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A Study Investigating the Experience of Teachers' Innovative Adaptation of Teaching and Learning

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ABSTRACT

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The purpose of this qualitative phenomenological study was to identify and examine the technology-based instructional strategies and digital tools being used by teachers in grades 3-5 that engage children in problem-solving learning opportunities. The study included 11 purposely sampled participants from a school district in East Tennessee who responded to questions during a Zoom interview. Seven of the participants submitted artifacts to provide examples of how they have incorporated technology and problem solving in their classrooms. Participants provided information about the digital tools and technology-based instructional strategies they have used to enrich problem solving in their classrooms. Participants in the study communicated using group work as a primary instructional strategy when integrating technology to enrich problem solving. The participants discussed student engagement, creativity, real-world connections, and technology exposure for students when sharing their perceptions about how digital tools can enhance problem solving. When explaining how technology integration has adapted their curriculum, they shared how they use technology to provide quick feedback and differentiation. The researcher used Magana's (2017) T3 Framework to code each example of technology as a translational, transformational, or transcendent use of technology and shared some examples of each.

DEDICATION

This work is dedicated to all the wonderful people in my life who supported and encouraged me throughout this journey. Thank you to my husband, Lance, who continually loved on our girls so I could hide away and complete this dissertation. Lance, you are a fantastic father and the love and support you have shown me through this journey has been so helpful to me. Thank you for always being willing to proofread! To Penelope and Oni, I love you both so much. Always remember you are stronger than you think you are. The two of you are the reason that I pushed myself to achieve this goal.

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Chapter 1. Introduction

Educators are continuously required to adapt to new curriculum, teaching strategies, and standards. Technology has been the focus of a major source of change in education in the 21st century (Calderon & Carlson, 2019). Part D of the Elementary and Secondary Education Act (ESEA) of 2001 known as No Child Left Behind (NCLB) outlined the purpose for enhancing learning through technology use (Enhancing Education Through Technology Act, 2004). The U.S. Department of Education (2010) developed the National Education Technology Plan, which placed more pressure on schools to integrate technology in classrooms. Although 20 years has passed since the 2001 reauthorization of the Elementary and Secondary Education Act (ESEA) known as No Child Left Behind (NCLB) teachers are still struggling to use technology in effective ways (Vega & Robb, 2019).

Vander Ark (2018) stated that the combination of standards reform in the 1990s and this new encouragement for technology integration narrowed the view of how teachers and students could use technology. He noted that instead of using technology to teach to the test, educators need to think creatively when considering technology integration and take advantage of the innovations such as intimate computing (technology that responds to human feelings), experiential computing (the use of technology in our daily lives), worldwide connectivity, tech-facilitated personalized learning, and competency and credentials. Rodberg (2019) explained that many educators think of technology as the change factor, but it is the vision and plan for innovation that enacts change.

Schlechty (2011) identified the importance or providing students with meaningful, engaging learning opportunities that empower them to be critical thinkers. He explained that the work that teachers give students must be valuable of their time. As institutions continue

navigating the changes occurring due to the implementation of technology, educators must continue to have the same goals of meaningful, valuable, empowering work in mind for their students. Rodberg (2019) identified the importance of creating and maintaining a vision to achieve transformative learning through technology integration. Schlechty's (2011) vision for student work is an approach that also applies when designing technology-based student work.

Vega and Robb (2019) surveyed over 1,200 teachers to gain an understanding of the teacher perspective regarding the 21st Century Classroom. This census displayed some of the barriers and concerns with technology integration. Out of the teachers surveyed 60% said they used video streaming for classroom learning. Only 50% of the teachers surveyed reported using productivity and presentation tools such as Google Slides, Forms, Docs, or Microsoft Office. The survey responses suggested that teachers value digital creation tools, but only 25% of teacher reported using those in the classroom. Only 40% of survey participants said they found professional development on technology integration to be effective.

Teachers are being forced to integrate technology but without proper training and support many are struggling to apply their pedagogy to technology-based learning opportunities in the classroom (Davies & West, 2014). There are two important considerations for teachers regarding adapting instruction to integrate technology. Davies and West recommended that students need to learn how to use technology to be prepared for their future careers. Collins (2014) posited that regardless of technology integration teachers need to be providing opportunities for students to expand their 21st century skills such as critical thinking, problem solving, and communication. These two considerations make it imperative that teachers learn to achieve both technology integration while continuing to strengthen the 21st century skills of students.

Statement of the Problem

Teachers have a demanding job staying current on the latest technologies, working with students all day, and preparing students to use the latest technology in the future (Arnett, 2016). With the surge in accessibility to technology, many teachers were provided devices to use in their classroom with little to no training on how to use them (Culatta, 2019; Rodberg, 2019; Vega & Robb, 2019). With little training some teachers relied on these devices to provide skill-based support to students via games or apps (Mcfarlane, 2019). Although there is value in this type of technology integration the value is low. When students are passively consuming technology the learning is not as meaningful (Magana, 2017). Arora and Chander (2020) expressed that teachers are the key to successful growth in technology integration. Many teachers are still researching and experimenting to find the best ways to implement technologies to support problem solving in the classroom.

Significance of the Study

The initiatives to provide 1:1 computer experiences in K-12 schools began in the late 1990s (Herold, 2016). As devices have become more accessible and affordable schools have been pressured to adopt 1:1 initiatives. Kolb (2019) described a conversation with an administrator in which the administrator admitted that they pressure teachers to use the technology even though the administrator is not privy to the best ways to use those devices. Herold (2016) claimed that due to the pressure to get devices in schools with limited funding, there is often a lack of planning when carrying out a 1:1 device program. Mcfarlane (2019) supported these claims by stating that device use does not guarantee learning.

Rodberg (2019) explained a similar experience that he had as a principal. He was excited to make a change in his school by implementing a 1:1 program. He found the devices themselves

did not result in a change in student learning or achievement. This lack of planning and vision leaves teachers and classrooms with devices without providing the information and training to help educators improve their teaching with these devices (Culatta, 2019). These are frequently used for mere consumption and automation of activities rather than to reach a deeper level of learning (Magana, 2017).

The ISTE technology standards were first developed in 1998 and have since changed to keep up with the needs of learners for successful achievement in society (Snelling, 2016). When the standards were originally developed a school computer lab was the extent of technology integration being implemented. At that time the biggest need among students was the need to learn how to use the technology, thus that was the goal of the original standards.

In 2007 the ISTE technology standards were updated to keep up with the changing needs of students (Snelling, 2016). As more schools became successful teaching students to use technology, a shift occurred that demanded a focus on using technology to learn. Snelling stated the driving force in the standards shift was still productivity but there was also an emphasis on how educators could use technology to helps students grow in critical 21st century skills such as critical thinking, problem solving, and collaboration. One of the big changes that ignited this shift was that schools had more devices and greater access to devices. It was suddenly possible for students to work on projects with students in other schools, states, or even other countries.

In 2016 the latest rendition of the ISTE technology standards was pushed out (Snelling, 2016). When the standards were being revised for 2016, the emphasis became using technology to transform learning. Snelling stated that the goal of the 2016 ISTE technology standards was to continue to redefine learning and teaching to encourage practices that are beneficial to student learning based on the current technology and career demands. Instead of focusing on a checklist

of what to cover, these standards focus on empowering the learner and are applicable across content areas. Snelling claimed that these standards do not give the teacher something else to teach but instead provide an approach that supports all other content standards.

The continued development of the ISTE Technology Standards from 1998-2016 has supported the directive to use technology to engage students in 21st century learning opportunities that encourage collaboration and problem solving. Although this is the goal, without proper training many teachers end up struggling to help their students reach this level of learning through technology integration (Culatta, 2019; Darling-Hammond et al., 2017; Rodberg, 2019). Gillepsy (2019) drew conclusions between the focus on transformative learning for students in the ISTE technology standards and the need for that same transformative experience for educators. Gillepsy claimed that an important component of transforming the learning experience for students is also transforming the learning experience for teachers.

This study is important because educators can learn from the work that others have done to facilitate change. The researcher hopes that sharing the experiences that teachers have had with the phenomena of technology integration will help transform the learning of other educators by encouraging them to refine their own practices based on what is communicated in this study. This study documents the strategies, programs, and activities that teachers are currently implementing in the classroom with technology, which could spark ideas for others, spark ideas for research studies, and encourage growth among teachers (Manches & Plowman, 2017).

Purpose of the Study

The purpose of this study was to identify and examine the technology-based instructional strategies and digital tools being used by teachers in grades 3-5 that engage children in problem-solving learning opportunities.

Theoretical Framework

The researcher used both the 21st Century Learning Framework (Batelle for Kids, 2019) and the T3 Framework for Innovation in Education (Magana, 2017) to guide this study. The researcher used the 21st Century Learning Framework (Batelle for Kids, 2019) to identify key themes that were present in current uses of technology among the participants. Some of the themes identified in the 21st Century Learning Framework that the researcher looked for in the technology uses among participants were: creativity and innovation, critical thinking, problem solving, collaboration, leadership, communication, and self-direction.

The T3 Framework for Innovation in Education (Magana, 2017) was used to categorize technology use. The researcher collected information to identify how teachers are responding to the phenomenon of technology integration. This framework provided a guide to categorize examples of technology integration as translational, transformational, or transcendent to gauge the success and depth that teachers are currently achieving in technology integration. Magana (2017) claimed that translation technology integration results in the lowest depth of learning, highlighting the fact that activities in this category do not benefit the student's level of learning. In the transformational category activities begin to transform the learning experience for students and result in a deeper level of thinking and learning. The final category, transcendent technology, results in a level of learning that transcends what would have been possible without the integration of technology. This is the category that contains the most potential for deep student learning. This categorization was essential in communicating results as well communicating recommendations for implementation and further research.

Research Questions

The following research questions guided this study:

Central Question: What are teacher perceptions of the technology-based instructional strategies and digital tools they are implementing to enrich problem solving for students in grades 3-5?

Sub-question 1: What are the teacher perceptions of the value of technology-based instructional strategies to enrich problem solving for students in grades 3-5?

Sub-question 2: What are the teacher perceptions of the value of using digital tools to enrich problem solving for students in grades 3-5?

Sub-question 3: How have teachers adapted and implemented valuable technology activities in grades 3-5?

Definitions of Terms

Digital Tools: Digital tools are defined as websites, applications, and learning platforms that help students learn by using technology (Vega & Robb, 2019).

Instructional Strategies: Instructional strategies are defined as approaches used by educators to captivate learners. (Meador, 2019).

1:1 Initiative: 1:1 initiative is defined as a program that provides every teacher and student within a school a device that they can use at school and at home (Davies & West, 2014).

Blended Learning: Blended learning is defined as the use of technology in classroom learning (Hrastisnki, 2019)

Technology Enhanced Learning (TEL): TEL is defined as learning that is improved through the use of technology (Chan et al., 2006).

Limitation and Delimitation

Phenomenological studies focus on depth of information from those who have experienced a phenomenon (Patton, 2014). Patton identified one of the limitations of interview data to be that it can be biased and may not be a completely accurate depiction of reality. It is possible that participant responses in this study were distorted because of the pressure that teachers might feel to communicate positive things happening in their classrooms. This is one reason that the researcher felt it was important to collect another form of data, in this case documents such as teaching materials and lesson plans were collected to provide some validity to the participants' responses.

This study was delimited to one school system in East Tennessee. The school system has a program for educational technology leaders. These technology leaders are trained in cohorts and help train other teachers within their school. The researcher chose to narrow the study by selecting teachers who had been technology leaders within this school system. Another delimitating factor is that all the participants taught grades 3-5.

Summary

This is a phenomenological study focused on identifying and examining the technology strategies being used by teachers in grades 3-5 that engage children in problem-solving opportunities. This study includes five chapters. Chapter 1 contains context for the study, statement of the problem, significance, purpose, the theoretical framework, research questions, definition of terms, and limitation and delimitations of the study. Chapter 2 is a review of the relevant literature pertaining to the study. Chapter 3 contains the methodology of the study including the purpose statement, research questions, design, site selection, population, sample, participants, data collection strategies, data analysis strategies, assessment of the quality of rigor,

and the role of the researcher. Chapter 4 contains the findings of the study. Chapter 5 identifies the conclusions of the study including discussion, implications for practice, and recommendations for future research.

Chapter 2. Review of Literature

Society is influenced by the influx of technology and information. Due to the development of the internet most basic information can be accessed easily without much thought. This change has brought about a focus in education on developing 21st century skills that increase depth of thought, communication, problem solving, and collaboration (Ramey, 2016). Teachers are given the directive to teach these important life skills to make students employable and successful in the future while also dealing with curriculum changes, technology integration, and standards reform. Teachers must help mold students to be deep thinkers that are able to communicate, collaborate, and persevere to solve problems. The 21st Century Framework (Batelle Kids, 2019) is a helpful tool for teachers to use when implementing strategies to teach 21st Century Skills.

Technology is becoming a resource for students and teachers as more schools gain access to devices, apps, learning platforms, and software. Vander Ark (2018) claimed that the standards reform of the 1990s placed pressure on teachers and narrowed the view of what students can accomplish with technology. The focus was placed on content knowledge to meet academic standards. With the recent adoption of common core standards the directive switched to thinking and problem solving. Teachers are now in a position to deliver personalized learning through the integration of technology.

It is important to consider the way that technology is being integrated in the classroom. The T3 Framework developed by Magana (2017) provides guidance for integrating technology with strategies that will result in the highest level of student learning. Magana (2017) identified the phases of technology integration as translational, transformational, and transcendent. The

research-based framework includes clear guidelines for integrating technology as well as a way to measure and set goals for professional growth.

