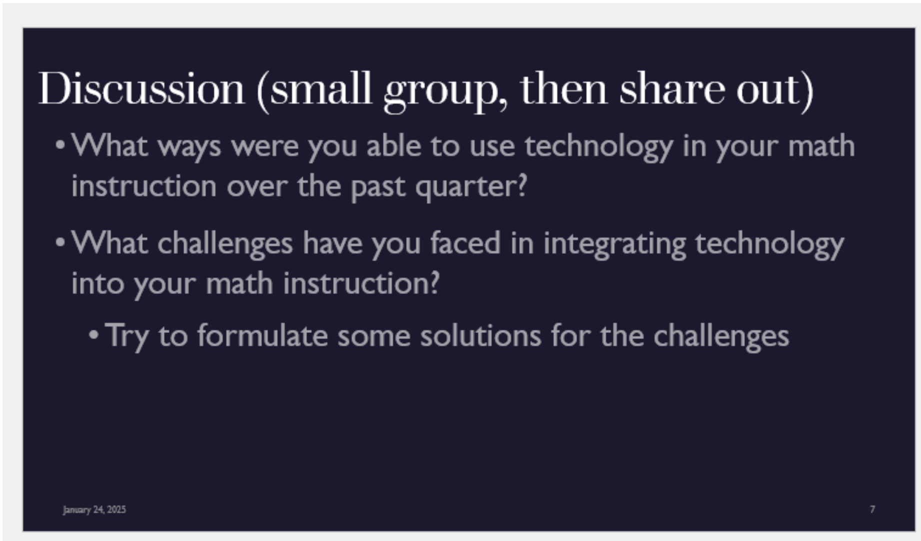


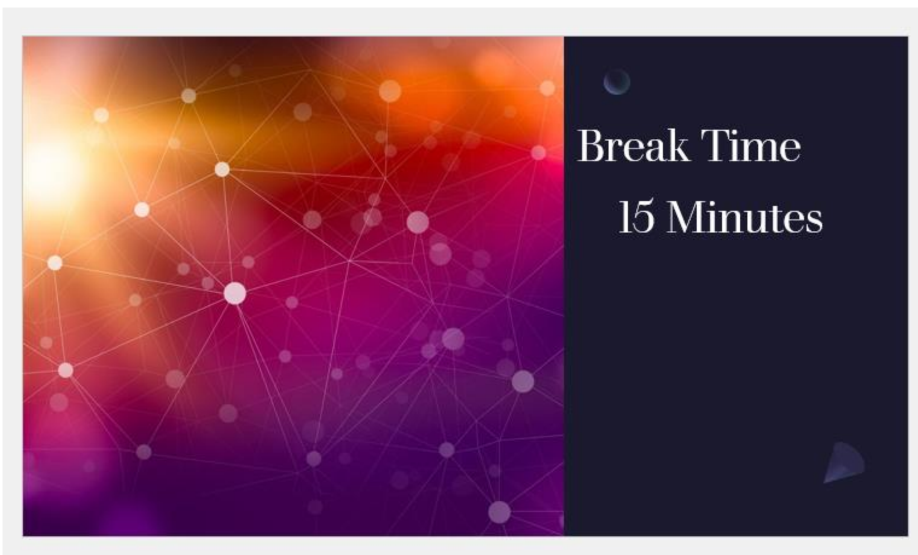

Icebreaker
Your job: On the piece of paper on the tables white one math-based technology resource. Crumple the paper into a 'snowball' and wait for my next direction!
March 28, 2025
3


Why are we here?
• RQ1: In what ways are teachers in the study district currently incorporating technology into their mathematics curriculum?
• Teachers are using technology in their classroom, though not often in their mathematics instruction time.
• RQ2: What guidance is needed to ensure teachers are prepared to use technology within the mathematics curriculum?
• Teachers are requesting guidance in both technology resources and technology training.
• RQ3:What supports are needed to ensure teachers can utilize technology to support the mathematics curriculum?
• Teachers are requesting additional support with the technology devices and programs provided, additional support from people in the district to assist with technology integration, and support from the district administration.
March 28, 2025
4


Outcomes
Gain skills in connecting technology devices in the classroom.
Gain skills in integrating technology into the mathematics instructions.
Discuss various ways to incorporate technology into their mathematics instruction.
Gain skills in troubleshooting technology devices used in their mathematics instruction.
Develop teaching strategies to integrate technology at all three levels of the T3 Framework for Innovation (translational, transformational, and transcendent)

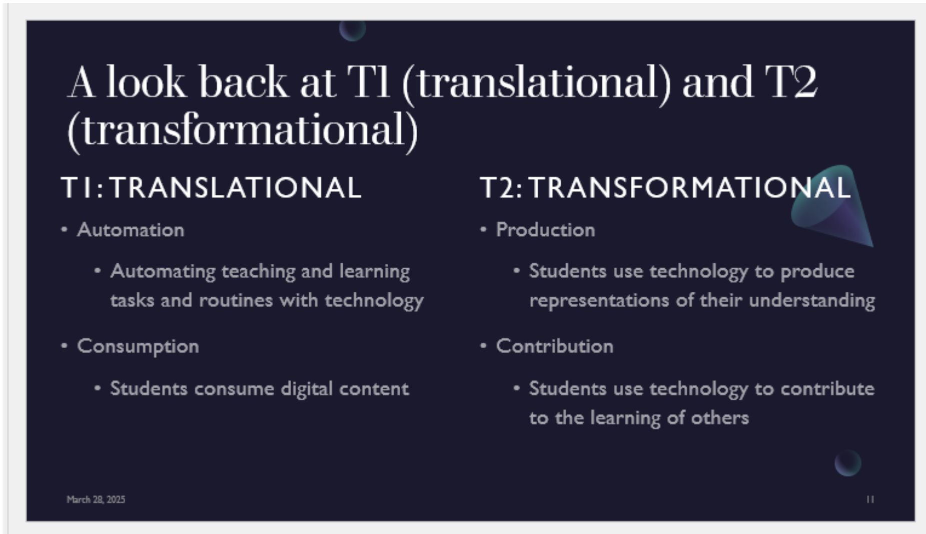

Recap…
• Gained skills in integrating technology into the mathematics curriculum
• Discussed various ways to incorporate technology into mathematics instruction time and brainstormed grade-level lessons
• Discussed and planned to incorporate technology at the transformational level
• Production and Contribution

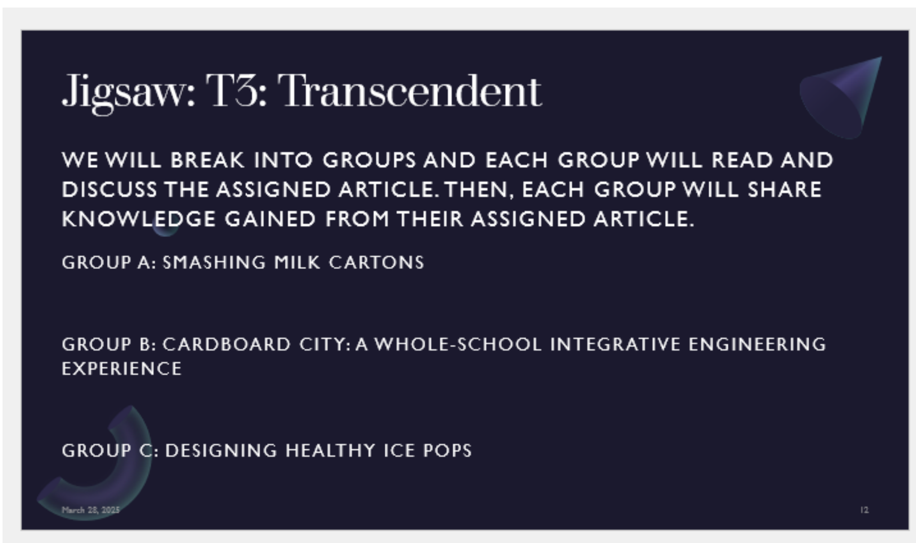

Discussion (small group, then share out)
• What ways were you able to use technology in your math instruction over the past quarter?
• What challenges have you faced in integrating technology into your math instruction?
• Try to formulate some solutions for the challenges
January 24, 2025
7