The combination of these two frameworks sets the stage for determining the current state of teaching practices and how to improve them to prepare students for the future. Teachers are paramount in implementing a transformation in which students are able to use technology in a way that they can build 21st century skills (Arora & Chander, 2020). Hall and Hord (2019) affirmed that change requires work and learning. Support from leadership, structure, and culture are necessary for supporting teachers during any change (Deal & Peterson, 2016). Teachers also need to feel that creativity is valued and accepted by leadership in order to feel encouraged to embark on the creative path of implementing transformational and transcendent learning (Drew, 2011).

Understanding the current technology research is a good starting point for teachers who want to institute change in technology implementation. The next step is continually sharing resources, strategies, and information to increase what is known about technology integration (Manches & Plowman, 2017). Providing teachers with the support and knowledge to use technology to incorporate 21st century skill learning in the classroom is likely to increase their motivation and attitudes toward technology integration ensuring greater success (Schelly et al., 2015). The components of the frameworks, current research pertaining to technology implementation, collaboration, and curriculum design provide a clear picture of the ideal integration of technology and 21st century skills.

21st Century Skills

Teachers are preparing students to be the future of our society. The world around us is ever-changing. Twenty First Century Skills are important for students to possess so they can

navigate this changing world. Ramey (2016) claimed that although the traditional skills pertaining to science, math, language arts, and engineering are essential it is also equally as important to teach skills to encourage thinking and dispositions that will prepare learners for the challenge ahead of them. The factors of student learning that are not focused on content knowledge are considered noncognitive factors (Farrington et al., 2014). Teachers must also be well versed in these skills so they can enhance pedagogy to support student development of transfer, critical thinking, and problem solving (Collins, 2014). Teaching these skills helps mold students to apply what they have learned to new situations, use their knowledge to reason, and create solution pathways to solve those problems.

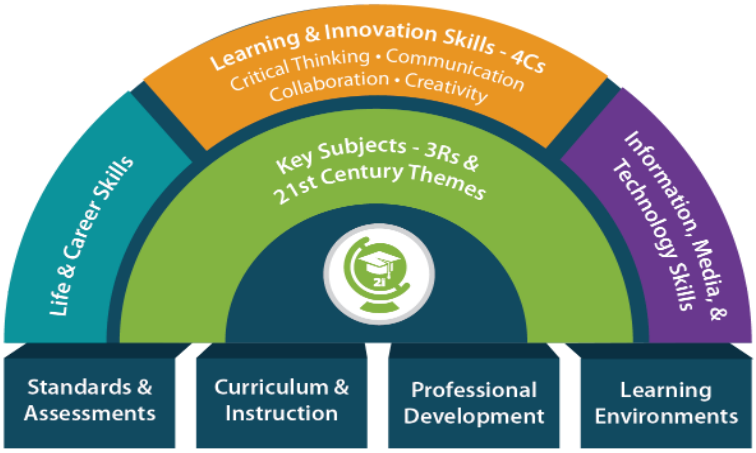
The U.S. Bureau of Labor and Statistics (2020) provides an Occupational Outlook Handbook. Teachers need to consider the occupational outlook for the students they are teaching when preparing instructional and curriculum plans in order to ensure that students are being prepared for occupational success in the 21st century. According to the Occupational Outlook Handbook (2020), computer and information technology occupations are projected to grow 11% from 2019 to 2029, which is much more quickly than other occupations. While not all students will go into a computer and informational technology occupation, the reality is that there will be the most demand for workers within that field. In order to give our students the best chance of being hired in the future we need to prepare them to pursue higher education and careers in the category of information and computer technology if that is what they choose to do (Drew, 2011). Van Laar et al. (2017) noted that preparedness for these careers requires a combination of technology skills and 21st century skills.

In addition to the need for career readiness in computer and informational technology teachers also must consider the overarching 21st Century Skills that are important for all

occupations and life in general (Chalkiadaki, 2018). The Partnership for 21st Century Skills (Battelle for Kids, 2019) has developed The Framework for 21st Century Learning. This framework established the information and skills that students must possess to build a successful future for themselves. This framework encompasses the various aspects of education including standards and assessments, curriculum and instruction, professional development, and learning environments as noted in the figure below. Teachers can use the student outcomes listed in the framework to consider ways to enrich their instructional design to help students grow in creativity, critical thinking, problem solving, communication, collaboration, technology skills, life and career skills, flexibility, adaptability, initiative, productivity, and responsibility.

Figure 1

21st Century Framework



Note. This figure encompasses all aspects of the 21st Century Skills Framework. From

Collaborative Learning

Hesse et al. (2015) defined collaboration as the "activity of working together towards a common goal" (p. 28). Three critical components for collaboration are communication, cooperation, and responsiveness. It is important in true collaborative work for all these elements

to be present to ensure that members of the group are exchanging ideas, working together, and responding to each other as well as the task at hand. The authors provide a Framework for Teachable Collaborative Problem-Solving Skills that includes a description of what each element of collaborative problem solving looks like at a low, middle, and high level. This framework could be useful for teachers when they are developing collaborative problem-solving tasks to ensure opportunities are provided for students to engage in each of these elements. The framework can also be used to assess the level of collaborative skills students possess to help teachers provide opportunities and support to encourage student growth as problem solvers.

There has been a shift from emphasizing cooperative learning to emphasizing collaborative learning. These two terms are defined, compared, and contrasted in detail by Dillenbourg et al. (1996). Cooperative learning only requires that members of a group divide the work to meet the end goal. Although they will discuss and plan at some point, they are doing their own work rather than working with one another. In collaborative learning the process of completing the task or solving the problem requires a continual exchange of ideas and communication of a plan. Collaboration requires a higher level of social skills which provides the perfect opportunity for practicing and assessing 21st Century Skills (Alismail, McGuire, 2015). Collaboration is also a way to help students with lower academic achievement increase their knowledge and skill set (Loes and Pascarella, 2017).

Collaborative problem solving requires a combination of cognitive skills and social skills (Hesse et al., 2015). The social skills used in this process are grounded in the need to manage group members' personalities and conversations. For participants to be successful with collaborative problem solving they need to be mindful of the social dynamic of the group, perspectives of all group members, as well as the assets that each group member brings to the

table. Hesse et al. grouped elements of social skills present in collaborative problem solving into three main groups: participation, perspective taking, and social regulation.

Participation is focused on the level of action, interaction, and whether tasks are completed. This category aims to determine if students are initiating actions or merely responding to the actions of others, if they can participate in effective communication, and if they are able to persevere through challenging problems. It is also possible that the learners' level of skill will change throughout a problem-solving task or based upon their connection with the task at hand. Assessing the level of participation among students can help the teacher scaffold activities to help groups be successful and become more invested in their commitment to the task (Hesse et al., 2015).

Perspective taking is assessed on the ability of a learner to first understand another group member's perspective, and secondly respond to that perspective by providing feedback or adjusting the problem-solving path. Hesse et al. (2015) identified perspective taking as multidimensional. It is an extremely important skill for people to learn in order to help them appreciate differences among people. Learning that engages students through collaboration provides an opportunity to become more accepting of differences, to see strengths in the fact that people think and communicate differently, and helps children become less egocentric.

Social regulation is the last category of social skills described by Hesse et al. (2015). This category includes negotiation, self-evaluation, transactive memory, and responsibility initiative. These elements focus on the need for participants to recognize the diversity of group members and respond to those differences in a way that will help the group progress toward a solution. Recognizing the strengths and weaknesses of the group members is the first step in this process but students also need to be able to use those strengths to the advantage of the group. Their

ability to work through conflict, communicate, adjust their plan, and seek a solution is assessed through this group of elements.

Cognitive skills in collaborative problem-solving focus on managing the solution or task that the group is working towards completing. Hesse et al. (2015) identified two categories in cognitive process skills including task regulation and learning and knowledge building. The cognitive process skills identified by the Hesse et al. are based on the same types of cognitive skills that would be valuable in individual problem solving. Students who perform the cognitive skills of planning and task regulation are more likely to be productive and motivated (Bakhtiar & Hadwin, 2020).

The first category described by Hesse et al. (2015) is task regulation. To be successful a group needs to plan, set goals, locate resources, be flexible, and continue seeking solutions. In most situations group members will have varying levels of ability among these elements. One benefit to collaborative problem solving is that it allows participants to observe and learn from each other. If a group member is not typically a strong planner, they might learn from listening to someone else explain their planning process.

The social regulation and task regulation described by Hesse et al. (2015) focuses on a student's level of self- discipline. Researchers Duckworth and Seligman (2005) implemented a study to determine whether self-discipline outdoes IQ when making predictions about the future academic performance of students. The study used reports from the students, teachers, and parents along with behavioral measures. The researchers conducted two studies in order to collect data from two cohorts of students. The first group contained 140 students and the second group contained 164 students. Both studies had students, parents, and teachers complete questionnaires regarding the self-discipline level of students. IQ tests were also administered.

The study found that students who received high scores on the assessments of self-discipline achieved higher grades, higher test scores, and better attendance than those with a high IQ. This study provides a strong argument for the importance in development of skills such as task regulation and social regulation that can further improve self-discipline among students.

The second category of cognitive skills is learning and knowledge building. Achieving this element of problem solving requires participants to learn and build knowledge through their relationships with group members and manipulation of the task at hand. Participants who are engaged in the problem-solving process, interact with each other, investigate the task, reformulate a plan when they hit a roadblock, and continue working until a solution is met. Ultimately through the course of the problem-solving experience they are building knowledge and learning (Hesse et al., 2015).

Student collaboration is a key component of developing 21st century skills. One way to increase collaborative skills is to provide students with opportunities to collaborate with one another. A second opportunity to build collaboration skills is by exposing students to quality examples of collaboration. One example of this was documented by Hunter-Doniger (2016). Hunter-Doniger shared the way in which an art teacher and a math teacher collaborated to create lessons that integrated two disciplines. The activities prepared by the teachers integrated math, art, and culture into a learning opportunity to students. The teachers found students were engaged and able to participate in creativity through this experience. Not only did this expose students to the 21st century skill of creativity, but it also provided them with a successful model of collaboration which as noted by Urbani et al. (2017) is an important way for children to learn 21st century skills.

T3 Framework

Teachers and students are living in an era in which they are surrounded by technology. Magana (2017) called this a disruptive transition and claims we are not giving enough consideration to the value that is added by integrating technology in the classroom. He discusses two current frameworks that are implemented in many schools, TPACK (Technological, Pedagogical, and Content Knowledge) and SAMR (Substitution, Augmentation, Modification, and Redefinition). Although both frameworks provide some guidance for teachers and schools integrating technology, they lack actionable steps to help teachers assess their current situation and move toward a deeper level of integration that uses technology to add value to learning. Magana has worked to establish a new framework, the T3 framework to meet this need. Table 1 shows a comparison of the T3, TPACK, and SAMR frameworks (Magana, 2007).

Table 1

Comparison of the TPACK, SAMR, and T3 Models

Attribute	TPACK	SAMR	T3
Research-based framework	✓		✓
Unambiguous	✓		✓
Contextualized in teaching and learning	✓		
Hierarchical		✓	✓
Unambiguous stages			✓
Unambiguous transitions			✓
Design questions			✓
Actionable			✓
Highly Reliable instructional strategies			✓
Clear indicators of progress			✓
Can be used to set clear professional growth goals			✓
Can be used to measure progress on growth goals			✓
Can be used to track progress on growth goals			✓

Magana (2017) completed extensive research over 30 years to increase his knowledge of technology integration. He claimed that an actionable useful framework is imperative to help teachers make sense of the phenomena of technology integration. The T3 framework provides that structure and support to teachers with the goal of helping them become innovative practitioners who are able to use technology to reach their potential for the highest level of learning.

The first stage of the T3 framework is the translational stage. It is important to note that although this stage has the lowest level of additional value there is still value here. The point of this framework is not to criticize but rather to assess current practice and consider ways to extend

technology integration. In this stage technology is merely used to translate activities from traditional paper and pencil tasks to a task that uses technology. The technology is not actually adding value or a different set of learning skills for students. At this level teachers need to consider the needs of their learners when determining what translational forms of technology are necessary for their students (Gomaa et al., 2019).

The translational stage is divided into two phases, automation and consumption. Activities that translate a task into a digital version might add automation to the task. For example, moving from a worksheet to a Google Form for a task results in something that can be automatically graded. There is value in this shift, but the value is not focused on new learning for the student. Instead the value might be decreasing the time the teacher spends grading or increasing automatic feedback. Automatic feedback can help students reflect to make improvements and motivate them (Dawson et al., 2019).

The second phase of this stage results in consumption of content via technology. Again, there are benefits to consuming information via technology, one of which is the vast amount of content that teachers can expose students to because of technology access. However, the actual extension of problem solving, collaboration, or higher order thinking is not present from translational consumption technology uses (Magana, 2017).

The next stage of technology use defined by Magana (2017) is the transformational stage. In this state technology is used to promote learning in a way that would not be possible without the use of technology and helps the learner accomplish a higher level of learning. This stage focuses on a shift from teacher directed learning to student directed learning. This stage is divided into two phases, production and contribution.

The production phase comprises three different facets including goal production, evidence of mastery, and thinking process involved for students. The first two activities include production of goals and production of evidence that students have accomplished their goals. Magana (2017) suggested that technology can be an effective way to help students set their own goals and document the tools that they have produced to build knowledge and meet those learning goals. The framework shares a premade graphic organizer that can be used to help students document their goals and evidence. The third component is the thought process that students had to produce and complete to create archives that document evidence of mastery and learning.

Contribution is a phase that is focused not only on how students can contribute to their own learning but how they can help others learn as well. When this level of technology is implemented students use technology to create products or artifacts that can be shared with others to help them learn. Student motivation and confidence is increased when they are able to contribute to the process of learning both for themselves and for others (Aulia et al., 2019). A higher level of learning is met here than with the translational level because students are using technology to transform their learning experience, explain their thinking, and teach others (Magana, 2017).

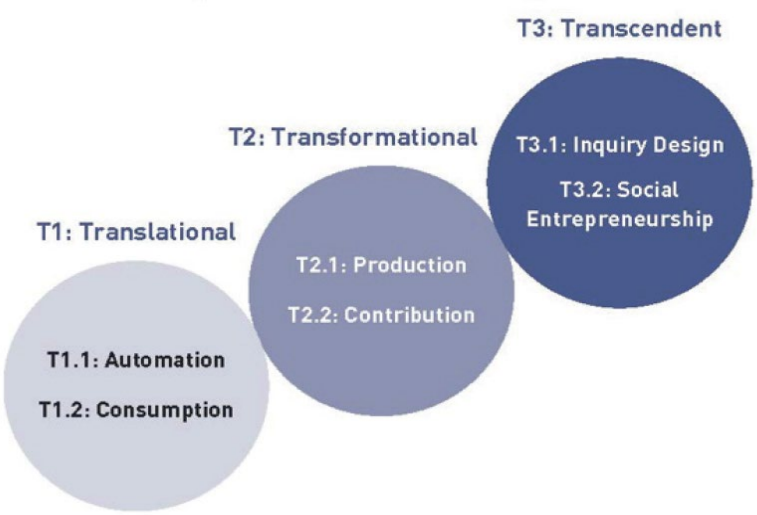
The third and final stage of technology integration in the T3 framework is the transcendent stage (Magana, 2017). When technology use is transcendent it exceeds the typical expectation. The phases of transcendent technology use are inquiry design and social entrepreneurship. In the inquiry design phase students are given opportunities to investigate problems that matter to them. The goal is that they use technology to participate in the inquiry process, design solutions and communicate findings.

Social entrepreneurship is the final phase of technology integration and occurs when students take ownership of their learning to share it in a way that impacts the world around them. Ultimately this is the highest level of value that could be achieved through technology integration. Examples of transcendent learning resulting in social entrepreneurship include students creating apps, platforms, or other digital tools to encourage others to learn from their knowledge and lead them to aid in solving the initial problem (Magana, 2017).

Aurora and Chander (2020) supported the conclusion of Magana (2017) that the T3 framework provides an actionable plan through the use of self-assessment, goal setting, and reflection. In a review of technology integration frameworks McFarlane (2020) addresses the T3 Framework for Innovation in Education. She noted that there is extensive evidence that the transformational stage of Magana's (2017) framework results in deeper student learning and engagement. It is also noted that although there is less evidence for effectiveness of the transcendent stage in technology this stage contains credibility because it focuses on principles that are long supported in an array of research such as inquiry and real-world problem solving (McFarlane, 2019).

Figure 2

T3 Framework for Innovation in Education



Note. This figure displays the three stages of the framework and the phases within each stage.

Technology Integration Research

There are many reasons to use technology in the classroom. Based on the T3 framework it seems easiest to implement translational uses of technology. Educators are being pushed to implement rigorous standards and encourage the development of 21st century skills in the classroom. Devices are an important component of integrating technology, but too often teachers are given devices without the necessary support to use them effectively. Daniel et al. (2019) affirmed that having devices will not help students succeed, it is instead how teachers and students use the devices that is important. Teachers can learn from current technology research to support and develop the practices that they are using in their classrooms to integrate technology.

One study by Hwang et al. (2015) investigated how using a multi-touch tabletop device could affect student collaboration. The participants in the study included 48 fourth grade students. The participants were divided into a control group and an experimental group. Both

groups received 20 minutes of fractions instruction once per week for 3 weeks. Students in both groups worked in small teams to complete the instructional learning tasks. In the control group students used individual tablet PCs to complete their work. In the experimental group students used multi-touch tabletop devices to complete their work.

Hwang et al. (2015) implemented pre and posttests to assess student growth for all participants. A paired-samples t-test found a significant growth in the mean scores between the pre and posttest for the experimental group ($p=.025$). This suggests that the multi-touch tabletop was a successful tool to help student learning. Researchers noticed that students using the multi-touch tabletop collaborated more. They inferred that this was due to the shared workspace because they could easily see what all participants were doing and that helped them communicate with one another. All schools may not have access to multi-touch tabletops but the conclusion from Hwang provides supports for further research to determine if other forms of collaborative technology such as Google Slides, Docs, or Jam Boards could be beneficial for the same reason that they provides students with the opportunity to share workspace and see what other students are doing.

Downes and Bishop (2015) investigated how 1:1 implementation relates to the middle school concept. They used observation, interviews, focus groups, and student work to look for intersections between the middle school concept and 1:1 implementation. Downes and Bishop discussed the concern surrounding current research on 1:1 implementation claiming that a common issue with the research is that it focuses on accessibility of devices rather than how the devices are used. This discrepancy results in contradictory data. The authors cited various studies that make opposing claims about student outcomes in situations in which 1:1 implementation is

present suggesting that this opposition occurs because the greater variable to consider is how technology use impacts student learning.

Fulton (2012) stated that the flipped classroom has the capacity to increase the amount of time that students must focus on important, challenging, engaging, collaborative work with peers and teachers in the classroom because it maximizes instructional time in the classroom. Suprabha and Subramonian (2015) explained that blending online learning and in-person instruction has the opportunity to offer the best of both worlds. More research is necessary to provide evidence for the specific ways that teachers use the extra instructional time in the classroom and the exact ways that students benefit from those. Due to the focus on increasing the number of devices rather than the quality and specificity of how those devices are used described by Downes and Bishop (2015) teachers are continuing to be given devices without the appropriate vision of how to help students achieve success in the classroom with those devices.

Downes and Bishop (2015) found that one hindrance in technology implementation was the lack of team development among teachers. Although teachers expressed a desire to have a strong team, the reality was that some teachers were not implementing the technology projects as a team. One example of this was a project that was to be implemented with student choice, but some teachers chose to limit the choices for students. This was an example of a lack of cohesion that frustrated students and caused tension among teachers.

In the fourth year of the study, teachers focused on building a team and creating a more positive culture resulting in a more positive outlook on technology implantation. The collaborative school culture made teachers feel more supported and boosted morale which in turn helped build their confidence in providing engaging curriculum for students using technology. Hall and Hord (2019) also pointed out the importance of school culture and teamwork for

successful facilitation of a change such as 1:1 implementation. Another positive product of the fourth year of the study was the student perceptions of projects (Downes & Bishop, 2015). The authors concluded that school culture, supportive team members, and uninterrupted time for teacher collaboration were elements that helped teachers implement 1:1 technology in a more engaging way for students (Downes & Bishop, 2015).

Schellinger et al. (2017) investigated having 125 fourth and fifth grade students use technology during a field trip to make them active participants on the trip. Participants in this study used digital journals and databases to collect, evaluate, and share information about animals and their habitat while visiting a wildlife center. Researchers used the VOSI-E questionnaire to assess student knowledge of inquiry concepts before and after the field trip. The questionnaire is an open-ended assessment, so researchers scored student responses as naïve, transitional, and informed.

The data suggested that students primarily held naïve understandings of inquiry concepts prior to the field trip (Schellinger et al., 2017). There was a significant increase between pre and post scores ($p<.001$) but a small effect size was also noted. Most students still held naïve viewpoints after the experience but there was an increase in both transitional and informed responses. Although the student growth displayed in this study was small it does present a possibility that technology could be a supportive component to helping students learn more about the inquiry concepts of science.

Aidinopoulou and Sampson (2017) examined the effects of implementing a flipped classroom in primary grades. Although the flipped classroom is an innovative strategy that many teachers are attempting, the research on implementation in primary grades is limited. This study included 49 fifth grade students. There were 26 students in the experimental group and 23 in the

control group. The researchers documented how instructional time was used in each of the groups and assessed student learning through student assessments. The study found that teachers were able to use instructional time for more meaningful, extensive thought-provoking conversation and activities because no time was spent on classroom lectures. Although teachers were able to maximize instructional time there was not a significant difference in student learning outcomes between the two groups in this study.

In another flipped classroom study Zainuddin (2018) investigated the effects on student learning when a gamified approach was applied to the approach of the flipped classroom in a school in Indonesia. In this study 56 students were separated into two groups. One group received instruction through a gamified flipped classroom while the other group received instruction through the traditional flipped classroom approach. Data were collected through tests, surveys, and interviews. In the gamified classroom students earned badges and points for completion of the independent work requirements in the flipped classroom. The researcher found that students in the gamified flipped classroom reported that they were motivated to complete the independent segments of the work. Both groups of students communicated that they felt more prepared for class which encouraged them to participate. The students in the gamified flipped classroom made higher scores on the posttests than the students in the non-gamified flipped classroom, suggesting that motivated students are more likely to engage and succeed.

The various instructional strategies and devices discussed in this literature review provide students the opportunity for Technology Enhanced Learning (TEL). Technology Enhanced Learning helps improve learning for students by using technology (Chan et al., 2006). The rationale behind TEL is that instead of focusing on improving technology skills schools should be focused on improving learning. If schools and teachers keep the focus on improving learning

through the use of technology, the value to students is likely to be greater than if educators just focus on finding ways to use devices.

Arnett (2016) discussed the ways that blending innovations, including technology can increase the effectiveness of teachers, thus benefiting student learning. An effective teacher must design curriculum and policies that result in the success of all students (Young 2018). Teachers are overwhelmed when they attempt to reach the highest level of achievement in all their job requirements. The reality is that teachers cannot completely understand the exact depth of knowledge, areas of weakness, for every student in every single lesson because it is an ever-changing continuum for each student (Chan et al., 2006). Finding a way to partner expert teachers, non-expert teachers, and innovations can help teachers achieve more in less time. Arnett (2016) claimed that combination provides more opportunity for teacher and student growth.

In this partnership non-expert teachers can use software programs such as Pearson's WritetoLearn, Kahn Academy, Mindspark, etc. to build their content knowledge and confidence in various content areas (Arnett, 2016). The partnership also provides an opportunity for assistants or paraprofessionals who might not be trained in certain content areas to supervise students when expert teachers are doing work with a small group. Another role of the non-expert teacher can be providing extra emotional support and helping with skills that are not specifically content related such as communication, problem solving, and other 21st century skills.

The same types of automated programs provide expert teachers with the gift of time with students. Students can practice skills and learn basic new content while simultaneously providing the teacher with relevant data on their abilities. While students are occupied with the automated program teachers can meet with other students to have conversations with them, provide

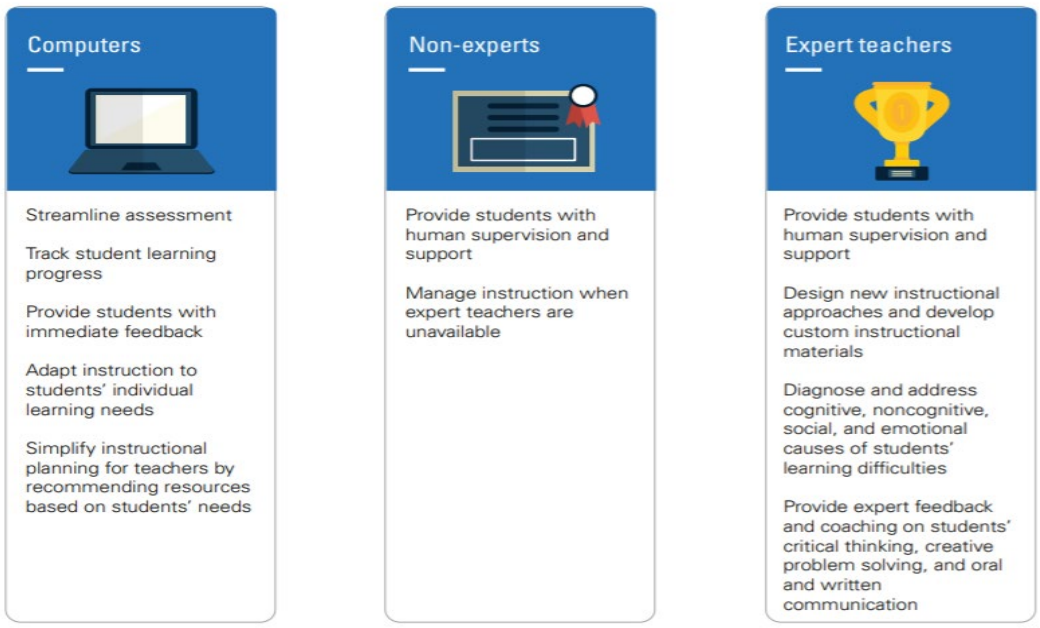
specialized instruction and intervention, and work on higher order thinking tasks (Arnett, 2016). McFarlane (2020) also stated that technology could be useful for drilling skills, reviewing concepts, and assessing student learning. However, she also noted that these tools lack value if the teacher is not trained and qualified to use the data to drive further instruction.

In this partnership computers take on the role of providing immediate, specific feedback to students, document, and track student progress, change instruction based on the level of the student, and help teachers with instructional plans. Arnett (2016) makes the point that high quality differentiation is important for students but almost impossible for teachers to achieve alone. With the help of computer automated programs teachers can provide different learning tasks to different students without personally creating separate lessons for every student. This level of differentiation including instruction, data, and feedback results in personalized learning for students (Slocum, 2016).

In the partnership the focus in technology use is on automation and consumption in order to provide the teacher with more time to work with students on transformational and transcendent learning activities in small groups (Arnett, 2016). Although technology can assist the teacher in providing content and assessment teachers still need to consider the other components of quality data-driven instruction. Teachers must analyze the data and use their findings to take action. This level of instruction in classrooms sets the stage for high quality data driven instruction in a school (Bambrick-Santoyo, 2019). The chart below identifies the advantages of each group in the partnership (Arnett, 2016).