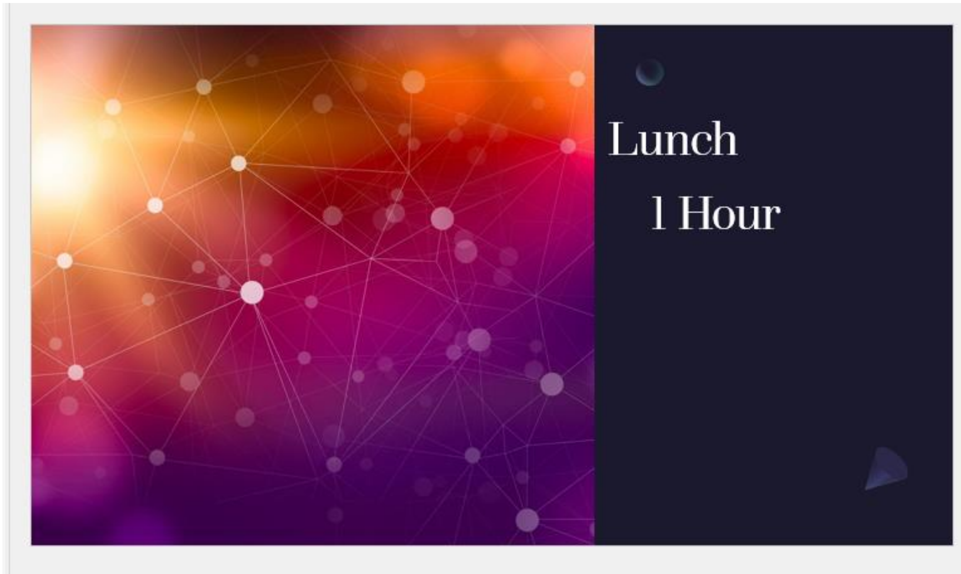

Break Time
15 Minutes


Everyone you will ever meet knows something you don't.
• Bill Nye
March 28, 2025
9

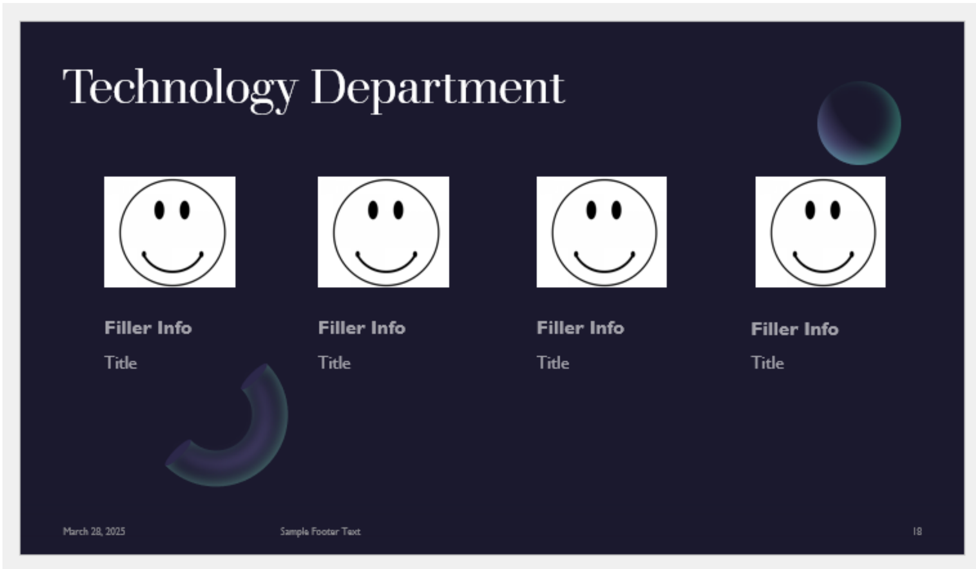

T3 Framework for Innovation: T3: Transformational
T3 FRAMEWORK FOR INNOVATION
• Dr. Sonny Magana
• Builds on TPACK and SAMR
• Allows stakeholders to see the value that technology brings to the classroom
• Research shows that using T3 strategies led to a quadruple student achievement
T3: TRANSFORMATIONAL
• Inquiry Design
• Students identify, investigate, and hypothesize solutions to real-world problems that matter to them
• Social Entrepreneurship
• Students design and implement solutions to problems that matter to them
March 28, 2025
10