Figure 3

Comparative Advantages of Computers, Non-experts, and Expert Teachers



Note This figure compares the advantages of each component of the partnership.

A third benefit to using the strengths of computers, non-expert teachers, and expert teachers is that it can help teachers make time to focus on factors outside of academics. Farrington et al. (2012) claim that specialists in the field of education are placing an emphasis on the importance of non-academic "factors" in education (p. 4). The need for developing 21st century skills in preparation for the real world is a large part of the push for teachers to incorporate this focus in the classroom. Arnett (2016) noted that time is one of the biggest obstacles in a teacher's success which makes adding this extra responsibility on them difficult. In this instance automated programs can provide assistance by making time for teachers to focus on improving skills among students like self-discipline, grit, and emotional regulation. There are also programs such as Mindset Works and Brainology being developed to provide automated

learning experiences to students to focus on mindset and growth. Providing metacognitive supports such as these to student increases their development of self-regulation skills (Karaoğlan Yılmaz et al., 2018)

There are at minimum two approaches here. One in which technology is used to create meaningful, engaging, challenging work for students and one in which automated, passive technology use makes it possible for the teacher to provide meaningful opportunities with students without the use of technology. A mesh of the two approaches discussed is most likely to create the necessary balance for successful education of students (Safar & AlKhezzi, 2013).

Curriculum Design

The components of teaching 21st century skills and the aspects of technology integration identified in the T3 framework are massive components of curriculum design for teachers. Schlechty (2011) and Pink (2009) explained the things that teachers must do to motivate and engage students. The elements of designing engaging work are essential to teaching 21st century skills while also integrating technology in a way that is the most meaningful for students.

Teachers must consider student motivation when designing curriculum. Pink (2009) stated that intrinsic rewards that focus on providing students with the opportunity of thinking critically and being creative significantly increase student production and engagement. He claimed that three most crucial components to keep in mind when designing work for students are autonomy, mastery, and purpose. Under this directive, teachers integrating technology using the transformational and transcendent phases of the T3 framework (Magana, 2017) are more likely to see intrinsic motivation among their students.

Intrinsic motivation is likely to produce more autonomous, creative thinkers (Schlechty, 2011). The characteristics of learners who are intrinsically motivated align closely with the learning characteristics that are identified in the 21st Century Framework for Problem Solving (Batelle for Kids, 2019). Schlechty (2011) also claimed that extrinsic rewards can have negative effects on student growth, problem solving, and learning. This information from Schlechty is important for teachers to consider as they are developing and designing curriculum and considering how they will integrate technology.

As documented in Arnett (2016) one possible solution to meeting various needs is to implement some forms of automated technology use. The goal of this strategy is to make more time for the teacher to differentiate and work with a variety of students. Schlechty (2011) claimed that teachers need to be cautious when offering extrinsic rewards for success with academic work. This suggestion was made to guide teachers in the process of creating engaging work for students, thus it also applies to the work that students complete via automated programs on devices.

One way that teachers can determine whether a particular curriculum component and its use is motivating students extrinsically or intrinsically and truly engaging them is to consider whether they are designing curriculum or planning curriculum. Designing curriculum results in deep thinking, multiple solution pathways for students, invention, and problem-solving. Mere planning of curriculum is focused on cookie cutter activities that follow specific rules and procedures (Schlechty, 2011). Curriculum design described by Schlechty aligns closely with the second (transformation) and third (transcendent) phases of the T3 Framework (Magana, 2017). Planning is more aligned with the first (translational) phase.

Magana (2017) stated that the point of transformational and transcendent phases of technology integration is to engage students and deepen the level of learning. Schlechty (2011) identified the same goal in designing curriculum, thus teachers can apply Schlechty's design qualities when determining the best path for integrating technology in order to achieve the second and third phases of the T3 Framework.

The first quality for designing engaging work identified by Schlechty (2011) is a product focus. Teachers must consider the product of the curriculum. This aspect of curriculum design is what makes work meaningful and results in engagement among students. Kangas and Seitamaa-Hakkarainen (2018) agreed that considering the product is an important component of designing collaborative work. The authors suggested maintaining an appropriate balance of guidelines and creativity in order to help students get the most out of their learning.

When teachers are described as engaging it can mean a multitude of things. It might mean that the teacher is liked and respected. It could also mean that the way that the teacher teaches including the way they prepare and design curriculum engages students in a deep way. It is also possible for a teacher to have both an engaging presence and an engaging pedagogy. Schlechty (2011) pointed out the importance of understanding which type of engagement needs to be enhanced, because in order to see students reach the required level of 21st century skills we must focus on the engagement of pedagogy.

Arnett (2016) discussed replacing some teacher tasks with technology focused tasks. If teachers want to continue the same level of engagement that they provide with technology-based tasks then it is important to determine if those technology programs contain the qualities of engaging teachers identified by Schlechty (2011). He stated that teachers must continue to work on their personal level of critical thinking to continually push students to achieve a higher level

of thinking and engagement. Continually learning as a teacher provides the required skills to determine if the curriculum you are using includes the right work for students. In an era in which more and more curriculum is transitioning from paper and pencil to technology-based programs, activities, and equipment teachers have to continue to provide the same level of scrutiny when designing work that integrates technology for students.

Intelligence theories can also be factors of motivation among students. Blackwell et al. (2007) completed a study to determine if students who believed that intelligence was fixed performed at the same achievement levels as those who believe that intelligence is moldable. The researchers found that students who believed that intelligence could be molded, are more likely to show growth in academic achievement. This importance of mindset regarding intelligence relates to Schlechty's (2011) claims that students need to be engaged and motivated. If teachers implement the design qualities he suggests then the emphasis becomes focused on what students can learn instead of solely being focused on what they know.

Project and Problem Based Learning are two curriculum approaches that could integrate technology and have been shown to increase student engagement. Dole et al. (2017) surveyed teachers in a study to determine the level of engagement achieved from problem and project based learning. The responses from teachers showed that students were eager to work on their projects, research, and learn. The students in the 36 classrooms that were included in the study were reported to be engaged and working very hard on their projects. Teachers also communicated evidence of perseverance among their students during the projects. Students were very determined to seek solutions and create their products. Project based learning increases student engagement and attitude toward learning (Beier et al., 2019; Duke et al., 2021; Reid-Griffin et al., 2020).

Teacher Perceptions of Technology Integration and 21st Century Skills

A key component of successful technology implementation is teacher support and perception. Byker et al. (2017) examined teacher candidate perceptions of technology integration and student voice. Teacher candidates in this study completed a questionnaire to explain the way technology was used in the classroom and the skills they perceived to be the most important for students. Over 87% of teacher candidates claimed that technology was primarily being used for educational games and to practice content-based skills. This suggests that teaching candidates mainly witness translational use of technology (Magana, 2017) in their classrooms.

The researchers also inquired about the technology skills that candidates found to be the most important for students to learn. These responses centered around research, internet skills, internet safety, and understanding multiple uses for technology indicating that teacher candidates felt that students should be participating in more technology-rich experiences. The ISTE Technology Standards also support this need for technology-rich experiences (Crompton, 2017). The ISTE Technology Standards suggest that students should be using technology to create and engage with it in an active role rather than passive role (Sheffield et al., 2018). When students engage actively with technology as the ISTE standards suggest they achieve the transformational or transcendent levels of technology use (Magana, 2017)

In a recent Gallup poll (2019) 81% of teachers strongly agree or agree that digital learning tools are valuable for classroom teaching. Although teachers agree on the value of digital learning tools there seems to be more ambiguity on the level of preparedness needed to effectively implement technology. Schelly et al. (2015) completed a study to discuss the implementation of a 3-day workshop in which teachers learned to build 3D printers. After the completion of the workshop teachers completed a survey to provide reflections about their

experiences. The researchers found the workshop to be a transformative learning experience and found immense value in engaging in that experience. Teachers reported that by engaging in such a rich experience they were encouraged about the benefits their students could receive from participating in similar experiences. The researchers also found that by having the teachers participate in the hands-on process of building the printers their confidence levels increased and helped them feel more prepared to provide these types of experiences to their students. This conclusion is also supported by McFarlane (2020) who claimed that teachers need to have a rich understanding of technology to use it effectively in the classroom.

The study conducted by Schelly et al. (2015) established the idea that professional development is an important component of improving teachers attitudes and perceptions toward technology integration. Darling-Hammond et al. (2017) completed an analysis of professional development for teachers. The researchers found that a relationship among leaders, experienced teachers, and new teachers was important for providing appropriate professional development. The idea is that these individuals need to work together to determine what works, share it, and improve on it. In this particular case, the professional development would be focused on what forms of technology integration are working well in classrooms.

In a study conducted by Namsone et al. (2016) researchers investigated the success of lesson-based professional development in preparing teachers to teach 21st century skills to students in Latvia. The researchers found that teachers were encouraged by the support from their school, having the opportunity to work with their peers and learn together, while also being provided with the time to prepare and reflect on individual activities. The results of this study also suggest that teacher perceptions are an important factor in successful professional development when attempting to implement a change in teaching practices within a school.

Another factor that can improve professional development is more comprehensive research regarding what teachers are doing in their classrooms to integrate technology. Manches and Plowman (2017) called for a focus on sharing knowledge between teachers and researchers to facilitate professional development. These authors conclude that a deeper partnership between teachers and researchers would result in an increase of technology integration research which would also increase the ability for teachers to rely more heavily on research-based practices for technology implementation.

Chapter Summary

Education is constantly changing due to changes in society, technology, and careers. There is currently an emphasis placed on educators to develop 21st century skills among learners to prepare them for success in the future. The 21st Century Framework (Batelle for Kids, 2019) along with recommendations from Schlechty (2011) provide guidance for educators in developing and designing curriculum that will engage students and encourage them to think deeply.

Given the influx of devices that are available to schools it is important for educators to consider ways to continue promoting 21st century skills while also integrating technology. The T3 Framework developed by Magana (2017) provides support to teachers working to increase the value of student learning through the use of technology. The transformational and transcendent phases of the T3 framework have the ability to provide collaborative problem-solving opportunities and extend 21st century skills among students.

Creating a culture among teachers in which learning, creativity, and sharing ideas are valued is likely to spark a successful change (Deal and Peterson, 2016). Teachers need to be supported in their endeavors through professional development to encourage them to continue

trying new things with technology integration (Byker et al., 2017) Teachers also need to continue sharing the ways they are integrating technology to create a widespread community focused on improving the learning experiences of students (Manches & Plowman, 2017). The integration of the 21st Century Learning Framework, the T3 Framework, and a culture of sharing among teachers has the capability of improving the education of students.

Chapter 3. Methodology

The purpose of this study was to identify and examine the technology strategies being used by teachers in grades 3-5 that engage children in problem solving learning opportunities. Schlechty (2011) described the importance of engaging and motivating students through problem solving learning opportunities. He expressed the importance of designing engaging, meaningful curriculum. The 21st Century Learning Framework (Battelle for Kids, 2019) and the T3 Framework for Innovation (Magana, 2017) align with his directives for curriculum design.

Vega and Robb (2019) published a census to explain the teacher perspective regarding the 21st century classroom. The census showed that teachers value digital tools and believe that they could be beneficial to student learning, but that many teachers feel unprepared to design curriculum that integrates technology in a meaningful way for students. Teachers are pressured to use devices in schools (Culatta, 2019; Rodberg, 2019). Due to the lack of professional development to help teachers learn the best way for students to use the devices many teachers resort to using them for skill-based support rather than transformative learning experiences (McFarlane, 2019)

The ISTE technology standards have changed drastically since their first implementation in 1998 (Snelling, 2016). When educators were first beginning to integrate technology, the focus was on helping students learn to use the technology. Snelling explained that the focus has now shifted to transforming student learning experiences using technology. The challenge that educators currently face is designing meaningful work that benefits students in the deepest way possible (Magana, 2017).

Gillespy (2019) posited that educators also need to experience transformative learning to grow in their pedagogy in a way that will help them provide transformative learning to students.

The researcher in this study is hopeful that sharing the experiences of teachers who have encountered the phenomena of using technology to teach will help motivate and encourage others.

Research Questions

The following research questions guided this study:

Central Question: What are teacher perceptions of the technology-based instructional strategies and digital tools they are implementing to enrich problem solving for students in grades 3-5?

Sub-question 1: What are the teacher perceptions of the value of technology-based instructional strategies to enrich problem solving for students in grades 3-5?

Sub-question 2: What are the teacher perceptions of the value of using digital tools to enrich problem solving for students in grades 3-5?

Sub-question 3: How have teachers learned to adapt and implement valuable technology activities in grades 3-5?

Research Design

The researcher applied a qualitative, phenomenological approach to this study to obtain information focused on the specific, in depth experiences of a small group of teachers. Creswell and Creswell (2018) stated that phenomenological research methods allow the researcher to understand the lived experiences of participants in relation to a phenomenon. The researcher investigated the experiences of teachers adjusting to the phenomenon of integrating technology into teaching. There is a push for technology integration in classrooms to prepare students for future careers and expectations of society (McCurry, 2000). This shift requires teachers to adapt their current instructional methods to integrate technology. The focus of this study was to

research the experiences of a group of teachers who have encountered the phenomenon of technology to provide examples from which others can learn.

The researcher developed this study to learn more about the instructional teaching strategies and online applications that teachers use to develop collaborative problem-solving opportunities for students and how those activities fit into the T3 framework. The phenomenological qualitative design of this study helped provide in depth information about the experiences of teachers. The researcher used Magana's (2017) T3 Framework to determine the level of student value that is achieved by the various activities and strategies that the teachers in the study have implemented.

Site Selection

The researcher chose to use a school system in East Tennessee for this research study because the school system has a technology leader program. As part of the program each year the school system identifies teacher technology leaders at the Elementary, Middle, and High School level. These teachers receive training to improve their skills for technology integration and share what they have learned with teachers in their building. The researcher chose this school system because of their innovative approach to technology training for teachers. The participants in this study are teachers who have had adequate experience with technology training and integration, making their personal experiences rich and meaningful to the purpose of the study.

Population and Sample

Creswell and Creswell (2018) stated that purposeful sampling is a strategy that can be used to allow the researcher to pick a sample that has experience with the phenomenon being studied. The teachers who have been technology leaders in this school system were ideal

participants because they have had technology training, access to devices and programs, as well as experience integrating technology in the classroom.

The researcher selected the technology leader group to obtain a population of participants who matched the purpose of the study (Patton, 2014). The researcher contacted the director of the technology leader program to select teachers who teach grades 3-5 and were interested in the study. The researcher included the criterion of teachers who teach grades 3-5 to focus the experiences on a specific grade band. The researcher chose to include the grade level criterion to ensure that participant experiences could be compared and used to find commonalities. Participant selection was not limited and any teachers who wanted to participate were welcome. The sample included 11 third through fifth grade teachers who have been technology leaders in the selected school system.

Data Collection Strategies

Once participants were selected the researcher assigned pseudonyms to all participants and set interview dates with the participants based on their availability. Due to a global pandemic interviews were conducted via zoom to be mindful of the safety of the participants as well as the researcher. Interviews were scheduled as 45–60-minute Zoom sessions. Interviews were audio and video recorded and transcribed. During the interview, the researcher explained the purpose of the study to participants. The researcher used open-ended interview questions to learn more about the participants' experience with technology integration, the type of technology they are implementing, their instructional design process, and how they feel students have grown in 21st century skills through technology integration.

The researcher also asked participants to submit artifacts based on the items they discussed in their interviews. These artifacts varied but included lesson plans and examples of

instructional materials. Collecting both interview responses and artifacts provided multiple data sources to aide in triangulation of data, which gave credibility to the study (Patton, 2014).

Data sources were organized by participant pseudonyms to protect the privacy of participants. All electronic data were stored on the researcher's password protected computer. Any non-electronic data sources were collected and stored in a locked filing cabinet at the researcher's home.

Data Analysis Strategies

After all interview and artifact data were collected the researcher reviewed the data and winnowed any data that did not pertain to the purpose of the study in order to focus on the relevant data that were collected (Creswell & Creswell, 2018). The MAXqda software was used to code transcript data. Tesch (1990) identified eight steps in the coding process. The researcher used the steps Tesch identified as a guide when coding the data. The researcher began by reading all transcripts to begin to understand the data collected. Next the researcher reviewed one transcript to begin to start to list themes for the data. After doing this for several transcripts the researcher went back through the themes to determine if any themes needed to be combined. After determining emerging themes the researcher assigned codes for them and used those codes to analyze the rest of the data. Finally, the researcher assembled the data pertaining to each code in one place so that it could be analyzed.

After the data were coded the researcher analyzed the data to look for commonalities and themes between participant responses. The researcher used the 21st Century Framework (Batelle for Kids, 2019) and the T3 Framework (Magana, 2017) to analyze coded data and determine what examples of technology integration were discussed by participants to classify them as examples of problem solving, translational, transformational, or transcendent activities.

Assessment of Quality and Rigor

The researcher triangulated the data by analyzing both artifacts and interviews (Patton, 2014). This form of triangulation provided credibility to the study because artifacts supplied by the participants helped the researcher document and analyze the specific examples mentioned by participants made in their interviews.

The researcher used thick description to communicate the findings to help the reader understand the situation and experiences of the participants in the study. This understanding can help readers determine if the experiences of these teachers are transferrable to their classroom or school.

The researcher made a commitment to be transparent in all the steps taken in data collection and data analysis. This transparency provides an opportunity for others to review the information in the study and determine the dependability of the study.

The researcher noted their personal bias in this study. A journal was kept with personal thoughts regarding data to help the researcher eliminate those personal biases from the research findings. Using theoretical frameworks such as the 21st Century Learning Framework (Battelle for kids, 2019) and the T3 Framework (Magana, 2017) as a guide in analyzing data helped limit the personal opinions of the researcher and provided confirmability to the study.

The Role of the Researcher

As an educator for more than 10 years who has witnessed the changes in technology over the years, this researcher had bias regarding technology integration. This researcher has had 1:1 devices in the classroom for the last 2 years, which is actually a much shorter time than many other school systems. The researcher witnessed various types of technology integration in several school systems while completing internship hours for an administrative endorsement. The

researcher realized at that time that there was a vast difference in the way that teachers were implementing technology. During the same time, the researcher was also taking additional coursework to learn more about STEM. In the STEM coursework the researcher continued learning the importance of collaboration, problem solving, and other 21st century skills. Although the researcher was being reminded of the importance of strong teacher pedagogy in the STEM courses in many of her observations in schools she was seeing teachers struggle to implement technology in a meaningful way. She realized the importance of meshing high-quality curriculum design with technology integration.

These personal reflections are what led the researcher to this study. The researcher acknowledged her own personal interests, opinions, and judgements regarding technology integration to be transparent. The researcher of this study was committed to bracketing personal bias and remaining objective to learn more about and share the experiences of the teachers in this study. To aide in reflexivity the researcher kept a journal to help engage in constant bracketing of personal judgements. The researcher worked to protect the rights of the participants and conduct a credible, dependable, transferable study.

The researcher gained IRB approval for this study from the Institutional Review Board at East Tennessee State University (ETSU). The researcher obtained permission to conduct the study with the school system. No risks were noted for the voluntary participants of the study. All participants were notified of the purpose of the study, data collection methods, and how the data would be stored. The researcher maintained confidentiality of the participants throughout the study.

Chapter Summary

This chapter identifies the research design, site, sample, population, data collection methods, data analysis methods, and the researcher's role. The researcher used interviews as well as documents such as lesson plans and examples of student activities to identify examples of technology integration. The researcher used Magana's (2017) T3 framework and the 21st Century Learning framework (Batelle for kids, 2019) to identify the examples of technology integration that offer valuable learning opportunities to students and allow them to engage in 21st century skills such as problem solving. The findings from this research study could also be used by teachers to find inspiration to adapt their current technology integration practices based on what worked well for the teachers who were part of this study.

Chapter 4. Findings

Introduction

The purpose of this study was to identify and examine the technology tools and strategies being used by teachers in grades 3-5 that engage children in problem-solving learning opportunities.

This qualitative, phenomenological study was conducted to learn more from the experiences of teachers and provide insight into how they have adjusted to the phenomenon of integrating technology. Purposeful sampling was used in this study to select a sample population who has experience integrating technology. The researcher interviewed participants using a predetermined semi-structured interview guide that contained open-ended questions (See Appendix). At the end of the interview, participants were asked to submit an artifact that incorporated both technology and problem solving for the researcher to review. Interviews were conducted, recorded, and transcribed via Zoom. The researcher reviewed all transcripts for accuracy and provided each participant with the opportunity to review their transcript for accuracy. Participants were encouraged to review their transcripts and revise them if they wanted to add to their original thought or omit any information from the transcript.

The central question of this study was: What are teacher perceptions of the technology-based instructional strategies and digital tools they are implementing to enrich problem solving for students in grades 3-5? The researcher developed a predetermined interview guide with open-ended questions that were designed to encourage in-depth responses from participants to answer the following research questions:

1. What are the teacher perceptions of the value of technology-based instructional strategies to enrich problem solving for students in grades 3-5?

2. What are the teacher perceptions of the value of using digital tools to enrich problem solving for students in grades 3-5?
3. How have teachers learned to adapt and implement valuable technology activities in grades 3-5?

The researcher used Magana's (2017) T3 Framework to classify technology use described by participants as translational, transformational, or transcendent. The purpose of this framework is to highlight the key components of each stage of innovation to help educators evaluate the current practices and determine ways to enrich the experience of students. Translational activities incorporate automation and consumption. These activities typically involve translating a task into a digital version to automate a particular aspect of a task or to help it be consumed by the student. Examples include digital textbooks, websites, digital presentations, digital games, and digital videos. The transformational stage shifts the learning from teacher directed to student directed. Examples that could be classified as transformational include digital goal setting student monitoring of those goals with evidence of their learning and tasks that require students to use digital production tools, particularly to contribute to the knowledge of their peers. The final stage, transcendent, involves student selection of problems that interest them, generating solutions, and communicating or defending their knowledge. The idea in this final stage of the framework is that students are using digital tools to solve important complex problems that matter to them.

The Framework for 21st Century Learning (Battelle for Kids, 2019) provided the researcher with background information that was helpful both in probing during interviews to guide participants to give rich responses and in coding participant responses to determine how the participant experiences with technology integration have helped prepare their students for the

future. The skills from the framework include: life and career skills, learning and innovation skills (critical thinking, collaborating, creativity, and communication), as well as information, media, and technology skills.

Description of Participants

The researcher contacted a school system in East Tennessee to participate in this study. This school system was selected by the researcher because of their technology teacher leader program. It was important to the quality of data that participants had access to technology and had been given opportunities to implement technology. After obtaining permission from the school system the researcher worked with the director of the technology teacher leader program to create a list of potential participants. Participants who taught in the 3-5 grade band and have been technology leaders in this school district were contacted to participate in the study.

Of the 26 possible participants 11 teachers chose to participate in the study. All 11 participants were asked to participate in an open-ended interview via Zoom. All participants were also asked to submit an artifact that incorporated technology and problem solving for the researcher to review. Out of the 11 participants, seven were able to provide an artifact for review. Although some participants did not submit artifacts, all participants discussed in depth the digital tools and strategies they implement, which provided the researcher with quality data.

Table 2

Participant Characteristics

Participant	Years of Experience
P1	16
P2	25
P3	21
P4	11
P5	10
P6	15
P7	10
P8	27
P9	26
P10	27
P11	7

Research Questions:

The central question of this study was: What are teacher perceptions of the technology-based instructional strategies and digital tools they are implementing to enrich problem solving for students in grades 3-5?

Question 1: What are the teacher perceptions of the value of technology-based instructional strategies to enrich problem solving for students in grades 3-5?

Ten out of 11 participants either specifically discussed students working together as a valuable instructional strategy when incorporating technology and problem solving or submitted an artifact that required student collaboration.

When P1 was asked to elaborate on how she determines when to use group work or independent projects for an instructional strategy during problem solving activities mentioned earlier in the interview, she explained two circumstances in which collaboration might be helpful,

> If it were content that's brand new, that I've never heard before, I would put them in groups or in pairs just to give them some scaffolding in particular. Or if there are students that I know come from backgrounds that may not have had a lot of exposure to the content area we're learning.

P1 shared an artifact example in which the instructional strategy was student collaboration. In the artifact was a prompt she had given students asking them to collaborate using Google Slides to do a "Story in the Round". Students were asked to discuss setting, characters, and plot. Then they took turns typing sentences of the story. The artifact also asked them to make sure they had a beginning, middle, and end in the story.

P2 described how she incorporates digital tools in group projects and stated that, "Group projects, especially, are ways they can problem solve with each other."

P3 discussed using digital breakout rooms to incorporate problem solving and stated that, "You have to get the right answer to move on to your next piece. They have to kind of work together to figure out where they've gone wrong or what they're missing to make that happen."

P4 submitted an artifact example in which students were working collaboratively to research biomes. She submitted student directions as well as a rubric. Students were scored on the following categories; having five slides, including a title slide, including pictures, including important biome information, and their ability to work together.

P5 discussed the strategy of incorporating the tool, Flip Grid, to pose open-ended questions. She stated that she has students,

> Explain how they went through each step or model in multiple ways of thinking. So, then they may comment on another student's flip grid that thought in a different way than they did and then relate how they all tie together to get the same answer.

P5 also described the value of group work as an instructional strategy by saying, "You have to problem solve with other people as an adult. So, I think it's important to have them work together on some of these pieces."

P6 discussed using modeling and collaboration as a strategy to get students to a point where they are able to use Google Slides on their own when she stated,

> A lot of times modeling is one of the best things… When we first started with Google Slides in the beginning of the year, I did an "All About Me". I asked them, what are some things you want to know about me and as they were talking, I was kind of adding to my little presentation and then I showed them how I built that. Then they did one with a partner. So, I model it, then they work together, and then the end activity would be them doing it on their own and presenting their ideas.

P7 discussed doing group puppet shows to incorporate social studies topics. She explained that. "If I tell them you're working with these three other people that you don't really know, it's just some life skills that they learn how to cooperate and get along with other people anyway."

P8 indicated that although working together is important it was more difficult this year due to the pandemic. She explained that she worked around this by putting students in breakout rooms to have conversations. She stated, "I just feel like being able to talk to each other and

being able to work together to problem solve or to brainstorm ideas as a whole group was a lot of them talking and not necessarily something based with technology."

When asked about technology-based instructional strategies that enrich problem solving, P9 discussed group work in her statement that, "You start with guiding the whole group, and then you may go into groups, and then partners, and then individuals to check for understanding and so forth."

P10 responded to the question about technology strategies that enrich problem solving by discussing a group project in which students,

> Built a couple of different kinds of robots, and there were six stations. A couple of stations were just self-starter stations for the students, where they could go in and just work, but then I had a couple where I really had to sit down with them and take time. So, I worked on a station rotation model where I would deliver direct instruction to four or five students, make sure they understood how to use the tool. How to do what we're doing and then move on, monitor the other groups and then another group would just rotate into me to do that.

P11 stated,

> In the past, my students respond well to the "I do, we do, you do" type strategy where I show them how I use it, and then we do it together and then let them do it together and then let them do it on their own."