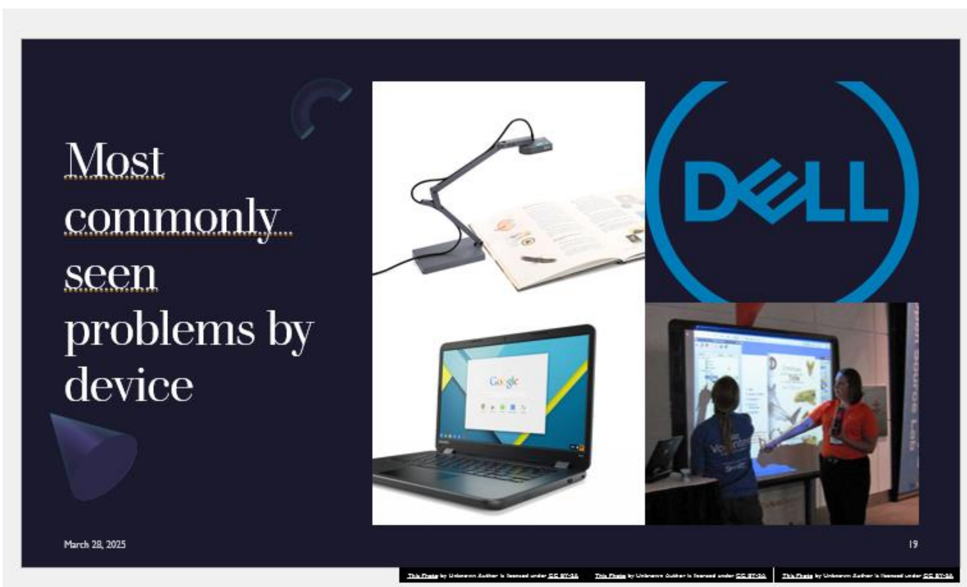

A look back at T1 (translational) and T2 (transformational)
T1: TRANSLATIONAL
• Automation
• Automating teaching and learning tasks and routines with technology
• Consumption
• Students consume digital content
T2: TRANSFORMATIONAL
• Production
• Students use technology to produce representations of their understanding
• Contribution
• Students use technology to contribute to the learning of others
March 28, 2025
11