Question 2: What are the teacher perceptions of the value of using digital tools to enrich problem solving for students in grades 3-5?

Teachers discussed various digital tools during interviews. Teachers felt that using digital tools to enrich problem solving was valuable in building engagement, creativity, providing real world connections to students, and exposing them to technology.

Engagement

When asked how they use digital tools to enrich problem solving, participants discussed using digital tools that provide variety for students including Buncee, student created videos, websites, YouTube Videos, and Flip Grid as well as tools that provide a game-like approach to keep students engaged. Some of the game-like digital tools they included in their answers were Kahoot, QUIZZIZ, Quizlet, and Gimkit.

P1 stated that she liked to, "Use technology applications sort of as a menu like what I felt like would enhance students' interest, what would engage them?" She elaborated on how using variety to keep them engaged helps with the thinking process by saying,

> I just think anything that's new to a student kind of captures their attention, whether it's a new topic, a new digital tool, a new way of combining how they go about a project as opposed to always doing something individually, working with a partner is different. Working in a group is different. So, any time that you present something in front of them that makes them think through, OK, how am I going to get this accomplished on my own or how am I going to find this information using this tool? Or now that I have this book and the digital tool, how am I going to go about it?

When discussing a specific example in which students had read a book about the American Revolution and then were asked to create a presentation about the four main battles of the war P1 explained how she used a tool, Buncee, to engage students.

> Buncee is like that [Adobe Spark] and it's got GIFS that they can use in it, photographs they can plug in, soundbites, that kind of thing. So, I had them create their own Buncee about the main four battles. It gave them some variety instead of just typing something or writing up a report about the battles.

P2 echoed the idea that technology should enhance the lesson when she explained why she chooses to incorporate technology. She stated,

> I always think I don't want to use technology, just for the sake of using technology, it should either enhance or you know, have a reason of some sort… Sometimes it's a different way to get them engaged, they'll be a little bit more interested in the lesson if they're able to do something with a digital tool.

P8 explained how she uses digital tools to build engagement among students in the beginning of her lessons when she stated,

> So, we usually start with a read aloud and we actually use YouTube videos and things like that or we use Flocabulary or Brain Pop or anything to help introduce the concept or get them excited about it. And like with science, we use a lot of digital things to create that phenomenon to get them excited for whatever we're learning. We always do something with the beginning.

She also indicated that students become excited about using technology when she stated, “But they do get excited when they’re able to kind of step out of that pencil paper world and do different things to create.

P6 discussed using Flip Grid to engage students saying that,

> It seems more fun, you know it's not just that typical teacher work they get to go find a quiet corner go out in the hallway and you know they want to look at their notes write things down kind of like a little script.

She also explained how using Flip Grid helps her engage students that typically might not provide much information when asked an open-ended question.

> It was fourth graders you know; they want to give you the bare minimum. So, if I’m asking open ended questions, I’m going to get one or two sentences. But if I do flip grid, they might talk for 5 minutes… I can see more about what they know… They can be creative, and they don't have to worry about all the rules that they have to think about when they're writing something down on paper.

P7 shared that she allowed students to use digital tools to choose how they presented information to her on an assignment. She stated that,

> I had this one great assignment where there were multiple ways that they could answer the question. And one of them was make a rap or sing a song. So, this girl made a rap and submitted it to me through Canvas. It was really great.

P3 shared how she used an online tool called QUIZZIZ to engage students by taking a less engaging activity and applying a digital tool.

> When we were practicing for TCAPs, we were going to read a passage and answer some questions, which is not fun, but we try to make it fun. But we would put the questions in the QUIZZIZ and we had a game where if the class average was eighty percent or higher, everybody got candy and they would encourage each other. OK, guys, we got to really slow down, make sure you're reading this carefully. They all had their highlighters out because they didn't want to be the reason the class didn't do well and they had to show me what they were highlighting in their text to find their answers.

When asked about the outcome for students regarding the tools that she implements P5 stated,

> They always love whenever I use any of these pieces of technology that I've told you, because a lot of them are game like, if I'm using them as an assessment, like QUIZZIZ, they're more game like and fun and they praise them after every question that they do correctly. Which if you do it paper and pencil, you're still getting the answer from them. But they're not getting praise and coins or tokens or things that keep them motivated throughout the entire thing. And it's competitive, which a lot of my third graders really like to be competitive. So, it keeps them engaged through that.

P5 also elaborated on another tool that she feels engages students called Quizlet Live and how it also builds problem-solving skills. She stated,

> It normally randomly mixes students, and it will pose the same question [to all students]. But only one student's Chromebook has the correct answer. So, it can create a lot of problems if students don't talk and work together because one student might think they have the answer and click it and it be wrong and they didn't collaborate with their group.

> But whenever everybody collaborates and works together, they can keep moving forward. If they get it wrong, they start back at zero and have to start over.

P9 discussed two tools she uses to engage students in her classroom. The first tool she discussed was Quizlet Live. She explained,

> I like to use Quizlet Live. I didn't get to do so much last year with COVID, but I love that one. It puts them in random groups and it's good for vocabulary review, vocabulary practice. An assessment tool review for quizzes. They love it because it assigns them the animal and then it puts them in the animal groups together, just randomly.

P9 also discussed using Kahoot and the way that it engages her students because of the competition involved. She stated,

> Again, they love Kahoot. It's competition, of course, but I'm always careful to stop and review the questions and explain anything that's been missed… of course they think it's just a big game but all in all we're reviewing each question.

P10 Stated that he uses a game-like review website to keep students engaged when he said, "I have them working in Quizlet or QUIZZIZ… but having little tools like that are engaging for them to work on vocabulary and playing the games. It just keeps them engaged."

Another digital tool that two participants discussed using to build engagement was Gimkit. Gimkit is another online quiz tool that applies a gamified aspect to the quiz. When asked how she uses digital tools to enrich problem solving for students, P4 shared,

> So, I think Gimkit would be a great example of that because they have to work together to, I mean, kind of solve a problem. They also have to problem solve with working

together as a group or in partners and a lot of that is more student directed than it is teacher directed.

P5 described the value of using Gimkit when she stated,

> The new game [Gimkit] that we played, oh man, they love that game, and they had no idea that they're reviewing information because the more questions that you answer correctly, the more points you get to be able to run analysis on people to see if they're imposters. And the whole goal is to see if you can determine who the imposters are in the class. So, the class has to work collaboratively. And when they're online, they can see their analysis that they're running on these people, but you can't even run the analysis unless you answer a certain number of questions correctly.

Creativity

Three participants discussed their perceptions regarding the value of creativity for students when using digital tools. Four artifacts that incorporated technology and problem solving provided by teachers also provided students with the opportunity to be creative with their submissions.

When asked how she determines what digital tools to incorporate into her lessons P4 stated that,

> It depends on what I'm asking the students to do. If there's an assignment where I want the students to showcase more creativity, use more voice and expression, I would typically give them something like Flip Grid or even like a PowerPoint or a Google Slides project.

P5 described what she likes about incorporating Jam Boards into her lessons,

> They used Jam Board to digitally create a bakery using different shapes and then tied into geometry with quadrilaterals. And they were able to explain the different attributes of shapes. But if just gives them more of that creation piece and they can get on and create with technology which is one of our ultimate goals as a teach leader. To get them to be able to create with technology.

P11 described how she uses Book Creator to get her students to create using technology in this statement,

> For example, Book Creator takes some playing around with the get used to. You come up with a story, you are given a blank white book that looks like a blank sheet, and you can design it however you want using the tools to create what you want. Then moving on into how to incorporate text images and make it engaging as well, you know, it's a book, I always tell them, 'What does your reader want to read?'

Four artifacts that were submitted incorporated creativity for students. In the "Story in the Round" artifact submitted by P1 students were collaborating to create a story digitally. P2 submitted a choice board that she gives her students in which they can choose between various activities to demonstrate understanding of a book the class was reading. Some of the activities on the choice board that included creativity are creating a "wanted" poster for a character in the book, acting as a character to create a vlog, creating a new book jacket for the book, creating a book trailer using Adobe Spark, using StoryboardThat to create a comic strip incorporating ideas from the book, and creating and interactive timeline of events from the book. P8 submitted a prompt in which she was asking her students to create a video where they explained how to tell elapsed time. In the directions it asked students to create their own elapsed time problem to share in their video. P6 shared a Flip Grid prompt in which students were to play the role of a

Confederate soldier during the Civil War to provide a firsthand account of their experiences. The teacher stated in the directions, “Be creative and bring all your drama and acting skills.”

Real-World Connections

Three teachers specifically described opportunities for students to make real-world connections or solve real-world problems as a result of having access to technology.

P1 stated,

> And then we would look at some real-world examples, like I might have a picture of the Eiffel Tower or a bridge and we would talk about, OK, “What kind of geometric figures do you see?” “Here were the acute angles,” or “I see parallel lines.” It helped them to make connections between what they were learning as far as the definition of those math terms, how they could see that in the real world, and that led to discussions of “What does an architect do or what kind of people build bridges?”.

P4 explained her perceptions on how using digital tools provide students with access to solve real-world problems they might experience when she said,

> Once technology is given to them they just become more eager to seek out how to fix something, how to make something work. I feel like they have a little bit more autonomy over technology than I had when I was younger. So, they seek out answers on their own. I mean, just for instance, just today, not even content specific related. I was talking to the kids about a reward. And a kid was just trying to explain squish balls, and without any kind of prompting, he just gets a laptop and opens it up and typed in exactly what it is that he was trying to explain to me. So, you know, just to give me that visual and that the words that I needed to understand what he was trying to explain.

P10 shared how he uses a digital tool that provides students with an opportunity to solve real-world problems,

> I actually started last year using something called Learning Blade and it's a STEM career focus program where students are given missions and they do math, science, ELA, and social studies challenges to build a team and a toolkit to solve a real-world problem that's going on.

Technology Exposure

When explaining the value of using digital tools to enrich problem solving four participants discussed the benefit of exposing students to technology.

P4 shared that when students were remote learning due to the COVID-19 Pandemic she tried to implement Google Slides. She explained that experience by stating, “They were learning the technology at the same time that I was trying to teach the content and that was a huge hurdle for me and parents at home… They just didn’t have the foundation for it.” She described that once they were back in person students were more successful and confident learning different technology tools in the following statement,

> Anything that I have been able to personally walk them through step by step and I could model it for them and I could problem solve any hiccups or hurdles they had as we’re going along. So they were still learning that piece of technology, but they weren’t necessarily on their island doing it on their own. So, if they felt confident in it, then they were way more receptive to using anything I gave them.

P6 explained how now that her students have been exposed to Google Slides they are able to use it to show what they have learned in the following statement,

> They've gotten so good at Google Slides that they can do one for me for an exit ticket… Instead of me just giving them a little exit ticket piece paper they'll go type something, They'll find a picture. I mean they can do that in five to seven minutes and send that to me.

P7 stated,

> We have to nail down this digital piece and that's an important part of the problem-solving piece too, when you're thinking about how you're going to learn to deal with this technology as you grow up. That's why there's got to be a level of us teaching them now so that they're prepared to do that.

When the researcher asked P9 how digital tools helped her students become problem solvers the participant replied,

> I think probably on the research end. We really talked a lot about appropriate resources and inappropriate as far as using the web in doing research throughout the year…And even if they had a question about math [morning work] … they realized they could go to their laptops and pull that topic of up and then find that answer in that way.

Later in the interview she elaborated when asked about the outcomes for her students by stating, "They're learning how to navigate into a world of technology. And so much of that was problem solving, so much of that was their trial and error, in my opinion."

Research Question 3: How have teachers adapted and implemented valuable technology activities in grades 3-5?

Teachers shared a variety of examples of valuable technology activities during their interviews as well as in their artifact submissions. Many of the activities outside what have already

been reported in the previous questions include assessments that deliver quick feedback and tools that provide differentiation for students.

Quick Feedback

One adaptation that most of the teachers in this study have implemented is digital forms, quizzes, and assessments that are graded automatically and provide students with immediate feedback. Three participants elaborated on the value in obtaining this quick feedback.

P2 stated,

> Outcomes, as far as the quick grading, because things can be graded so quickly and sometimes automatically or I can go through them very quickly. They get feedback a lot sooner and they don't have to wait for me to pass papers back or they don't have to come and see me. They can get it on their Chromebook and see the response immediately, as soon as it's graded. And then, if they have questions or I need to talk to them, we can do that a lot quicker than if we're waiting for things to happen, so I think that's helpful in them moving forward. It saves a lot of time and sort of guides them before they have more time to maybe make a few other mistakes they're redirected and steered back in the right direction, pretty quickly.

P3 stated,

> We do it also to kind of give us quick feedback on the Google Forms, I can look to see if our focus skill for the week is prepositions, I can look every day to see how many kids are getting that correct or incorrect. And that makes me think, "I need to do more on that. OK, I think you're getting it. We'll just kind of keep going with it." It'll kind of give us some guidance as to what we need to continue with or reiterate again.

When asked to elaborate more on the benefits of quick feedback P3 stated,

> When they do a Google Form, they get their score right then and then our goal was to go back and, “Did you look at the one you missed? Did you see why you missed it and what the right answer was?” And I think that kind of helped them solve problems in the future because they were able to see what they missed and why and hopefully not make that mistake a second time.

P9 discussed the benefit of feedback from QUIZZIZ in the following statement,

> I use QUIZZIZ. I have used it as a preview, but I think usually it's more of a review or an assessment tool, and after they complete the assignment, then we go back through each one [question]. Looking at the percentage of how many got it correct, it's letting me know what I need to reteach as well, whether one missed it or half of them missed it.

Differentiation

Participants communicated that technology helps them adapt their curriculum to differentiate for their students. Participants used technology to provide read aloud, a different level of content, and support for students.

When asked how she determines what digital tools to incorporate for her students P2 answered,

> Sometimes I look at differentiation. Some students need read aloud, for example, and different digital tools have that ability to read aloud. And I don't have to spend the time recording my own read aloud for them or taking them out of the room to read something to them.

P3 submitted a digital notebook that she used with students for her artifact. It included teacher inserted read aloud recordings that students could use to help them complete the notebook or study their notes later.

P6 explained how using Flip Grid provides support with both interpreting questions and providing responses for her students. She stated,

> A lot of times I record the question. It's my voice or it's just a sentence that I write and then they can just talk it out and if they think that didn't sound right, they can delete it and start again. They can hear it back to themselves, and so that is something across the board that they feel really confident in with the Flip Grid is just going and talking. They don't have to write and figure out how to spell this word and how to do that so that's something quick and easy.

P7 explained how she uses technology tools to accommodate students that need read aloud on tests and quizzes in the classroom. She stated, "We put all the questions to tests and quizzes and PowerPoint. And I had a template and then we would insert the read aloud like an audio recording button in there."

P2 explained how she uses IXL to provide differentiated content for students in the following statement,

> IXL, for example, I use really as a review or even sometimes as a preview of something we're about to do in a lesson and that particular tool gives them feedback for each question and based on how well they do it gives them harder questions, and so there it advances them a little bit further.

P3 discussed how she used Hapara to create separate lessons for students that need to work on a lower level. She explained that she,

> Create[s] their whole separate lesson and they had links for the week which told them what they needed to do each day with little videos and little teachings in there just for them to work separately at their own pace.

P5 explained that using Flip Grid in stations provides an opportunity to hear what her students are thinking while also meeting various learning levels. She stated,

> So, for example, if I'm teaching through a Flip Grid, let's say we're in the center. And I might have one group watching a small group lesson of me teaching then after that they can move on to something else. So, while all that's going on, I can be teaching a small group some remediation or some different skills. So, it really goes back to what you're wanting them to get out of the lesson.

P 6 described how she lets students use technology to support their learning. She stated,

> If there's a question that my kids have asking something about the Civil War. You know a lot of times they will raise their hand and say “I forgot”, or “I might not have been listening, can I go to Google, and read a little bit about this before I answer it?”. So, I think that when they do have that problem of you know “I’m stuck what do I do?” usually they're just sitting there in front of the piece of paper and a pencil, and they're just stuck and they write “I don't know” or “Can you help me later?”. So, this kind of gives them a chance.

P6 also explained using Google Slides provides some support for her students.

Even the Google Slides it's something that they can maneuver even with some of those learning disabilities, they know that if something's underlined that it's spelled wrong and what to do… They really like that, because you know at this age, they want things to look right. They are very frustrated when their work doesn't look like their peers, so in this way, you know it's not about handwriting it's not about how they drew something it's all something that you know they can create with a click and so that's always helpful too.

P9 discussed the benefits of using Whoo's Reading and IXL for supporting various needs of students. She stated,

…They put in their book. And then it asked them questions specific to the book. And it's going to be looking for certain words and so forth, but the thing is, it's typing and it's writing at the same time. So, the little owl will pop up and give them tidbits of hints of how they can improve their answer. It is really cool. And then there's another part to it to answer your question. They can choose which questions, you got your differentiation there. They can choose which question to answer. Again, the little owl is popping up… It was really neat it even called them out on punctuation and capitalization, but it would just pick up on their types of writing.

P9 also stated that they used,

IXL this year. We got to pilot it at our school and I was very impressed with it. I even sat through a Zoom workshop on it. You can recommend the lessons, but if they struggle, you can work it to where it will bring them down or they have to do remedial things.

T3 Framework

There were 108 examples of technology use mentioned in the interview and artifact data that the researcher collected. The researcher used Magana's (2017) T3 Framework guidelines to code the examples of technology use. Of the 108 examples the researcher coded 73 as translational, 34 as transformational, and one as transcendent.

Translational Technology Use

Magana (2017) identified the two components of translational technology use as automation and consumption. Automation refers to a teacher or student using technology to automate some aspect of instruction. Consumption refers to students consuming information through technology use. Some of the common examples listed by many participants included Kahoot, QUIZZIZ, Quizlet Live, Google Searches, Google Forms, and IXL. Magana stated that even the lower level of technology implementation results in value for the students. The researcher included eight high quality examples of translational technology use.

P1 shared the following example of technology use in which students were consuming information,

> This spring, we studied owls and their habitat. And so, part of what they had to learn about was where within a food web is the owl? What kinds of things do they do? They eat, how can we find that out? So beyond just doing a dissection of an owl pellet, they began to compare what kinds of things live in the habitat. So, what kind of habitat does an owl live? And so that is where they were really consuming. And they would do Google searches, I might have gave [sic] them a few websites where they could go and look that up themselves, and then I found like an interactive program where they can actually click on different parts of the food web to see is this a producer consumer?

P1 explained another translational use of technology in this statement about constructing roller coasters,

> I had a video that showed them how to make it so not only did I show them how to do it in class, but then they could go back and watch the video to just see how to cut it, how to fold it, where it needs to be tight.

P2 explained a translational use of technology when she explained how she uses Google Forms to automatically grade student quizzes.

> You know, sometimes it's as simple as I can grade things a lot quicker if they do it online and it just makes my job, a little easier and you know it's the exact same thing as doing it on paper, but grading would be easier.

P3 discussed using digital notebooks with students and submitted an example of a digital notebook which would be a translational use of technology. She stated,

> We started that during the first closure for COVID. We used to use a little composition notebook that we've always used especially the social studies, because we have no textbook because they've got to be able to take notes somehow. And when it happened the first time they were at home, so their journals were at school. So, we wanted to be able to get through the last nine weeks. So, I just took everything that would have been on paper, and we moved it over to a Google Slide. And so that's how they take their notes and we do them more kind of units like what they're going to be tested on. And we also include in those notebooks, resources and songs and things that they can use to study with. And so, we surveyed a couple of parents from that school year and asked their opinion and they all said they preferred that method, too, it was easier that way. You

know, parents want to have their kids study and they can't read their handwriting or they don't have everything written down.

P7 identified Kahoot and digital logic puzzles which are both examples of translational use of technology. She stated,

> I can give them the Kahoot... After they take it, I get a report. So if you make them log in with their first and last initial, then you can get that report, you can use it as a quiz grade. You could use it as a formative assessment. You can just get some really great data out of it and you can analyze it by question to see what they really don't understand… The logic puzzle, it has, I think, four to five different levels. And so, it's like, Judy had an apple and Tommy spent six cents on his grapes and so-and-so had an orange, how much did they spend on this fruit basket? And so, you have to work through it It's got a logic grid and everything that you can work out your problems. Before we did it digitally like that, we used to do it every Friday, my teammates and I would have like a logic puzzle Friday or some type of critical thinking skill because they just weren't getting it

P8 included an example in which she used a Mystery Science lesson with her students. The technology aspect of this lesson is translational as students are consuming the prompt via technology but completing it without technology. P8 stated,

> The lesson, “How can you keep a house from blowing away in a windstorm?” has students create a house using a given set of materials. Students test the design and then edit the design. Students work alone or in pairs, then discuss with partner or class, as well as complete an end of assessment worksheet to discuss findings.

P8 submitted her daily slide deck that includes all her lesson steps, links, and materials. This is a translational use of technology. She explained the value of this slide deck in the following comment,

> I do feel that students benefit from my daily slide deck. It helps me to stay on track and not spend wasted time searching for links and looking at lesson plans. When the teacher is prepared, the students benefit by having more time on task, an example of organized leadership, and assignments and links at the ready.

Transformational Technology Use

Magana (2017) identified transformational technology use as one that shifts the focus from teachers to students. He stated that the two components of transformational technology use are production and contribution. In this phase students are producing things to help them learn or demonstrate their learning and contributing to the learning of others. The researcher selected four high quality examples transformational technology use out of the 34 mentioned in the interview and artifact data to share.

P1 shared that, "There were a couple of kids that really got into it, and they would start making Google presentations of something we were studying even though I didn't even ask them to do so." This production of information and knowledge is a transformational example of technology use.

P5 shared an example of transformational technology when describing how she uses Flip Grid in the classroom to have students produce a video that explains their thinking and helps other students learn from their thought process. She stated,

> Well, we want them to have accountable talk with one another, so some students are not comfortable doing that in class. So, whenever they go to a quiet spot in the room, it's just them by theirself [sic]. So, it's uncomfortable at first because they're having to watch and listen to themselves. But I know whenever I talk and think out loud, whenever I'm teaching, it helps them. So, whenever they talk and think out loud when they're going through something and then they can listen to themselves and listen to their peers, I think they're able to put more meaning into what they're learning and see their mistakes.

P6 submitted an artifact that displays a transformational use of technology. She submitted the following Flip Grid prompt that she gives her students to get them to plan and create a video to show their knowledge of confederate soldiers.

> Imagine you are a Union or Confederate soldier during the Civil War. Give a first-hand account of your experiences (hardships you have faced, victories, things you have learned, do you feel your side will win the war and why?) Be Creative and bring all your drama and acting skills. *** Your classmates will be able to watch your video and leave comments.

P7 explained how her students collaborated using Canvas to create a puppet show to present to the class to teach about a social studies topic which is a transformational use of technology. She stated,

> So, in Canvas, you can go into Collaborations and you can add a Word doc and then you can pick the students that you want to be able to share that document. So, they can go in and they create their own puppet show. And so, I have Draft Back installed so I can see their conversations with each other. We have some rules like you can't be hateful, you

> can't say ugly things about people. It has to be on topic and all this other stuff. And so that was a really great way to get them to collaborate, even though they're still distanced, you know, sitting far apart from each other.

Transcendent Technology Use

Magana (2017) identified inquiry design and social entrepreneurship as the two components of the transcendent stage of technology. He stated that it results in "authentically original, and unprecedented growth in knowledge, contribution, and value-generating performance" (p.67). The researcher identified one example of transcendent technology use. P10 shared his role in creating a tech-help program in which tech savvy students were providing tech help to students and teachers. He stated,

> One of the things I implemented my last year was when they were starting to get the one-on-one laptop initiative at the high school, not thinking that someday there was going to be a pandemic and kids are going to need to have computers in their hands, I developed what was called the [high school] Tech Team, and it was a group of very tech savvy high school students that worked as a help desk at the high school, so there were about 12 students. It was a leadership course for them, and so during their day they would work as tech support for the school to help students and teachers use their laptops and all their new technology.

Chapter Summary

The researcher conducted interviews via Zoom with 11 participants and was able to collect artifacts from seven of those participants. The participants were all technology leaders in their school system and taught in grades 3-5. The researcher asked the questions in the interview guide (See Appendix) during the semi-structured interview. All participant interviews and

artifacts were coded based on the research questions identified by the researcher. The researcher also coded all examples of technology use to categorize them based on the T3 Framework. Chapter 4 contains the findings from this research study. Chapter 5 includes a discussion of the findings, implications for practice and recommendations for future research.

Chapter 5. Conclusions

Introduction

Teachers are consistently forced to adapt to changes in curriculum, materials, and instructional strategies. Vega and Robb (2019) claimed that teachers are still struggling to use technology in effective ways. Between the standards reform that took place in the 1990s and an increased emphasis on using technology teachers have had a great deal to learn which has resulted in a narrowed view of technology implementation for many teachers (Vander Ark, 2018). The purpose of this study was to identify and examine the technology tools and strategies being used by teachers in grades 3-5 that engage children in problem solving.

The researcher used both the 21st Century Learning Framework (Batelle for Kids, 2019) and the T3 Framework (Magana, 2017) to guide this study. The frameworks were beneficial in providing the researcher with important background knowledge as well as helping the researcher identify research questions, interview questions, coding data, and discussing conclusions.

The researcher used a qualitative, phenomenological approach to design this study to obtain rich data regarding the experiences of teachers who are implementing technology. The researcher used purposeful sampling by selecting participants who were technology leaders in their school system to ensure they had experience integrating technology and access to technology. The researcher chose to add teachers who teach grades 3-5 as a criterion to provide some similarity among the participants.

The researcher interviewed all participants via Zoom using the open-ended questions in the interview guide (Appendix). The researcher used probing questions based on the responses of each participant to learn more about their specific perceptions and experiences. Transcripts were recorded via Zoom. The researcher reviewed all transcripts for accuracy and sent them to each

participant to provide an opportunity for the participant to identify any omissions or make any additions to the transcript. The researcher then began reviewing transcripts and artifacts to begin identifying emerging themes. After identifying themes, the researcher selected codes and reviewed all of the transcripts again to code data. As new themes emerged the researcher went back through previous transcripts to recode them based on the new themes. The researcher used the MAXQDA software to code data so that it could be analyzed.

Discussion

Research Questions

The central question of this study was: What are teacher perceptions of the technology-based instructional strategies and digital tools they are implementing to enrich problem solving for students in grades 3-5?

Research Question 1: What are the teacher perceptions of the value of technology-based instructional strategies to enrich problem solving for students in grades 3-5?

Teachers in this study overwhelmingly discussed group work as an instructional strategy when asked about what types of instructional strategies they implement to enrich problem solving. P1 and P6 specifically commented on the use of group work to provide support to students learning new content or a new technology skill. When students are working together by exchanging ideas, strategies, and tips to learn how to create a product together using a new technology they are engaging in the collaborative problem solving that Hesse et al. (2015) described. The combination of their social interactions and cognitive abilities is helpful in increasing the knowledge and ability of the group as a whole.