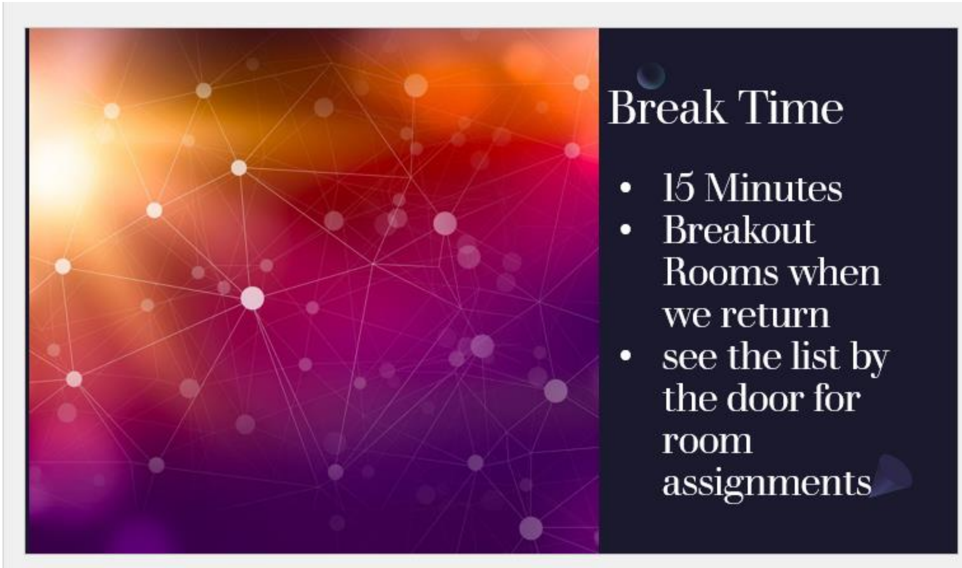

Jigsaw: T3: Transcendent
WE WILL BREAK INTO GROUPS AND EACH GROUP WILL READ AND DISCUSS THE ASSIGNED ARTICLE. THEN, EACH GROUP WILL SHARE KNOWLEDGE GAINED FROM THEIR ASSIGNED ARTICLE.
GROUP A: SMASHING MILK CARTONS
GROUP B: CARDBOARD CITY: A WHOLE-SCHOOL INTEGRATIVE ENGINEERING EXPERIENCE
GROUP C: DESIGNING HEALTHY ICE POPS
March 28, 2025
12

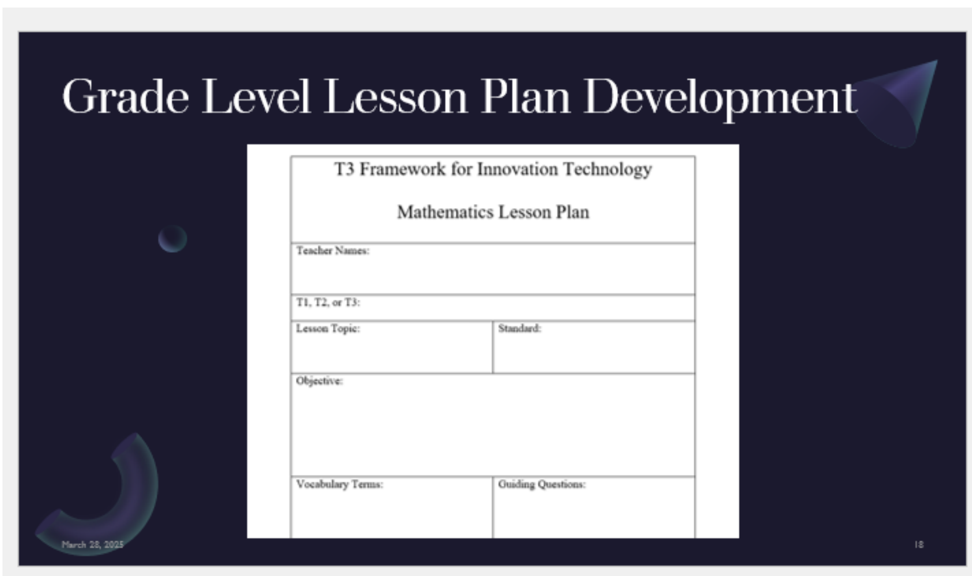

Lunch
1 Hour

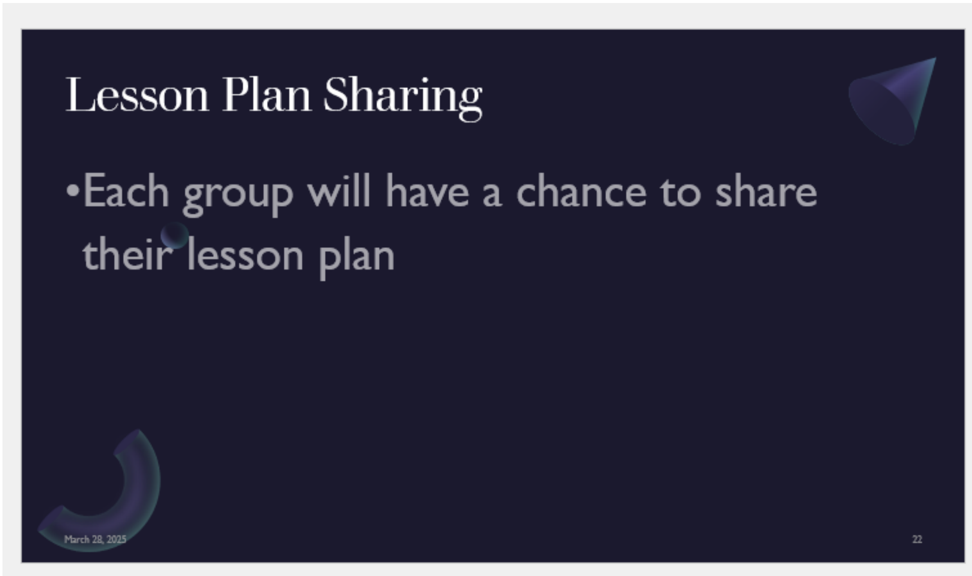

Troubleshooting Workshop
Help!
March 28, 2025
17

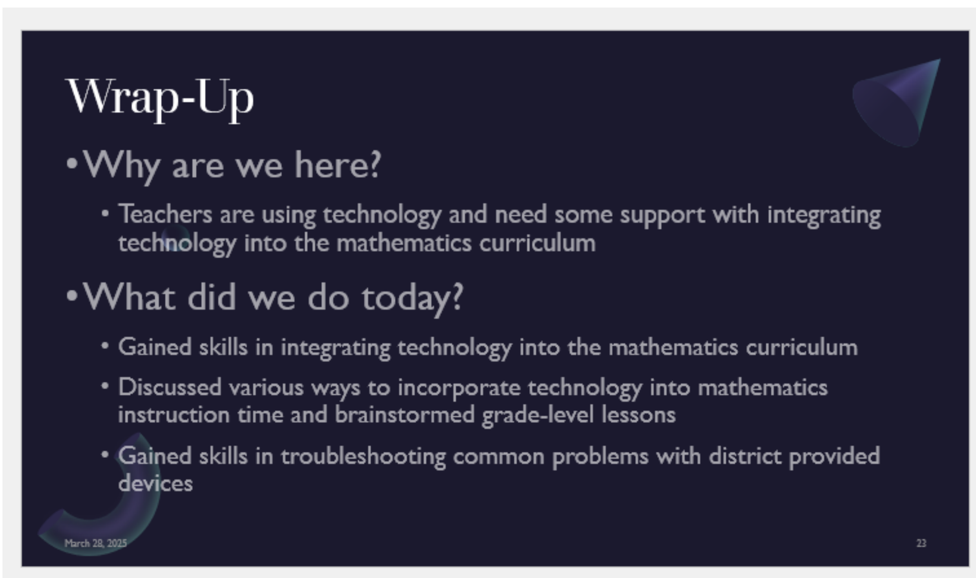

Technology Department
Filler Info
Title
Filler Info
Title
Filler Info
Title
Filler Info
Title
March 28, 2025
Sample Footer Text
18