P5 discussed the importance of providing students with opportunities to work together to prepare them for working with adults in the future when she stated, “You have to problem solve

with other people as an adult. So, I think it's important to have them work together on some of these pieces." She discussed how using Flip Grid to facilitate that knowledge scaffolds communication skills. She said,

> Well, we want them to have accountable talk with one another, so some students are not comfortable doing that in class. So, whenever they go to a quiet spot in the room, it's just them by theirself [sic]... Whenever they talk and think out loud when they're going through something and then they can listen to themselves and listen to their peers, I think they're about to put more meaning into what they're learning and see their mistakes.

In this example, the teacher found a way to foster communication skills by alleviating the initial social pressure of working in a group. Ideally, those communication skills and thinking skills that are improving from an activity such as this will support learners and help them begin to feel more confident working in a group with peers to collaboratively problem solve. Hesse (2015) stated that it is important that all members of a group contribute, but the reality, which was pointed out by P5, is that sometimes students do not feel comfortable doing that. In this case the digital tool, Flip Grid, is supporting the development of the instructional strategy of group work.

The Framework for 21st Century Learning (Battelle for Kids, 2019) identified critical thinking, communication, collaboration, and creativity as skills that are imperative to the success of adults in the 21st Century. Teachers in this study explained that group work was helpful in the problem-solving process. Providing their students with opportunities both to learn technology and also to collaborate with one another is an important step towards preparing students for their future expectations.

Question 2: What are the teacher perceptions of the value of using digital tools to enrich problem solving for students in grades 3-5?

The participant responses related to this question suggested that digital tools are helpful in building engagement, creativity, providing real world connections to students, and exposing them to technology. All these valuable components combined help prepare students for future academic and career opportunities.

Pink (2009) posited the value of critical thinking and creativity in motivating and engaging students. Teacher responses regarding how they use technology to engage students included review games with technology tools and using technology to create things that demonstrate learning. There was a balance in teacher responses between using technology to consume information in a way that is engaging for students, using technology to create, and using technology to assess student knowledge. This balance between automation, consumption, production, and contribution is important for meeting the current needs of students while also preparing them to problem solve and collaborate with others in the future.

Most participants in this study discussed having students create using a variety of tools including Google Slides, Google Docs, Jam Boards, Adobe Spark, Buncee, and Book Creator. Participants found these to be engaging tools for their students that enriched problem solving opportunities. The 21st Century Learning Framework (2019) includes information, media, and technology skills as important aspects of 21st Century Learning. By exposing their students to these different aspects of technology and setting the stage for using them in collaborative ways these teachers are helping ensure that their students will have the technology skills necessary to take charge and facilitate important projects later in their academic and professional careers.

There are many adults in society that are currently struggling to learn how to use some of these technology tools to improve their practice. For example, the live collaboration component of Google Docs, or a similar program, could be a beneficial tool for many people in various occupations. Unfortunately, there are still a lot of adults who struggle to learn how to use new tools such as these to enhance their work duties and help them solve problems in their daily life. The responses from participants listed under technology exposure in Chapter 4 demonstrate how quickly students can begin using technology in ways that benefit them once they are exposed. By exposing students to these technology skills at an early age and encouraging them to collaborate with them, teachers are preparing their students to use technology in transformative and transcendent ways in the future.

Question 3: How have teachers adapted and implemented valuable technology activities in grades 3-5?

Obtaining and providing quick feedback as well as differentiation were two ways that the teachers in this study have used technology to adapt their instructional activities to benefit students. For the teachers in this study this included a balance of technology tools that automate tasks and allow students to produce with technology.

Arnett (2016) posited automated technology use as a solution to meeting student needs in the classroom. One way that teachers have used automated technology to help meet students' needs is by giving formative and summative assessments through technology tools such as online games and Google Form assessments. P2 described how quick grading helps her discuss mistakes with her students more quickly saying that it, "Guides them before they have more time to maybe make a few other mistakes they're redirected and steered back in the right direction." P3 stated that the quick feedback helps her analyze data to aide her with the instructional

planning process. She also explained how it helps free up the time to immediately review the responses with students stating that she thinks it, “Kind of helped them solve problems in the future because they were able to see what they missed and why and hopefully not make that mistake a second time.” P9 said that when she uses QUIZZIZ the class will go back through each question and look at, “The percentage of how many got it correct, it’s letting me know what I need to reteach as well, whether one missed it or half of them missed it.” Although teachers can use paper-pencil assessments to get the same types of data the automaticity of these assessment tools is beneficial because it allows for a quicker, more immediate analysis while students have the topic fresh on their mind. The way that teachers in this study used automated tools to provide quick feedback and data to drive instruction is a good example of the high-quality data driven instruction that Bambrick-Santoyo (2019) identified as an important goal for schools.

Arnett (2016) explained that technology devices can be helpful in meeting the diverse needs of students. Teachers in this study communicated that technology has helped them adapt their instruction to meet the needs of their students. P2, P6, and P7 discussed the benefit of being able to record themselves or provide read aloud through technology to helps students who would typically struggle with reading. P3 submitted a digital notebook as an artifact that included self-recorded read aloud for students. Providing read aloud as an accommodation through technology use frees up the teacher to meet needs of other students while also providing an opportunity for students with disabilities to feel empowered because they can complete a task on their own without teacher support. P6 also communicated that being able to answer questions via video or with the support of spell-check helps her students feel more confident in their ability to create a thorough response.

The second way that teachers communicated using technology to differentiate content for students was through automated programs such as IXL and Whoo's Reading. Arnett (2016) stated that computer programs such as the ones suggested by participants in this study are valuable because they provide individualized learning to more students than one teacher could physically offer without the use of technology. The reality is that teachers are teaching students on various learning levels and there is not enough time in the day to create and deliver individualized lessons to each student without some assistance. Several participants in this study stated that they use IXL to provide individualized learning that is specific to each student. P9 also discussed using Whoo's reading for providing individualized learning and feedback stating that in the program, "The little owl will pop up and give them tidbits and hints of how they can improve their answer." In this example students are getting support from the program and using critical thinking skills to improve their responses. Using this program provides all students with the opportunity to get one-on-one immediate feedback that otherwise would take an entire instructional block and result in wasted time for many students that are waiting on a teacher to get to them.

T3 Framework

Translational Technology Use

In this study the researcher found 108 examples of technology use in the interview and artifact data. The researcher coded 73 of those examples as translational technology use. According to Magana (2017) translational technology use is teacher directed and focused on automation and consumption. Magana also stated that although the value increases with each stage of technology use there is value in all stages. The researcher found that the experiences communicated by teachers in this study suggested that the ways they have implemented

translational activities have been helpful in building engagement, providing read aloud, exposing students to technology, providing students with resources that they may not have had access to without technology, and also providing teachers with curriculum resources they may not have had access to without technology.

The participant responses that related to increased student engagement included both translational and transformative technology uses. Most of the examples that would be considered translational were online review games that teachers used to help assess student prior knowledge, what they had learned, or to help them review for a test. These were coded as translational because technology use itself in these activities is translational, not requiring students to use technology to transform their learning. However, many of these teachers implemented these tools with students in groups, collaborating and working together to find the correct answer. Although it is translational because students were not using the technology to collaborate or produce something, the interactions that occurred because of the instructional scenario were valuable to students.

Other translational examples mentioned by participants related to consuming information via technology resources. P1 shared how students used websites to consume information about habitats. P3 shared how she used digital notebooks for provide students with a study tool. P9 and P6 explained how her student took advantage of technology access to review content they could not recall. The value in these examples is that students are learning to use the resources they have at their fingertips which will help them continue to find the best ways to locate and use resources to solve future problems.

P8 explained how she uses a daily slide deck to organize her resources, steps, and materials for the day. She stated that, “The students benefit by having more time on task, an

example of organized leadership, and assignments and links at the ready." Even though again, this is a translational use of technology she is providing a good example for her students that could help them develop organization and life skills, which are important components of The Framework for 21st Century Learning (Battelle for Kids, 2019).

Transformational Technology Use

Transformational technology use is identified by Magana (2017) as using technology for production and contribution. Transformational technology use shifts the focus from teacher to student. In this situation students should be using technology to create products, set goals for themselves, monitor those goals, and contribute to the learning of others. Goal setting was not something that participants in the study specifically communicated or discussed. It is possible that it is an element in their teaching, but it was not a topic that came up in interviews. The other aspects of using technology to produce and contribute to the learning of others were prevalent in the research findings.

Participants in this study shared a variety of examples of transformational technology use. There were a total of 34 examples of transformational technology use documented in the study. The researcher selected some of the best examples to report in the findings. P1 shared how students started creating their own Google Slides presentations without teacher prompting to showcase what they were learning. P5 explained how she uses Flip Grid to have students produce videos that explain their thinking and contribute to the learning of others because they share them and comment on peer videos. P6 shared a similar Flip Grid Assignment that had students produce a creative video to demonstrate their understanding of Confederate soldiers. P7 explained how her students worked together and used live collaboration via technology to create a puppet show to teach others about a social studies topic. All of these examples provide students

with an opportunity to make a product and contribute to the learning of other students either by collaborating with them or by presenting the information to them.

In the examples of transformational technology use provided by participants, students were engaged in high quality tasks that gave them creative freedom. This type of creative engagement is identified by Pink (2009) as a motivating factor for students. Schlechty (2011) discussed the components of engaging student work. He advised that engaging student work is challenging, allows students to investigate multiple solution pathways, creation, and problem solving. The examples provided by transformational activities listed above meet these guidelines which suggests that using technology in a transformative way helps teachers provide engaging learning opportunities for students.

Transcendent Technology Use

Magana (2017) stated that transcendent technology use goes above and beyond the expected. It requires students to use technology to solve problems that they are passionate about that will impact the world around them. The components of this stage are inquiry design and social entrepreneurship. Transcendent technology use requires a foundation that can be achieved from the previous two stages that Magana identified.

The researcher identified one example of transcendent use of technology. Even finding one example of transcendent technology use is an important finding to discuss, because it is the most difficult phase to achieve. P10 shared how he worked with high school students to create a tech-help program in which a group of students were the ones supporting teachers and students with technology. He stated,

> It was a group of very tech savvy high school students who worked as a help desk at the high school, so there were about 12 students. It was a leadership course for them all, and

so during their day they would work as tech support for the school to help students and teachers use their laptops and all their new technology.

In this example there was a problem that was important to the success of the school. The school had received new technology and there were a lot of people that needed support with that. The students who had the necessary passion and knowledge were able to make an impact in the world around them while solving problems in their school.

This example of transcendent technology use is inspiring. Providing students with the opportunity to be involved in something so important is empowering for them and helps them partake in an experience that will no doubt incorporate life and career skills, learning and innovation skills, as well as information, media, and technology skills, which are all the components identified in the Framework for 21st Century Learning (Battelle for Kids, 2019).

Implications for Practice

The review of literature paired with the experiences from teachers in this study helped the researcher make the following recommendations.

1. Teachers need to continue designing curricula to incorporate technology in a way that encourages students to problem solve and collaborate because it is an effective process that enhances student learning and engagement.
2. Teachers should examine these findings to learn from the examples that were included by teachers and begin to reflect on the current level of technology integration in their own classroom.
3. Considering the value of current technology tools and instructional strategies could help teachers determine ways to expand on the current practice to achieve an even greater value for students.

4. To guide students in achieving transcendent technology use teachers need to understand their students' passions. Knowing and understanding your students and learning about their interests will help teachers encourage them to use technology to solve problems that impact the world around them.
5. Districts and regions need to create a structure for teachers to share what they are using, how they are using it, how effective it has been.

The researcher would also like to note that as a teacher she found it highly motivating to read the examples of technology integration that teachers shared. Examining them helped the researcher see value in tools and strategies that she previously had not considered. The researcher found the process of collecting and analyzing this data was personally meaningful will improve her practice as an educator.

Implications for Future Research

This research study was conducted during the COVID-19 Pandemic which required teachers to change their instructional practices. During this pandemic there were instances of remote and hybrid instruction in which students were learning at home. There were also restrictions in the classroom that prohibited close contact, making group work a challenge. Although participants were not guided to focus on the changes the pandemic caused, many of them mentioned those changes in their interview. The timing of this study along with the findings of the study led the researcher to make the following recommendations for future research.

1. Research should be conducted to identify how teachers adapted curriculum and instruction during the COVID-19 Pandemic in ways that were valuable for student learning.

2. Research should be conducted to identify what practices were incorporated during the COVID-19 Pandemic that educators continued after the Pandemic.
3. Research should be conducted to identify more transcendent uses of technology. Examples of transcendent technology use could be inspiring and helpful to educators as they continue enhancing their pedagogy to integrate technology at the highest levels.
4. Research should be conducted to determine how technology use impacts teacher efficacy.

Chapter Summary

The purpose of this study was to identify and examine the technology-based instructional strategies and digital tools being used by teachers in grades 3-5 that engage children in problem-solving learning opportunities. The researcher collected interview data from 11 participants that were technology leaders and 3-5th grade teachers. The researcher was able to collect artifacts from seven of those. The researcher reviewed data to communicate the value of using digital tools and technology-based strategies as well as ways that teachers have adapted their instructions to provide engaging technology-based activities to students. The researcher categorized all examples of technology use as translational, transformative, and transcendent. The results of this study suggest there is value in providing learning opportunities to students that incorporate problem solving, collaboration, and technology.

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APPENDIX: Teacher Interview Questions

1. Describe your current teaching assignment and your teaching experience in general.

2. Describe the digital tools you use when teaching and under what circumstances you incorporate them into your lessons.

3. Explain how you use the digital tools to engage your students in problem solving.

4. Describe instructional strategies you use that incorporate digital tools and problem solving.

5. Explain how your students respond to these strategies that you have identified. What are the outcomes for students with respect to problem solving? Provide an example or examples.

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