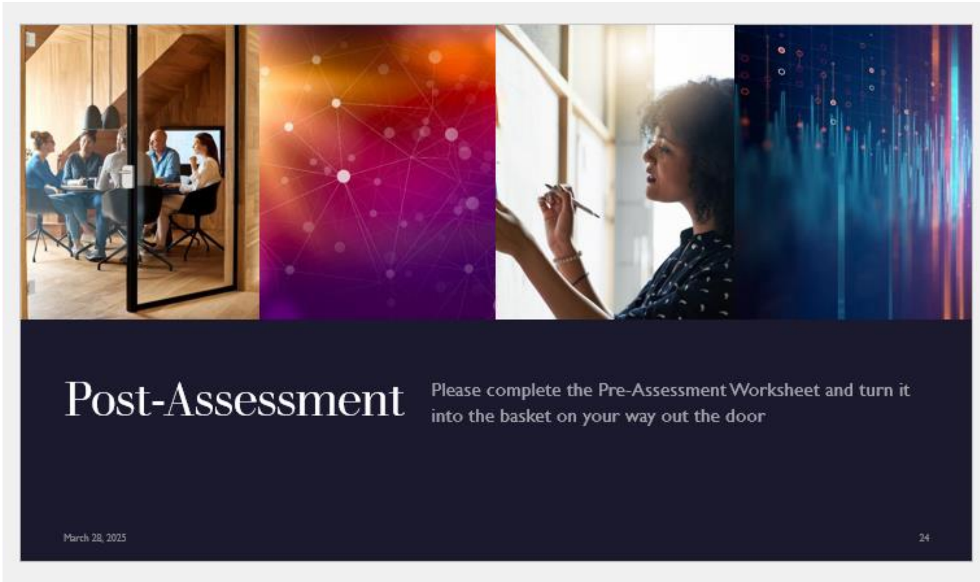

Most commonly seen problems by device
DELL
Google
March 28, 2025
19


Break Time
• 15 Minutes
• Breakout Rooms when we return
• see the list by the door for room assignments


Grade Level Lesson Plan Development
T3 Framework for Innovation Technology
Mathematics Lesson Plan
Teacher Names:
T1, T2, or T3:
Lesson Topic:
Standard:
Objective:
Vocabulary Terms:
Guiding Questions:


Lesson Plan Sharing
•Each group will have a chance to share their lesson plan
March 28, 2025
22


Wrap-Up
•Why are we here?
• Teachers are using technology and need some support with integrating technology into the mathematics curriculum
•What did we do today?
• Gained skills in integrating technology into the mathematics curriculum
• Discussed various ways to incorporate technology into mathematics instruction time and brainstormed grade-level lessons
• Gained skills in troubleshooting common problems with district provided devices
March 28, 2025
23


Post-Assessment
Please complete the Pre-Assessment Worksheet and turn it into the basket on your way out the door
March 28, 2025
24

Day 3 Handouts

Post assessment Survey (to be completed at the end of Day 3)

1. In what ways are you currently integrating technology into your mathematics instruction?

   ____
   ____
   ____
   ____
   ____

2. What knowledge do you have of the T3 framework for innovation?

   ____
   ____
   ____
   ____
   ____

3. On a scale of 1-5, where would you rate your comfort level of using technology in the classroom, with 1 being not comfortable at all and 5 being very comfortable?

   1 2 3 4 5

   Comments:

   ____
   ____
   ____
   ____
   ____

Transcendent Stage Lesson Plan Template

T3 Framework for Innovation Technology Mathematics Lesson Plan	
Teacher Names:	
T1, T2, or T3:	
Lesson Topic:	Standard:
Objective:	
Vocabulary Terms:	Guiding Questions:

<table>
<tr><td>Materials:

Math App/Site/Program:</td><td>Instruction:</td></tr>
<tr><td>Remediation:</td><td>Enrichment:</td></tr>
<tr><td colspan="2">Additional Notes:</td></tr>
<tr><td colspan="2">Explanation for how this is translational/transformative/transcendent use of technology:</td></tr>
</table>

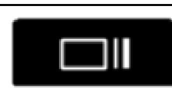
Troubleshooting/Tips and Tricks Worksheet

For all technology devices the first step in troubleshooting starts with a shut down and restart!

Promethean:

Troubleshooting	Tips and Tricks
Issue: No Signal • Check connections: ensure all cables are securely plugged into the Smartboard and into the docking station/computer (also check the connection between the docking station and computer • Check Input Channel • Try plugging into a different port Issue: Screen Frozen • Check if the 'freeze' button was clicked • Check if 'no touch' was clicked Issue: Touch not working • Check if 'no touch' was clicked • Check connection of touch cable Issue: Pen not working • Check if pen works on a different board • Check connections to the computer • Restart the board Issue: No WIFI Connection • Check date and time	• Split Screen: Open whiteboard app and select the split screen button at the bottom. • Lots of math tools available in the whiteboard app as well as charts, grid paper, music staff, and lined paper • Extended Screen option (windows button+P on computer) allows the Promethean to be used as a second monitor • Screen Share allows students to share their device screen on the Promethean • Promethean has a resource library! https://resourcelibrary.mypromethean.com/resources

Chromebooks:

Troubleshooting	Tips and Tricks
Issue: Black Screen • Brightness: Check the brightness level • Power On: Press and hold the power button for 6-10 seconds	 Switch Window Key: Quickly view all open windows CTRL+Shift+T: Open recently closed tabs. This opens Chrome tabs that were

- Reboot: Press Power and Reload buttons together

Issue: Flipped Screen

- Rotate: Press the CTRL+Shift+Reload buttons at the same time to rotate 90 degrees, repeat as needed

Issue: Won't load or loads slowly

- Clear Cache: CTRL+Shift+backspace

Issue: Chromebook Running Slowly

- Clear Cache: CTRL+Shift+backspace
- Restart

Issue: Can't get on WIFI

- Clear Cache: CTRL+Shift+backspace
- Restart

Issue: Keyboard or Trackpad not working

- Hard reset: hold refresh and power button

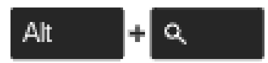
Issue: Won't Charge

- Allow time to charge again
- Try different charger/outlet
- Check connection of charger

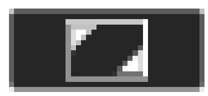
closed. Reuse many times to open more closed tabs

CTRL+ALT+Shift+H: Version History – G Suite Apps. Check student revisions on all Google Docs, Sheets, Slides, and Drawings. Restore old versions.

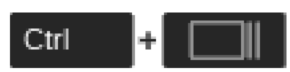
CTRL+H: Browser History. Review sites students visited.



Enable/disable caps lock.


Full-screen: This button will hide tabs, bookmarks, etc. Press again to return to the normal view.

View emoji keyboard



Screen shot (entire screen)

Partial Screenshot: press and select the area of the screen you want to capture.

Select-to-Speak: press and select text to have it read aloud.

Reset zoom to 100%

Appendix B: Interview Protocol and Questions

Introduction:

Thank you for your time and meeting with me today. This interview will take approximately 30 to 45 minutes. The purpose of this interview is to explore what guidance and supports you feel are necessary to be able to efficiently and effectively integrate technology into your mathematics instruction. I will be audio recording our interview today and I will use the audio recording to develop a transcript. This study will not identify you as a participant, and all responses, the audio recording, and the transcript will be kept confidential. You may choose to end the interview at any time, and you may choose to not answer any question(s) during the interview. Please share any questions or concerns you might have at this time. If you agree to be interviewed as described above, please say "yes" to the audio-recording when I ask, "Do you agree to be interviewed for this study?"

Questions:

1. Describe your knowledge and use of technology in your mathematics instruction in your classroom.
2. Describe your strengths in using technology in your mathematics instruction.
3. Describe your weaknesses in using technology in your mathematics instruction.

Magana's T3 framework for innovation is being utilized for this study. In this framework, Magana proposes there are three stages of technology integration. translational, transformational, and transcendent. In the translational stage, technology is used to automate our classroom practices to guide student consumption of media. In this stage, students might use a Google Form to complete an exit ticket activity.

4. Describes times in your mathematics instruction when you use technology at the translational level, or in a way that could also be accomplished with paper and pencil.

The second stage of the T3 framework for innovation is the transformational stage. In the transformational stage, students move beyond translation to use technology for production and contribution to learning. In this stage, students might be creating a multiplication video and providing feedback to peers on their videos.

5. Describe times in your mathematics instruction when you use technology at the transformational level, or in a way that students use technology for production or contribution.

The third stage of the T3 framework for innovation is the transcendent stage. In the transcendent stage, students are using technology for inquiry design and entrepreneurship. In this stage, students research a real-world mathematics problem they are interested in and use digital resources to research and provide a potential solution using new and emerging technologies.

6. Describe times in your mathematics instruction when you use technology at the transcendent level, or where students use technology for inquiry design.

7. What guidance from the district do you feel is needed to help you with integrating technology into your mathematics instruction?

8. What supports from the district do you feel is needed to help you with integrating technology in your mathematics instruction?

Closing

Those are all the questions I have for you today. Do you have any questions or any additional information you would like to add at this time? I want to thank you again for your time and support in my study. I will follow up with you within one week. Please feel free to reach out anytime if you have questions or concerns.